STANDARD SPECIFICATIONS FOR
AIRPORT CONSTRUCTION

State of Wisconsin
Department of Transportation
Bureau of Aeronautics

2021 Edition

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Part 1 – General Requirements and Covenants

Section 10 - General Information, Definitions, and Terms

10.1 General

10.1.1 Intention of Terms

(1) Whenever, in these Specifications or on the Plans, the words “directed,” “required,” “permitted,” “ordered,” “designated,” “prescribed,” or words of like import are used, it shall be understood that the direction, requirement, permission, order, designation, or prescription of the Engineer is intended; and similarly, the words “approved,” “acceptable,” “satisfactory,” or words of like import, shall mean approved by, or acceptable to, or satisfactory to the Engineer, subject in each case to the final determination of the Owner.

(2) References to a specific requirement of a numbered paragraph of the Contract Specifications or a cited standard shall be interpreted to include all general requirements of the entire section, specification item, or cited standard that may be pertinent to such specific reference.

(3) These Standard Specifications for airport construction are written to the Bidder before award of the Contract and to the Contractor after award of the Contract. The sentences directing the Contractor to perform work are written in the active voice-imperative mood. These contractor directions are written as commands. For example, a requirement to provide cold-weather protection would be expressed as, "Provide cold-weather protection for concrete," rather than "The Contractor shall provide cold-weather protection for concrete. In the imperative mood, the subject "the Bidder" or "the Contractor" is understood.

(4) Requirements to be performed by others are written in the active voice. Sentences written in the active voice identify the party responsible for performing the action. For example, "The Engineer will determine the density of the compacted material." Certain requirements of the Contractor may also be written in the active voice, rather than the active voice-imperative mood, if the sentence includes requirements for others in addition to the Contractor. For example, a sentence that involves action by both the Contractor and the Engineer would be expressed, "After the Contractor provides initial written notice, the Engineer will revise the Contract as specified in 40.2."

(5) Sentences that define terms, describe a product or desired result, or describe a condition that may exist are written in neither the active voice nor the imperative mood. These types of sentences that describe a condition use verbs requiring no action. For example, "The characteristics of the soils actually encountered in the subgrade may affect the quality of cement and depth of treatment necessary."

(6) Working titles such as foreman and workmen are used in the Specifications only for brevity and are intended to refer to persons regardless of gender.

10.1.2 Department’s Role as Agent

(1) The role the Department of Transportation plays in the airport development process is unique. The Wisconsin DOT does not own any of the airports in the State. Most of the airports eligible for state and federal funding are publicly owned along with a few privately owned airports which are part of the state and federal airport system plans. As a result, the individual airport Owners legally designates the Secretary of Transportation, and thus the Department, as agent to administer the airport project on their behalf.

(2) Due to the agency relationship, throughout this specification, the terms; Department, Owner and Sponsor are used interchangeably. Throughout this specification when the Department has an action or role it is “as if” the Department is the Sponsor. Similarly, if the term Owner or Sponsor are used, because the Department has been identified as its agent any direction, order role or responsibility provided by the Department is “as if” it was given directly by the Airport Owner or Sponsor. And Departmental authority is equivalent with that of the Owner or Sponsor.

(3) The fully executed agency agreement spells out the authority and powers granted to the Secretary.

(4) There are exceptional circumstances where the Department on its own authority sponsors a project. In those cases, the Secretary and the Department are acting within its own authority.

(5) Acting within its agency role, the Secretary has a fiduciary responsibility to each individual airport Owner. In addition, the Secretary also has a fiduciary responsibility to the public at large. In cases when fiduciary responsibilities of the various airports conflict, the fiduciary responsibility to the overall best public interest will prevail.

10.1.3 Department Construction Materials Manual (CMM) Use

(1) The CMM manual is created and published by the Department. The CMM manual is referenced within this specification. The CMM was created for highway and bridge projects as guidance to administer construction projects. Since it was originally created for highway and bridge type projects, in certain instances, the direct literal use of the CMM guidance does not always directly correlate with airport specific conditions or use of terms. In those cases, where airport conditions or terms differ from those used in CMM, utilize the intent of the CMM and apply the guidance as appropriate for airport projects. CMM guidance, referenced in the Plans and Specifications are made part of the Contract.

10.1.4 Use of State Highway Specification (SHS) by Reference

(1) This specification will from time to time reference the Wisconsin Department of Transportation, Standard Specifications, commonly referred to simply as; “State Highway Specifications” (SHS). When a SHS reference is used, the reference is meant to use the specification identified in the SHS edition that is current and valid on the date the airport project is bid.

(2) When portions of the SHS are referenced, terms referring to elements of highway construction will be interpreted to have a similar meaning in the airport environment. For example; specifications for a roadway will refer to taxiways, runways and aprons, as well as access roads. “Right of Way” would mean the land area used for airport purposes and generally include the airport property and easement areas.

10.1.5 Specification Format

(1) The document contains the following components identified by number and organized in a hierarchy as follows:

a. Parts, for example "Earthwork" referred to as: Part 2.
b. Sections, for example "Bidding Requirements and Conditions" referred to as: Section 20.
c. Subsections, potentially containing subordinate subsections, for example "Furnishing of Proposal Forms, Plans, and Specifications" referred to as: 20.3 or "General" referred to as: 20.3.
d. Paragraphs, for example paragraph one of 10.1.5 referred to as: 10.1.5(1).
e. Numbered items, for example item 1 of 10.5.1(1) referred to as: item one of 10.5.1(1).

(2) The General Requirements and Covenants consist of general contract requirements for which no direct payment is made. The requirements contained in the General Requirements and Covenants are applicable to all contracts.

(3) Each Part utilizes AASHTO’s five category format as the standard method for placing information within the Specifications. This format generally classifies requirements into the five categories:

a. Description,
b. Materials,
c. Construction Methods,
d. Method of Measurement, and
e. Basis of Payment.

(4) Part's II through XI consist of construction Contract requirements for specific items of Work. Work under these Parts is paid for directly or indirectly according to Section 90 - Measurement and Payment, and the specification section ordering the Work.

10.2 Definition of Terms

(1) Whenever the following terms are used in these Specifications, in the Contract, or in any documents or other instruments pertaining to construction where these Specifications govern, the intent and meaning shall be interpreted as follows:

AASHTO	The American Association of State Highway and Transportation Officials, the successor association to AASHO.
Access Road	The right–of–way, the roadway and all improvements constructed thereon connecting the Airport to a public highway.
Addendum	Authorized revisions to the Plans or the proposal form developed and issued to the Bidder before opening of proposals.
Administrator (FAA)	Administrator of the Federal Aviation Administration (FAA) or their duly authorized representative.
Adverse Weather Day	For calendar day or completion date contracts, a day the Contractor is scheduled to work when weather, or job conditions caused by recent weather, cause the Contractor to lose four or more hours of work on the controlling item.

Advertisement (Advertisement for Bids) A public notice, as required by law, inviting bids for work to be performed and materials to be furnished. The Advertisement will indicate with reasonable accuracy the quantity and location of the work to be done, or the character and quantity of the material to be furnished, and the time and place of submitting and opening the proposals.

Advisory Circulars (AC) Publications of the FAA. When referred to in the Contract Documents, they shall be the latest current document listed in the Federal Register Checklist as of the time of Advertisement for Bids. Obtain copies from the U.S. Department of Transportation, General Services Section, or the Bureau.

Agent Secretary of the Department of Transportation of the State of Wisconsin, may act as the Sponsor's Authorized Agent in accordance with Chapter 114, Wisconsin Statutes (current edition).

Agency Agreement An agreement between the Sponsor and the Secretary of Transportation authorizing the Secretary to act for the Sponsor in the receipt and disbursement of funds, the supervision of the preparation and execution of legal documents, the supervision of the preparation of Plans, Specifications and the letting of Contracts, the making of periodic inspections of construction, and the performance of incidental administrative acts and coordination necessary for the successful accomplishment of the Project within the laws of the State and the charters, laws, ordinances and resolutions of the Sponsor.

Airport Improvement Program (AIP) A grant-in-aid program, administered by the Federal Aviation Administration (FAA).

Air Operations Area (AOA). For the purpose of these Specifications, the term air operations area (AOA) shall mean any area of the airport used or intended to be used for the landing, takeoff, or surface maneuvering of aircraft. An air operation area shall include such paved or unpaved areas that are used or intended to be used for the unobstructed movement of aircraft in addition to its associated runway, taxiway, or apron.

Airport Airport means an area of land or water which is used or intended to be used for the landing and takeoff of aircraft; an appurtenant area used or intended to be used for airport buildings or other airport facilities or rights of way; and airport buildings and facilities located in any of these areas, and includes a heliport.

Apron The area of the Airport required by airplane pilots to position airplanes during ground operations, not involving landing, taxiing and takeoff. Apron areas are primarily used for parking, storing or tying down of aircraft. Same as “ramp”.

ASTM International Formerly known as the American Society for Testing and Materials (ASTM).

Award The acceptance, by the Department, of the successful Bidder's Proposal.

Base Course The layer or layers of material placed on a subbase or subgrade to support a flexible surface course.

Bid See proposal

Bidder Any individual, partnership, firm, joint venture, corporation, Limited Liability Company, limited liability partnership, or a combination of any or all jointly, submitting a proposal (bid) for the work advertised in the Advertisement or Invitation for Bids, acting directly or through a duly authorized representative.

Bid Bond See Proposal Guarantee.

Brand Name or Equal Specifications A specification limited to one or more items by manufactures’ name, make, model or catalogue number to describe the standard or quality, performance and other salient characteristics needed to meet the Owner requirements and which provides for the submission of equivalent products. Prior to incorporation into the work, the Engineer must approve the equivalency of the item.

Building Area An area on the Airport to be used, considered, or intended to be used for Airport buildings or other Airport facilities or rights–of–way together with all Airport buildings and facilities located thereon.

Bureau The Bureau of Aeronautics of the Department of Transportation of the State of Wisconsin. The Authorized representative of the Secretary acting as agent for the airport Owner and Sponsor of the project.

Business Day Every day the calendar shows, except Saturdays, Sundays, and department-specified holidays.

Calendar Day Every day shown on the calendar, including Saturdays, Sundays, and department-specified holidays.

Certificate of Compliance (Manufacturer's Certificate) A document, provided by a manufacturer, producer, or supplier of a product, stating that the product as furnished to the Contractor complies with the pertinent Specifications and Contract requirements.

Certified Report of Test or Analysis A certified test report, provided by a manufacturer, producer, or supplier of a product, indicating that actual results of tests or analyses comply with the elements of the specification requirements.

Change Order See Contract Change Order and Contract Modification.

Completion Date The calendar date shown in the proposal on or before which the work contemplated under the Contract shall be completed.

Construction Safety and Phasing Plan (CSPP) The overall plan for safety and phasing of a construction project developed by the airport operator, or developed by the airport operator's consultant and approved by the airport operator. It is included in the invitation for bids and becomes part of the project Specifications. In WI we do not include as a separate document the CSPP, rather it is incorporated into the Plans and Special Provisions.

Contract The written agreement between the Department and the Contractor described in the Contract Documents setting forth the obligations of the parties to the Contract, including, but not limited to, performance of the work, furnishing of labor and materials, and basis of payment.

Contract Bonds The Department approved form of security, executed by the Contractor and the Contractor's surety or sureties, guaranteeing the performance of the Contract work, completion of the Contract requirements, and the payment of claims as provided in 779.14 of the Wisconsin statutes. (See also Payment Bond & Performance Bond)

Contract Change Order (CCO) A written order or authorization the Engineer executes covering work within the original scope of the project, not otherwise provided for in the Contract, revisions in or amendments to the Contract, or conditions specifically prescribed in the Specifications as requiring Contract change orders. The change order document becomes a part of the Contract when executed by the Department. Work that increases or decreases a major Pay Item by more than 25%, or that is outside the original scope of the project is done by Supplemental Agreement. See definition for Supplemental Agreement.

Contract Documents The Contract Documents include the Advertisement for Bids, Proposal Forms, documents accompanying the Proposal Forms, Contract Form and Contract Bonds, Standard Specifications referenced in the Proposal, Specifications, Supplemental Specifications, Special Provisions, Schedule of Prices, Addenda, Wage Rates, general and detailed Plans, and these General Requirements and Covenants, and any Contract Change Orders and Agreements that are required to complete the construction of acceptable Work, including authorized extensions thereof, all of which constitute one instrument.

Contract Item (Pay Item) A specific unit of work for which a price is provided in the Contract.

Contract Modification Any change to the Contract made after it is executed, including but not limited to, the following:

- A Contract change order.
- A supplemental contract agreement.
- An administrative change adding a non-bid item.
- A general administrative change.

Contract Period The period from the specified date of commencing work to the date that the specified number of calendar or working days has elapsed, both dates inclusive, or from the specified date of commencing work to the specified completion date, both dates inclusive; as specified in the Contract.

Contract Revision See: Contract modification

Contract Time The number of calendar or working days shown in the proposal representing the time allowed for the completion of the work contemplated in the Contract. If a calendar date of completion is stated in the proposal, in lieu of a number of calendar or working days, the Contract shall be completed by that date.

Contractor The individual, partnership, joint venture, corporation, limited liability company, limited liability partnership, or agency undertaking the

performance of the work under the terms of the Contract and acting directly or through a duly authorized representative.

Contractor's Laboratory The Contractor's quality control organization in accordance with the Contractor Quality Control Program.

Contractors Quality Control Program (CQCP) Details the methods and procedures that will be taken to assure that all materials and completed construction required by the contract conform to contract plans, technical specifications and other requirements, whether manufactured by the Contractor, or procured from subcontractors or vendors.

Controlling Item of Work An activity on the project schedule, that if delayed, delays completion of the project.

Control Strip A demonstration by the Contractor that the materials, equipment, and construction processes results in a product meeting the requirements of the specification.

Cost Reduction Incentive (CRI) A Contractor proposed alternative construction method other than detailed in the Plans and Specifications. The proposal shall include significant alteration of the means and methods of construction. This proposal resulting in an estimated significant cost savings to the project which, if accepted may be shared equally between the Department and the Contractor. Simple substitution of materials or other minor changes do not qualify as a CRI.

Construction Materials Manual (CMM) A departmental produced manual providing information and guidance as to how to administer project details. The manual is continuously updated and provides a Department and industry consensus to consistently apply procedures for project administration.

Day Unless otherwise qualified as working day or business day, day is defined as a calendar day.

Department The Wisconsin Department of Transportation. The Department acts as agent for the airport Owner on airport development projects.

Drainage System The system of pipes, ditches, and structures by which surface or subsurface waters are collected and conducted from the airport area.

Engineer The Secretary of the Department of Transportation or the secretary's authorized representative limited by the particular duties assigned to the representative as agent for the Owner. Also called Resident Project Representative (RPR)

Erosion Control Implementation Plan (ECIP) The erosion control implementation plan, or ECIP, as required under Trans 401 of the Wisconsin administrative code.

Equipment Machinery and articles necessary for the proper construction and acceptable completion of the work. This includes the supplies, tools, and apparatus for upkeep and maintenance of the equipment.

Extra Work All work performed by the Contractor, with approval of the Engineer, that does not appear in the proposal or Contract as a specific Pay Item accompanied by a unit price, and that is not included under the price bid for other Pay Items in the Contract. Extra work may also consist of additions to, or changes in, design of Contract Pay Items or portions of Contract Pay Items, if additions are wholly disassociated from or outside the scope of work in the Contract, and if the work caused by these additions or changes must be performed under conditions or in a manner materially different from the conditions and manner existent for Contract Pay Items under the original scope of work.

FAA The Federal Aviation Administration of the U.S. Department of Transportation. When used to designate a person, "FAA" shall mean the Administrator or his or her duly authorized representative.

Federal Specifications The Federal Specifications and Standards, Commercial Item Descriptions, and supplements, amendments, and indices thereto are prepared and issued by the General Services Administration of the Federal Government.

Force Account A method of payment to a Contractor, based on the cost of labor, equipment, materials furnished, and consideration for overhead and profit as specified in 90.4.5.

Furnish To equip or provide what is needed to fulfill the Contractual obligation(s).

Hazardous Substance A substance or combination of substances, including waste of a solid, semisolid, liquid, or gaseous form, that may cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating, reversible illness, or that may pose a

substantial present or potential hazard to human health or the environment.

Holidays The following days are department-specified holidays for use in determination of working days:

New Year's Day	Thanksgiving Day
Martin Luther King Jr. Day	Christmas Eve Day
Memorial Day	Christmas Day
Independence Day	New Year's Eve Day
Labor Day	

Inspector The authorized representative of the Engineer assigned to inspect the work or materials

Laboratory The official testing laboratory of the Department or other testing laboratories that the Engineer designates.

Lien. A formal notification of claim in accordance with State Statute 779 by a subcontractor, supplier or service provider procuring or furnishing labor, services, or materials towards the public project payment rightly owed/ due them. Lien rights extend to **ALL** tiers of subcontractors and suppliers in accordance with 779.14(1) a.

Lighting A system of fixtures providing or controlling the light sources used on or near the Airport or within the Airport buildings. The field lighting includes all luminous signals, markers, floodlights, and illuminating devices used on or near the Airport or to aid in the operation of aircraft landing at, taking off from, or taxiing on the Airport surface.

Local Force Account A means of payment for work performed by the airport Owner with their own forces. This is not to be confused with FORCE ACCOUNT work as earlier defined and as described in 90.4.5.

Major and Minor Pay Items A major Pay Item is a Pay Item whose total cost, determined by multiplying the bidding schedule quantity and the Contract unit price, is equal to or greater than 5 percent of the total amount of the original Contract. Other Pay Items are minor Pay Items. A minor Pay Item, when its quantity is increased, becomes a major Pay Item if it meets this five percent criterion.

Materials Substances specified for use in the construction of the work. See also: new material, reclaimed asphaltic pavement material, recovered material, recycled material, and special waste.

Materially Unbalanced Bid A bid that generates a reasonable doubt that award to the Bidder submitting a mathematically unbalanced bid will result in the lowest ultimate cost to the Department.

Mathematically Unbalanced Bid A bid containing lump sum or unit price Pay Items that do not reflect reasonable anticipated actual costs of labor, equipment, materials, plus a reasonable proportionate share of the Bidder's anticipated profit, overhead costs, and other indirect costs.

Must Establishes a requirement, generally the same meaning as shall.

New Material Material not used for another purpose before incorporation into the work.

Notice to Contractors See also Advertisement or Advertisement for Bids.

Notice to Proceed (NTP) A written notice from the Engineer to the Contractor of the time period within which the prosecution of the work shall begin.

Object Free Area (OFA) A defined surface surrounding the runway as defined in the latest edition of Advisory Circular 150/5300-13.

Obstacle Free Zone (OFZ) A defined surface surrounding the runway as defined in the latest edition of Advisory Circular 150/5300-13.

Owner The airport Owner and Sponsor of the project. The Owner authorizes the Department to act as its agent on airport development projects. Direction, orders etc. made by the Department hold the same force and effect as originating from the Owner.

Pavement The combined surface course, base course, and subbase course, if any, considered as a single unit.

Pavement Bed The graded portion of the airport, within top slopes and side slopes, prepared as a foundation for the pavement structure including shoulders if present.

Pavement Foundation The area underlying the proposed pavement within the limits of assumed one-to-one slopes extending outward and downward from the outside edges of the lowest part of the pavement structure.

Pavement Structure The combination of subbase, base, and surface course placed on a subgrade to support the traffic load and distribute it to the pavement bed.

Payment Bond The approved form of security, executed by the Contractor and the Contractor's surety or sureties, guaranteeing the payment of claims as provided in 779.14 of the Wisconsin statutes.

Pay Item See Contract Item.

Performance Bond The approved form of security, executed by the Contractor and the Contractor's surety or sureties, guaranteeing the performance of the Contract work and completion of the Contract requirements as provided in 779.14 of the Wisconsin statutes.

Plans The official approved plans, profiles, typical cross-sections, working drawings, and supplemental drawings that show the location, character, dimensions, and details of the work to be done and which are considered part of the Contract, supplementary to the specifications.

Project The designated physical area together with improvements to be constructed under the Contract.

Project Engineer The authorized representative of the Engineer having direct supervision of the administration of the Contract also commonly referred to as resident engineer.

Proposal The written offer of the Bidder, submitted on the prescribed proposal form, to perform the work at the prices quoted by the Bidder in accordance with the Contract documents; also commonly known as the "bid".

Proposal Guaranty (Bid Bond) The security furnished with a bid to guarantee that the Bidder will enter into the Contract if the bid is accepted.

Provide To furnish and install.

Quality Management Program (QMP) The Department's specifications defining both Department and Contractor responsibilities for assuring quality construction. The Specifications provide for the following:

- **Contractor Assurance (QA)** Optional Contractor sampling and testing to assure the accuracy of the QC test results.
- **Quality Control (QC)** Required Contractor sampling and testing the Department uses to determine specification conformance.
- **Quality Verification (QV)** Department sampling and testing the Department uses to validate the quality of the final product.
- **Independent Assurance** Activities the Department uses to evaluate the QC and QV sampling and testing procedures.
- **Dispute resolution** Procedures the Department uses to resolve disputes over conflicting test results for nonconforming work.

Ramp see Apron

Reclaimed Asphaltic Pavement Material A recovered material from existing asphaltic pavement.

Recovered Material A product recovered from solid waste in a form identical to the original form, for a use that is the same or similar to the original use.

Recycled Material A product manufactured from previously used products.

Resident Engineer The authorized representative of the Engineer having direct supervision of the administration of the Contract. Commonly referred to as project engineer. Also known as Resident Project Representative (RPR)

Resident Project Representative (RPR) The authorized representative of the Engineer having direct supervision of the administration of the Contract. Commonly referred to as project engineer.

Responsive Bidder A responsive bid conforms to all significant terms and conditions contained in the Department or Owner provided bid documents.

Responsible Bidder A Bidder determined by the Department to possess the ability to perform the Contract Work and complete the Contract Requirements.

Right–of–Way All lands or other property interests provided or acquired for the development, protection and operation of an Airport and its appurtenances.

Roadbed The graded portion of the airport, within the top slopes and the side slopes, prepared as a foundation for the pavement structure and shoulders.

Roadway The portion of work, within the construction limits, used for the purpose of aircraft or vehicular traffic on the airport.

Runway The area on the airport prepared for the landing and takeoff of aircraft.

Runway Protection Zone (RPZ) A defined surface on the ground beyond the runway end as defined in the latest edition of Advisory Circular 150/5300-13.

Runway Safety Area (RSA) A defined surface surrounding the runway as defined in the latest edition of Advisory Circular 5300-13.

Safety Plan Compliance Document (SPCD) This form is required to be completed by the successful Bidder on federally funded projects. This form describes how the Contractor

intends to comply with the construction safety phasing plan (CSPP) listing any modifications to the original plan set & Contract Documents. This plan must be approved prior the commencement of work on the project.

Schedule of Prices The prepared schedule, included as a part of the proposal form, containing the estimated quantities of the Pay Items for which unit bid prices are invited. Also called schedule of items.

Secretary The secretary of the Wisconsin Department of Transportation.

Shoulder An area adjacent to the edge of paved runways, taxiways, or aprons providing a transition between the pavement and the adjacent surface; support for aircraft running off the pavement; enhanced drainage; and blast protection.

Shall Generally the same meaning as must.

Shop Drawings Drawings, diagrams, supplementary plans, illustrations, schedules, computations or similar data or information that are required and specifically prepared or assembled by or for the Contractor and submitted by the Contractor to the Engineer for review and approval prior to incorporation into the work.

Special Provisions Written directions and requirements applicable to a specific project and not otherwise thoroughly or satisfactorily detailed or prescribed in the Standard Specifications or Supplemental Specifications. Often times simply referred to as “specials”.

Special Services Services not specifically called for in the Plans and specification that are required to be provided by competent individuals for the faithful execution of the project intents.

Special Waste Solid waste characterized for beneficial use in public works projects by the WDNR under section 895.58 of the Wisconsin statutes.
http://docs.legis.wi.gov/statutes/statutes/895

Specifications Written directions, provisions, and requirements contained in the Standard Specifications or Special Provisions, together with written agreements and documents referenced in the Contract, pertaining to the method or manner of performing the work, the quantities of work, and the quality of materials to be furnished under the Contract; as made part of the Contract and contained in or referenced in the proposal. Specifications by reference shall have the same force and effect as if included in the Contract physically. See also: Special Provisions and Standard Specifications.

Sponsor The Owner of an Airport controlling the site on which the construction Work is performed. The term “Owner,” when used in reference to the Airport Owner, has the same meaning as the term “Sponsor.”

Stabilization Modification of soils or aggregates by incorporating materials that will increase load bearing capacity, firmness, and resistance to weathering or displacement.

Standard Specifications Written directions and requirements approved for general application and repetitive use for administration of construction contracts.

Standard Airport Specifications (SAS) Wisconsin Department of Transportation Standard Specifications, current edition, prepared to be included as part of the construction documents for airport projects.

Standard Highway Specifications (SHS) Wisconsin Department of Transportation Standard Specifications, current edition, prepared to be included as part of the construction documents for highway, bridge, and other transportation projects.

State The State of Wisconsin.

Structures Airport facilities such as bridges; culverts; catch basins, inlets, retaining walls, cribbing; storm and sanitary sewer lines; water lines; underdrains; electrical ducts, manholes, handholes, lighting fixtures and bases; transformers; flexible and rigid pavements; navigational aids; buildings; vaults; and, other manmade features of the Airport that may be encountered in the Work and not otherwise classified herein.

Subbase The layer or layers of specified or selected material of designed thickness placed on a subgrade to support the base course.

Subcontractor The individual, partnership, corporation, Limited Liability Company, joint venture or corporation to whom the Contractor, with the written consent of the Department, sublets any part of the Contract.

Subgrade The top surface of soil that forms the pavement foundation upon which the pavement structure and shoulders (if included) are constructed.

Superintendent The Contractor's authorized representative in responsible charge of the work who is present on the Work during progress, authorized to receive and fulfill instructions from the Engineer, and who supervises and directs the construction.

Supplemental Agreement A written agreement between the Contractor and the Owner covering: (1) work that would increase or decrease the total amount of the awarded Contract, or any major Contract item, by more than 25%, such increased or decreased work being within the scope of the originally awarded Contract; or (2) work that is not within the scope of the originally awarded Contract.

Supplemental Specifications Written directions and requirements adopted subsequent to the publication of the Standard Specifications, which amend the Standard Specifications.

Surety The Company executing a bond with the Bidder or Contractor to ensure acceptable performance of the Contract and for payment of all obligations pertaining to the Work.

Surface Course One or more layers of a pavement structure, the top layer of which resists skidding, traffic abrasion and the disintegrating effects of climate.

Taxilane A taxilane is an area designated within a portion of a larger contiguous paved area designed for low speed movement of aircraft between aircraft parking areas and terminal areas or to a taxiway.

Taxiway For the purpose of this document, the term taxiway means the portion of the Air Operations Area (AOA) of an airport that has been designated by competent Airport authority for movement of aircraft to and from the Airport's runways, aircraft parking areas and terminal areas.

Taxiway/Taxilane Safety Area (TSA) A defined distance extending each side of the taxiway or taxilane centerline being free from obstacles to allow the safe movement by aircraft using the taxiway/taxilane. See CSPP

Unbalanced Bid See materially and/or mathematically unbalanced bid.

Work The furnishing of all labor, materials, equipment, and incidentals and the performing of all tasks needed to complete the project or a specific part of the project as specified in the Contract, together with fulfillment of all associated obligations and duties required under the Contract.

Working Day A calendar day, except Saturdays, Sundays, department-specified holidays, and the period from November 16 to March 31, both dates inclusive, on which weather or other conditions not under the control of the Contractor will allow construction operations to proceed for at least eight (8) hours of the day with the normal working force engaged in performing the controlling item of work which would be in progress at this time.

END OF SECTION 10

Section 20 - Bidding Requirements and Conditions

20.1 Prequalification of Bidders

(1) The department will provide, upon request, information regarding departmental policy and procedures for prequalification of a Bidder.

(2) The Department will indicate in the Advertisement for Bids if a Contract does not require prequalification.

(3) Each Bidder shall furnish the Department with satisfactory evidence of their competency to perform the Work contemplated prior to the Department accepting a proposal from the Bidder. The specific qualification type and requirements will be stated in the Advertisement for Bids. The proper departmental form for the various types of prequalification statements shall be received by the proper Department office by the deadline as specified in the Advertisement for Bids or as indicated in an addendum.

(4) Any individual, partnership, or corporation desiring to bid on work under the jurisdiction or direct supervision of the Department shall submit a signed and dated statement, on the proper form provided by the Department, which fully states the financial ability, adequacy of plant, equipment and organization, prior experience, and other pertinent and material facts required. The Department shall receive these statements for examination and consideration no later than the time stated in the legal Advertisement for Bids or as amended. Statements received after the deadline listed may be processed, but the prospective Bidder may not be allowed to bid on the specific project where the deadline has passed at the sole discretion of the department.

(5) The Department will determine the classification of work and may establish the maximum capacity which the Bidder will be eligible to bid. The qualification, except as specifically extended, withdrawn, reduced or established by the Department, will remain valid for a period of time provided in the departmental policy.

(6) For Bidders which have previously established competency which remains valid in the area of work as listed in the Advertisement for Bid, a separate additional prequalification statement submittal is not required.

(7) In addition to being properly established as a prequalified firm, each Bidder shall submit a *Request to Bid/Current Workload* Form for each Proposal. The *Request to Bid/Current Workload* Form shall list all contracts and subcontracts representing all incomplete work in or out–of–State under contract at that given time. No contract will be awarded by the Department until the Department has received this information and made a determination that the Bidder is either within capacity in accordance with established prequalification limits, and in accordance with 20.3(4) and 20.3(5), or the Department is otherwise satisfied the Bidder is able to complete the additional work bid. The Bidder should submit this statement as soon as possible and the department should receive this form no later than 24 hours prior to the time for opening of Bids.

(8) The determination of acceptability of the information submitted, and authorization to bid is at the sole discretion of the Department. The Department will provide notification to the Bidder with the Department's determination for authorization to bid. If multiple contracts or projects are sought to be bid, a separate request to bid/current workload forms shall be submitted.

20.2 Contents of Proposal Forms

(1) The bidding proposal as furnished by the department or its representative engineering firm is the required form the prospective Bidder must use to prepare and submit bids for the work. The provided the bidding proposal will include:

a. Airport Owner, airport name, and project Identification number.
b. Amount of the proposal guaranty.
c. Departments deadline for receiving completed proposals.
d. Time to complete the work.
e. A location for the Bidder to indicate the name and address of the prospective Bidder.
f. A summary of the type of work to be performed or materials to be furnished.
g. Locations for the authorized Bidders' representatives Signature & notary public (if not electronically bid)
h. Contract requirements not contained in the Standard Specifications.
i. Special provisions.
j. Schedule of items.

(2) Documents bound with or attached to the bidding proposal are a part of the proposal. Do not detach or alter bound documents when submitting the proposal. The Plans, Standard Specifications, and other documents designated in the bidding proposal are a part of the proposal, whether attached or not, and need not be returned when the proposal is submitted.

(3) Documents inserted within, but not attached or bound to the bidding proposal are not part of the Contract proposal and are furnished for information purposes.

20.3 Furnishing of Proposal Forms, Plans, and Specifications

(1) Bidding proposals may be obtained from the source as indicated in the Advertisement for Bids. Proposal Forms are included with the Plans and Specifications.

(2) The prospective Bidder shall ensure that they have met the prequalification requirements as stated in the Advertisement for Bids. Subsection 20.1, Prequalification of Bidders, and the Advertisement for Bids provide the requirements for the establishment of the competency of prospective Bidders for the submittal of their Proposal. Subsection 20.13, Disqualification of Bidders and Subsection 20.7 Irregular Bids, outlines some of the causes for disqualification of the Bidder and rejection of Bid(s).

(3) Plans and Specifications that govern the work are on file and available for office examination at the office of the Wisconsin Bureau of Aeronautics, 4822 Madison Yards Way, 5th floor south Madison, Wisconsin and at other locations as stated in the Advertisement for Bids. The Advertisement for Bids provides the location for obtaining Bidding Documents.

(4) The Department may refuse to issue bidding proposals, or approved to bid, to a prospective Bidder for one or more of the following reasons:

a. The Department's estimate of the cost of the proposal, together with the value of the prospective Bidder's uncompleted contract work, exceeds the prospective Bidder's established ratings, as determined in 20.1, at the time set for receiving proposals.

b. The prospective Bidder has work under way, or has documented recently performed work not up to the proper standard of progress or quality. The prospective Bidder may request, in writing, that the Department review its refusal to issue a bidding proposal as provided in the Department's prequalification policy.

c. The award of additional work, in the Department's opinion, would preclude the satisfactory performance of the additional work or work already under way. The prospective Bidder may request, in writing, that the Department review its refusal to issue a bidding proposal or approved to bid as provided in the Department's prequalification policy.

d. Any of the causes for disqualification of a Bidder specified in 20.13.

(5) The Department will not issue bidding proposals for the following reasons:

a. The prospective Bidder has been suspended or debarred from bidding on Department contracts under Trans 504 of the Wisconsin administrative code, or federal debarred list .

b. The Department will not issue bidding proposals to two or more prospective Bidders on the same contract who are affiliated with each other.

20.4 Interpreting Bid Proposal Quantities

(1) Submit unit bid prices for the estimated quantities as given in the schedule of items. These quantities are approximate and the Department only uses them for the comparison of bids. Do not plead misunderstanding or deception because of these quantities as to the character, location, or other conditions pertaining to the work.

(2) The Department will only pay the Contractor for the actual quantities of the work performed or materials furnished under the Contract. The Department may increase or decrease the Contractor’s scheduled quantities of work as provided in 90.3 without invalidating the bid prices.

20.5 Examining Contract Documents and Work Site

(1) The Bidder cannot take advantage of an error or omission in the contract. Carefully examine the Contract documents and notify the department immediately upon discovering errors or omissions. Also perform a reasonable site investigation before submitting a proposal. Submitting a proposal is an affirmative statement that the Bidder has examined the Contract documents, investigated the site, and is satisfied as to the character, quality, quantities, and the conditions the Bidder will encounter in performing the work that the Bidder could determine by walking the project site. A reasonable site investigation also includes investigating borrow sites, hauling routes, and all other locations related to the performance of the work.

(2) Before the Department's execution of the Contract, obtain permission from the airport Owner before physically entering onto airport property, performing excavations, borings, or other activities on airport

property. Obtain the necessary permission from the airport Owner or authorized representative such as the airport manager.

(3) The Department may include in the Contract documents, or make available for the Bidder's review at the design engineering consultant or other offices, one or more of the following:

a. Record drawings.

b. Available information relative to subsurface exploration, borings, soundings, water levels, elevations, or profiles.

c. The results of other preliminary investigations.

(4) The Department provides information under 20.5(3) for the Bidder's general knowledge only. This information is not a substitute for the Bidder's own investigation, interpretation, or judgment. The information provided applies only to the locations and at the times indicated.

20.6 Preparing the Proposal

(1) Submit completed proposals on the Department's bidding proposal described in 20.2. Submit legible information only. Write everything in ink, by typewriter, or by computer-controlled printer. Provide all dollar amounts in dollars and cents, in numerals. Attach or acknowledge receipt of all Addenda to the submitted proposal.

(2) Properly execute the proposal. Place the required signatures, in ink, in the space provided on the bidding proposal as indicated below:

ENTITY SUBMITTING PROPOSAL	REQUIRED SIGNATURE
Individual	The individual or a duly authorized agent.
Partnership	A partner or a duly authorized agent.
Joint venture	A member or a duly authorized agent of at least one of the joint venture firms.
Corporation	An authorized officer or duly authorized agent of the corporation. Also show the name of the state chartering that corporation and affix the corporate seal.
Limited liability company	A manager, a member, or a duly authorized agent.

(3) Complete and execute and include the proposal guarantee in accordance with 20.8.

(4) The list of subcontractors should be completed and signed.

(5) It is recommended to complete and sign the *Agreement to Comply with Buy American Requirements* if included. The Contract cannot be awarded without this documentation on federally funded projects as specified in Section 30. Only the lowest Bidder will be required to submit *the Agreement to Comply with Buy American Requirements* on federally funded projects.

(6) Instead of using the schedule of items provided on the Department's bidding proposal, the Bidder may submit a substitute schedule with the proposal. Submit the proposed substitute schedule and obtain the Department's written approval before using a substitute schedule. Approval by the Department will not relieve the Bidder of any errors or omissions which may result in an irregular proposal and possible rejection.

(7) Provide a unit price for each Pay Item listed in the Schedule of Prices including alternate bids. Calculate and show, in the bid amount column, the products of the respective unit prices and quantities. For a lump sum Pay Item, show the same price in the unit price column and in the bid amount column pertaining to that Pay Item. Show the total bid obtained by adding the values entered in the bid amount column for the listed Pay Items.

(8) If a unit price or lump sum bid already entered in the proposal needs to be altered, cross out or obliterate the entered unit price or lump sum bid with ink or typewriter and enter the new price immediately adjacent to the original entry clearly identifying which unit price is being corrected, and initial it in ink.

(9) A change that the Bidder makes in the proposal is not an alteration if the Bidder makes that change as directed in a specific instruction contained in an addendum.

(10) Attach and/or include acknowledgment of all Addenda to the submitted proposal.

20.7 Irregular Proposals

20.7.1 Department Will Correct

20.7.1.1 All Schedules of Items

(1) The Department will correct arithmetic errors or omissions found in the completed schedule of items as follows:

a. Discrepancy between a unit price and the corresponding bid amount, or in the absence of a bid amount: Department will use the unit price to determine the correct bid amount.

b. Bidder leaves the unit price column or the bid amount column blank for a lump sum Pay Item: Department will use the single value shown to obtain the correct unit price and the correct bid amount for that Pay Item.

c. Discrepancy between the total bid and the sum of the correct bid amounts, or in the absence of a total bid: Department will use the correct bid amounts to determine the correct total bid.

20.7.1.2 Bidder-Generated Schedules of Items

(1) The Department will also correct errors in Bidder-generated schedules of items as follows:

a. Quantity is incorrect, and both the Pay Item number and description are correct: Department will correct the quantity and recalculate the bid amount.

b. Item number is correct and the description is incorrect: Department will correct the description.

c. Item number is incorrect and the description is correct: Department will correct the Pay Item number.

d. Item number is correct but out of sequence and the description is correct: Department will ignore the error.

20.7.2 Department May Reject

(1) Proposals are irregular and the Department may reject them for one or more of the following reasons:

a. The proposal contains unauthorized alterations of format, words, or figures.

b. The Schedule of Prices contains errors, alterations, or omissions in, Pay Item numbers, quantities, descriptions, or units of measure, that cannot be corrected as specified in 20.7.1.

c. The proposal is not prepared as specified in 20.6.

d. There are unauthorized alterations, additions, conditional or alternate bids, amendments, attachments, or irregularities that may tend to make the proposal incomplete, indefinite, or ambiguous as to its meaning.

e. There are unauthorized erasures or alterations appearing on the designation of the party to whom the Department issued the bidding proposal.

f. The award of the bid, together with the value of the Bidder's uncompleted contract work, exceeds the Bidder's established ratings, as determined in 20.1, or in the judgment of the Department determines that the Bidder does not have the sufficient capacity to undertake the additional work at the time set for awarding the work.

g. A single entity, under the same or different names, or affiliated entities submit more than one proposal for the same work. The submitting entity may be an individual, partnership, joint venture, corporation, or limited liability company.

h. The Department reserves the right to reject any irregular proposal and the right to waive technicalities if such waiver is in the best interest of the Department (Owner) and conforms to local laws and ordinances pertaining to the letting of construction contracts.

i. The Bidder did not include, attach or acknowledge receipt of all Addenda within the proposal submittal.

j. Failure to provide (if included in the bid proposal) a completed Agreement to Comply with Buy American Requirements on federally funded projects as specified in 30.1(4).

k. Failure to provide timely accurate and sufficient disadvantaged Business Enterprise (DBE) information as required in the contract documents

20.7.3 Department Will Reject

(1) Proposals are irregular and the Department will reject them if the Bidder:

a. Has not established prequalification as specified in 20.1.

b. Does not properly sign the proposal.

c. Does not furnish the required proposal guaranty in the proper form and amount as specified in 20.8.

d. Does not submit a unit price for each Pay Item listed including alternate bids, except for lump sum Pay Items where the Bidder may show the price in the bid amount column for that Pay Item or allowed corrections in accordance with 20.7.

e. Includes conditions or qualifications not provided for in the Department-supplied bidding proposal.

f. Submits a schedule of prices with illegibly printed Pay Item numbers, descriptions, or unit prices.

g. Submits a schedule of prices for the wrong contract.

h. Submits a Bidder-generated schedule of prices with an incorrect Pay Item number and incorrect description for a single Pay Item.

i. Omits a Pay Item or bid price on a Bidder-generated schedule of items.

j. Submits a materially unbalanced bid.

k. The Department finds evidence of collusion.

20.8 Proposal Guaranty

(1) The Department will reject and will not post a proposal submitted without a proposal guaranty in the amount not less than 5% of the total bid amount or as designated and payable to the party designated in the proposal and Advertisement for Bids. Submit the required proposal guaranty in one of the following forms:

a. Properly executed proposal bid bond submitted on the Department's form.
b. Properly executed annual bid bond submitted on the Department's form.
c. Certified check drawn on the account of the Bidder submitting the proposal.
d. Bank's check.
e. Cashier's check.
f. Postal money order.

(2) When submitting a bid bond, ensure that the surety is licensed to do business in Wisconsin and has an equivalent A.M. Best rating of A- or better.

(3) If the proposal includes alternate bids, each alternate must be bid in their entirety, the proposal guaranty must cover the combined total of base bid and all alternates.

(4) If the proposal includes mutually exclusive option(s), the proposal guaranty must cover the combined aggregate of base bid, any and all alternates, and the least expensive of the option(s) specified.

(5) If the Department invites combined bids and the Bidder elects to bid one or more individual proposal in addition to the combined proposal, the Bidder must submit a proposal guaranty in the amount required for the combined proposal. The combined proposal guaranty covers each individual proposal bid.

20.9 Proposal Delivery

(1) Submit bids as directed in the Advertisement for Bids or as directed in the Specifications or Addenda.

(2) If submitting a bid on paper, place each proposal, together with the proposal guaranty, and all Addenda acknowledgement in a sealed envelope, furnished by the Department. On each envelope, indicate the proposal number and the name of the Bidder. For mailed submittals, mark the sealed proposal as indicated above and enclose in an additional envelope. The Department will receive proposals at the place, until the hour, on the date designated in the notice to contractors. The Department will return proposals received after the designated time to the Bidder unopened.

(3) In the event an addendum is issued after the Bidder has placed his bid into the mail or delivery service, notify the Department immediately and follow instructions directed by the Department on how to proceed.

(4) If electronically bid, submit the Bid in accordance with Departmental policy, or as the Specifications or Addenda direct.

(5) Proposals will only be received by the Department from Bidders that have established and maintain valid prequalification status regardless of omission of the Request to Bid/Current Workload form in accordance with 20.1(7). However, no award will be made until the current workload information is provided in accordance with 30.1(3).

20.10 Withdrawing or Returning Proposals Prior to Opening

(1) Provide a written request to withdraw a proposal already filed with the Department. Submit the withdrawal request before the deadline set for receiving proposals. The Bidder named on a withdrawn proposal cannot subsequently bid on that contract unless the Department issues a new invitation for bids.

(2) The Department may withdraw a bidding proposal already issued or return unopened a proposal already filed with the Department if, after issuing the bidding proposal, the Bidder is found to be ineligible to bid on that contract.

20.11 Withdrawing Proposal After Opening

(1) After opening, a Bidder will not be permitted to alter a proposal and resubmit it under any circumstance.

(2) The Department may permit the withdrawal of a proposal due to error after their proposal has been opened subject to the requirements of applicable laws including 66.0901(5) of Wisconsin statutes, upon written request by the Bidder due to a serious and honest error in proposal preparation. The written request shall provide documentation supporting such claim with evidence satisfactory to the Department. If a withdrawal is granted by the Department, the proposal guarantee may be returned at the discretion of the Department. The proposal guarantee will only be retained in payment for liquidated damages for costs incurred to the public.

(3) Action on remaining bids will proceed as though any withdrawn proposal had not been received.

20.12 Public Opening of Proposals

(1) The Department will publicly open proposals at the time and place indicated in the proposal and Advertisement for Bids or as amended in an Addenda. The Department as soon as practical after the bid opening except as specified in 20.8 will post the as read total bid for each base bid, alternate bid, and grand total if provided for each proposal on the departments aeronautics web site.

https://wisconsindot.gov/Pages/doing-bus/aeronautics/airports/arpt-applow.aspx

If a proposal has no total bid shown, the Department will not post the total bid.

(2) Bidders or their authorized agent and other interested persons are invited to be present.

(3) The Department may postpone the receipt of bids time or the opening of bids time due to emergencies or unforeseen conditions. If the Department changes the hour or the date of the receipt of bids time or the opening of bids time, the Department will issue an addendum or public notice to notify prospective Bidders

(4) After verification for accuracy under 30.1 and an award has been made, the Department will post bid tabulations for accepted bids, including unit prices (no unit prices will be provided for alternates not awarded, or bids that have been rejected.) on the Department's aeronautics web site.

https://wisconsindot.gov/Pages/doing-bus/aeronautics/airports/bidtabs.aspx

20.13 Disqualification of Bidders

20.13.1 General

(1) If the Department disqualifies a Bidder, the Department will notify that Bidder in writing. The Department will give the reason for disqualification, the term of disqualification, and instructions for reestablishing eligibility to bid on departmental contracts.

20.13.2 Department May Disqualify

(1) The Department may disqualify the Bidder from further bidding for a period of time determined by the Department for one or more of the following reasons:

a. The Department has notified the Bidder that it has initiated a debarment or suspension action against the Bidder under Trans 504 of the Wisconsin administrative code.

b. Developments, subsequent to establishment of a Bidder's competency and qualifications, which in the Department's judgment affect the responsibility of the Bidder.

c. Not complying, within a reasonable time, with the Department's request to update a prequalification statement.

d. Documented record of Contractor default under previous contracts with the Owner or Department.

e. Documented record of unsatisfactory work on previous contracts with the Owner or Department.

20.13.3 Department Will Disqualify

(1) The Department will disqualify the Bidder from further bidding, for a period of time the Department determines, if the Bidder has been suspended or debarred from bidding on Department contracts under Trans 504 of the Wisconsin administrative code, or federal debarred list.

END OF SECTION 20

Section 30 - Contract Award and Execution

30.1 Consideration of Proposals

(1) Following the public opening of the proposals received, the Department will compare them on the basis of the summation of the products of the quantities of work listed and the Contract unit prices offered. In case of discrepancies, errors, or omissions, the Department will make corrections as specified in 20.7.1. In awarding contracts, the Department, in addition to considering the amounts stated in the proposals, may consider one or more of the following:

a. The responsibility of the various Bidders as determined from a study of the data required under 20.1.

b. The information required on the bidding proposal.

c. Information from other investigations that the Department may make.

(2) The Department will also review the proposals for the irregularities described in 20.7 and review the eligibility of the Bidder as specified in 20.13. The Department will determine whether irregularities are matters of form rather than substance and can be waived without prejudice to other Bidders or the public interest.

(3) If a *Request to Bid/Current Workload* form is not received by the apparent low Bidder prior to bid opening in accordance with 20.1(7), or included within the bid submittal itself, no award will be made until the Bidder has provided workload information and the Department has determined the Bidder to be within prequalification rating limit or has determined that the Bidder can reasonably assume the added work and adequately complete the Contract acceptably.

(4) No award will be made until the *Agreement to Comply with Buy American Requirements*, if required, has been provided within five business days after the lowest Bidder has been notified by the Department of its omission. After this time, the Department may reject as specified in 20.7.

(5) No award will be made until the DBE commitment or Good Faith Effort, if required has been approved.

(6) The Bidder may submit individual proposals for more than one contract being let. Although each individual proposal may not exceed the Bidder's rating, a combination of more than one proposal and incomplete work currently under contract may exceed the Bidder's rating. If the Bidder exceeds its rating, the Department may award a proposal or combination of proposals within the Bidder's rating and most advantageous to the overall public interest.

(7) The Department may reject any or all proposals, or waive technicalities if the waiver is in the best interest of the Department and Owner and is in conformance with applicable State and local laws or regulations pertaining to the letting of construction contracts. The Owner/Department, in its own interest, may re-advertise for bids or proceed with the work in another manner.

30.2 Awarding the Contract

(1) Unless rejecting all proposals, the Department will award the Contract to the lowest responsible Bidder whose proposal complies with 30.1. If two or more Bidders submit identical low bids, the Department will determine the successful Bidder by flipping a coin.

(2) The Bidder, by written notice before the time set for opening of bids, may limit the Bidder's total dollar volume of work or number of contracts to be awarded in a letting, and the Department will determine which contract or contracts to award in compliance with the Bidder's self-imposed capacity limit.

(3) If the Department does not make an award within 30 calendar days after opening the proposals, the lowest responsible Bidder, after those 30 days, may request, in writing, that the Department make the award. Stipulate a deadline of 10 business days or more, after the date of the request, for the Department to make the award. If the Department does not make the award within the stipulated time, the Bidder is relieved of its obligation to execute a Contract and Contract Bond.

30.3 Canceling the Award

(1) The Department may cancel a contract award before execution without liability.

30.4 Returning Proposal Guaranty

(1) The Department will return the proposal guaranties of all except the two lowest responsible Bidders within 5 business days after determining the lowest qualified and responsible Bidder and making the award of contract. The Department will return the two lowest qualified and responsible Bidder's proposal guaranty as soon as the lowest Bidder executes and submits in the proper form the Contract, Contract Bond, and other required documents as specified under 30.5.

(2) If the Department does not make the award within the time stipulated by the lowest responsible Bidder as specified in 30.2(3), the Department will return their proposal guaranty within 5 business days after that deadline.

30.5 Contract Bond

(1) At the time of submitting the Contract for execution by the Department, deposit a valid surety bond with the Department in the amounts designated on the bond form covering both performance and payment. Submit the Contract Bond on a Department-furnished form. For contracts exceeding $100,000 the amount shall be no less than 100 percent performance and 100 percent payment bonds.

(2) Ensure that the surety is licensed to do business in Wisconsin and has an equivalent A.M. Best rating of A- or better. The surety is subject to the Department's and Owners approval, and to the governor's approval, if required by law.

30.6 Executing and Approving the Contract

(1) The Bidder shall execute the Contract. The principal and the sureties shall execute the Contract Bond. Present the Contract, the Contract Bond, and all other Department-required forms within 10 business days after the date of notice of the award, or receipt of the Contract documents.

(2) Prior to executing the Contract, the Department may request the Bidder to furnish documentation providing evidence that the Bidder will retain that portion of the work as specified in 80.1.

(3) The Contract is not binding on the Department until the final execution of the Contract. The Contract final execution date is the date the final signer signs the Contract.

30.7 Failure to Execute Contract

(1) The Department may cancel the award if, within 10 business days after the date of notice of the award of the Contract, the successful Bidder does not do the following:

a. Return required forms or supply other Department-requested information.

b. Execute a Contract and Contract Bond, as provided in 30.6.

c. Request and Department grant a time extension

(2) If the Department cancels the award, the Department may retain the proposal guaranty, not as a penalty, but in payment of liquidated damages the Department sustains due to the Bidder's failure to execute. If the retained proposal guaranty is a bid bond, pay the Department the proposal guaranty amount within 10 business days of demand.

(3) If the Department cancels the award, a replacement award may then be made to the next qualified Bidder, or the project will be re-advertised, or handled as the Department may elect.

30.8 Nullifying the Award

(1) The Department will accept the Bidder's request to nullify and will nullify the Bidder's acceptance of the Contract if the following conditions are met:

a. The Bidder files the required Contract Documents in proper form and order.

b. The Department does not execute the Contract within 30 calendar days after the Bidder files the required Contract Documents.

c. The Bidder files a written request to nullify with the Department. Wait the 30 days specified in item 2 of 30.8(1) before filing that request. Stipulate in the request a deadline for the Department to execute the Contract. This deadline must be 10 business days or more after the filing date of the request.

d. The Department does not execute the Contract within the stipulated deadline.

(2) The Department will notify the Bidder, in writing, if the Department agrees to nullify the award. The Department's failure to act within the stipulated deadline also constitutes nullification.

(3) The request to nullify is a voluntary act of the Bidder. The Department's nullification relieves the Bidder, the Bidder's surety, and the Department of all obligations under the award.

(4) Unless and until the Bidder files a request to nullify, and until the Department nullifies, the Department may execute the Contract without prejudice to any Contract terms and conditions.

END OF SECTION 30

Section 40 - Scope of Work

40.1 Intent of the Contract

(1) The intent of the Contract is to state the roles and obligations of the Department/Owner and Contractor regarding the construction, execution, and completion of the work. Perform the work as the Contract specifies. It is further intended that the Contractor furnish all labor, materials, equipment, tools, transportation, and supplies required to complete the work according to the Contract.

40.2 Revisions to the Contract

40.2.1 General

(1) The Department reserves the right to revise the Contract at any time. These revisions do not invalidate the Contract or release the surety. The Contractor agrees to complete the Contract as revised. Do not proceed with the revised work without the project engineer's prior written approval. Upon receiving written approval, proceed immediately with the revised work.

(2) The Contractor shall notify the Project Engineer if the Contractor believes a revision to the Contract is necessary. Whenever the words notice, notification, or notify are used in 40.2 with reference to the Contractor, the Contractor shall provide notice as specified in 40.3. The Project Engineer will determine if a potential Contract revision is necessary and will notify the Contractor of its determination in writing. The Contractor must proceed with the Project Engineer's direction.

(3) If the Project Engineer determines a revision is necessary, the Project Engineer will revise the Contract time as specified in 80.10 and will revise the Contract price as specified in 90.4. The Contractor is entitled to no reimbursement for loss of anticipated profit.

(4) If the Project Engineer decides that a potential Contract revision identified by the Contractor is not necessary, and the Contractor does not agree with the Project Engineer's decision, the Contractor may pursue a claim under 50.16.

40.2.2 Issuing Contract Change Orders

40.2.2.1 Change Orders for Extra Work

(1) The Department will issue a Contract Change Order to accomplish extra work as defined in 10.2

40.2.2.2 Change Orders for Differing Site Conditions

(1) During the progress of the work, if one or more of the following differing conditions are encountered at the site, the party discovering the condition shall promptly notify the other party of the specific condition before further disturbing the site and before further performing the affected work.

a. A subsurface or latent physical condition, differing materially from those indicated in the Contract.

b. An unknown physical condition of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work specified in the Contract.

(2) If the Contractor discovers the differing condition, the Contractor shall provide oral notification as specified in 40.3.2, of the specific differing condition before further disturbing the site and before further performing the affected work.

(3) The Project Engineer will investigate the conditions. If the Project Engineer determines the conditions materially differ and cause an increase or decrease in the cost, time, or both, required to perform the work under the Contract, the Project Engineer will adjust the Contract price, time, or both, and modify the Contract in writing accordingly. The Project Engineer will respond to the Contractor as to whether or not an adjustment is warranted. The Project Engineer will follow the Contractor notification procedures specified in 40.3.

(4) Wet or unworkable soils due to adverse weather or other cause, are NOT considered a differing site condition if the soils encountered are as identified or provided in the plans or other contract documentation.

(5) The Department will not allow a Contract adjustment unless the Contractor has provided the required notice as specified in 40.3.

40.2.2.3 Change Orders for Engineer-Ordered Suspensions

(1) If the Project Engineer suspends or delays the performance of all or any portion of the work in writing for an unreasonable period of time (not originally anticipated, customary, or inherent to the construction industry) and the Contractor believes that additional payment, Contract time, or both, is due because of the suspension or delay, the Contractor shall submit a written request for adjustment within seven

calendar days of receipt of the Project Engineer's directive to resume work. Ensure that the content of the request conforms to 40.3.5.

(2) The Project Engineer will evaluate the Contractor's request. If the Project Engineer agrees that the cost, time, or both, required for the performance of the Contract has increased due to the suspension or delay and the suspension or delay was caused by conditions beyond the control of and not the fault of the Contractor, its suppliers, or subcontractors at any approved tier, and not caused by weather, the Project Engineer will make an adjustment and modify the Contract in writing accordingly. The Project Engineer will respond to the Contractor as to whether or not an adjustment is warranted as specified in 40.3.6.

(3) The Project Engineer will not consider a Contract adjustment unless the Contractor submits the request for adjustment within the time specified above.

(4) The Project Engineer will not consider a Contract adjustment under this clause to the extent that the performance would have been suspended by any other cause, or for which an adjustment is provided or excluded under any other term or condition of this Contract.

40.2.2.4 Change Orders for Significant Changes in the Character of the Work

40.2.2.4.1 General

(1) Under the Contract a significant change is defined if either one of two separate and distinct circumstances occur as follows:

a. Altered work.
b. Changed Quantities.

(2) Before performing significantly changed work, reach agreement with the Department concerning the basis for the adjustment as specified in 90.4.4. If the Department does not acknowledge that the work has significantly changed, follow the notification procedures as specified in 40.3.

(3) If the alterations or changes in quantities do not significantly change the character of the work under the Contract, the Department will pay for the altered work at the Contract price.

40.2.2.4.2 Altered Work

(1) The Department will adjust the Contract if the character of the work as altered differs materially in kind or nature from that involved or included in the original proposed construction.

40.2.2.4.3 Changed Quantities

(1) The Department will adjust the Contract if the Department or Contractor demonstrates that quantity changes affect the Contractor's unit cost to perform the work and meet one of the following:

a. The quantity of a major Pay Item, as defined in 10.2, is increased in excess of 125 percent or decreased below 75 percent of the original Contract quantity. Any allowance for an increase in quantity applies only to that portion in excess of 125 percent of the original Contract Pay Item quantity, or in case of a decrease below 75 percent, to the actual amount of work performed.
b. The quantity of a minor Pay Item is increased to become a major Pay Item. An adjustment in the Contract unit price for that Pay Item applies only to the quantity of that Pay Item having a Contract value as follows:
    i. Original Contract less than $8 Million: In excess of 6.25% of the original Contract,
    ii. Original Contract greater than or equal to $8 Million: In excess of $500,000.
c. The quantity of a minor Pay Item that is part of an approved subcontract and that exceeds 10 percent of the original value of that subcontract is decreased more than 50 percent from the original Contract quantity for that Pay Item. Either party to the Contract may submit a request for a revision to the Contract unit price for that Pay Item. The Department's total payment for the final reduced quantity will not exceed 75 percent of the original Contract quantity at the Contract price.
d. The quantity of a minor Pay Item that is part of an approved subcontract and that exceeds 10 percent of the original value of that subcontract is increased more than 50 percent from the original Contract quantity for that Pay Item and which as increased does not qualify for adjustment as a major Pay Item. Either party to the Contract may submit a request to the other for a revision of the Contract unit price for that quantity of the Pay Item that is in excess of 125 percent of the original Contract quantity.

40.2.2.5 Change Orders for Eliminated Work

(1) The Department has the right to partially eliminate or completely eliminate a Pay Item the Project Engineer finds to be unnecessary for the project. If the Project Engineer partially eliminates or completely eliminates a Pay Item, the Project Engineer will issue a Contract Change Order for a fair and equitable amount as specified in 90.5.

40.2.2.6 Change Orders for Revisions to Contract Time

(1) The Department will issue a Contract Change Order to revise the Contract time as specified in 80.10.

40.3 Contractor Notification

40.3.1 General

(1) Subsection 40.3 specifies the step-by-step communication process to be followed to expedite the resolution of potential Contract revisions identified by the Contractor. Both Contractor actions and Department responses are outlined. The Contractor's non-compliance with the requirements of 40.3 may constitute a waiver of entitlement to a pay adjustment under 90.4 or a time extension under 80.10. The department and contractor can mutually agree to extend any time frame specified throughout 40.3.

40.3.2 Contractor Initial Oral Notification

(1) If required by 40.2, or if the Contractor believes that the Department's action, the Department's lack of action, or some other situation results in or necessitates a Contract revision, the Contractor must promptly provide oral notification to the Project Engineer. Upon notification, the Project Engineer will attempt to resolve the identified issue.

40.3.3 Contractor 2-Day Written Notice

(1) If the Project Engineer has not responded or resolved the identified issue within two business days after receipt of oral notification, provide a Contractor two-day written notice to the project engineer. At a minimum, provide the following:

a. A written description of the nature of the issue.
b. The time and date of discovering the problem or issue.
c. If appropriate, the location of the issue.

(2) The Contractor is encouraged to provide the additional information specified in 40.3.5 as early as possible to assist the Project Engineer in the timely resolution of an identified issue. The Project Engineer will not require, in subsequent submissions, duplication of information already provided.

40.3.4 Engineer One-Day Written Acknowledgment

(1) Within one business day after the Contractor provides initial written notice, the Project Engineer will provide a project engineer one-day written acknowledgment to the Contractor. The Project Engineer will continue to resolve the issue.

40.3.5 Contractor Five-Day Written Statement

(1) If the Project Engineer has not responded or resolved the issue within five business days from the date of the initial written notice, augment the original written notice with an additional Contractor five-day written statement to resolve the issue. In the written statement:

a. State why the issue is a change to the original Contract.
b. Refer to the Contract to show what has changed from the original Contract.
c. Provide all perceived adjustments to Contract prices, delivery schedules, phasing, and Contract time.
d. Provide an estimate of the time within which the Department must respond to the notice to minimize cost, delay, or disruption.

(2) The Department understands that the Contractor's estimates of the time required and additional costs may be based on incomplete information. The Department will attempt to comprehend and resolve the potential change as quickly as possible. The Contractor can help the Department in this process by providing the requested information as quickly as possible.

(3) With the submittal of the written statement, the contractor may also request a meeting with the region.

40.3.6 Department One-day Written Acknowledgement

(1) Within one business day after the contractor provides the 5-day written statement, the project engineer will provide a Department one-day written acknowledgment to the contractor. The project engineer will continue to resolve the issue.

40.3.7 Department 5-Day Written Response

(1) Within 5 business days after receiving the contractor 5-day written statement, the project engineer may request specific additional information to allow the project engineer to decide whether item a or b of 40.3.8(1) applies. The project engineer will state the information needed and date it is to be received for further review. Submit additional information as an amendment to the contractor 5-day written statement.

40.3.8 Department Final Decision

(1) Within 10 business days after receiving the contractor 5-day written statement or additional information requested in 40.3.7, whichever comes last, the region will consider all information and provide a region final decision in writing to the contractor with one or more of the following responses:

a. The Project Engineer will confirm that a Contract Change Order is necessary as specified in 40.2. The Project Engineer will give direction concerning the potential change.

b. The Project Engineer will deny that the Contract has to be revised. The Project Engineer will provide a statement as to why the issue is not a change to the Contract. At a minimum, the Project Engineer will respond to the Contractor's issues and refer to the Contract to show why the issues are not a change from the original Contract.

(2) If the Contractor does not agree with the Department's decision the Contractor may pursue the issue as a claim as specified in 50.16. Alternatively, if the Contractor and Department mutually agree, the Department will get a third party advisory opinion according to the Department's dispute resolution procedures.

(3) If a third party reviews the issue, their recommendation is not binding on either party. The Department has 10 business days after receipt of the third party's written recommendation to render a decision. If the Department fails to respond in writing within those 10 business days or the Contractor disagrees with the Department's decision, the Contractor may pursue the issue as a claim as specified in 50.16.

40.4 Requests for Information

(1) Either the Department or the Contractor may request information that the other party must provide in order for the requesting party to fulfill its Contract obligations. The requesting party shall submit requests for information (RFI) to the Department either in hard copy or via email. RFI must conform to the following:

a. Be of reasonable scope.

b. Explain why a response is necessary to fulfill Contract obligations.

c. Provide a requested response time, which must be reasonable in relation to its scope.

(2) The responding party shall respond either in hard copy or via email within the requested response time. If more time will be required to adequately address the issue, the responding party shall provide a written status report within the requested response time. The parties will discuss the status of outstanding RFI at each progress meeting until the issue is resolved.

40.5 Cost Reduction Incentive (CRI)

40.5.1 General

(1) Subsection 40.5 specifies a two-step process for contractors to follow in submitting a cost reduction incentive (CRI) for modifying the Contract in order to reduce direct construction costs computed at Contract bid prices. The initial submittal is referred to as a CRI concept and the second submittal is a CRI proposal. If accepted by the Department, the Contractor and the Department will equally share all savings generated to the Contract due to a CRI as specified in 40.5.4.2. The Department encourages the Contractor to submit CRI concepts for the following situations:

a. The contractor generates the original cost savings idea and formulates it into a concept.

b. The department generates the original cost savings idea and obtains the contractor's assistance to formulate the idea into a concept.

(2) Follow the procedures specified in 40.5.2 for submitting a CRI concept. If the Department determines a CRI concept has merit, the Department will encourage the Contractor to submit a CRI proposal. Follow the procedures specified in 40.5.3 for submitting a CRI proposal.

(3) The Contractor may submit a CRI concept from a subcontractor. The Department will reimburse the Contractor. Subcontractors may not submit a CRI except through the Contractor.

(4) The Contractor may submit a CRI concept only after the execution of the Contract. Do not base bid prices on the anticipated approval of a CRI proposal. If the Department rejects a CRI proposal, complete the Contract as specified in the original terms or as otherwise modified.

(5) The Department will consider a CRI that changes but does not impair the essential functions or characteristics of the project. These functions or characteristics include, but are not limited to, appearance, service life, economy of operations, ease of maintenance, design, and safety of structures and pavements, construction phasing or procedures, or other Contract requirements. The Department will not consider a CRI that changes the following:

a. Permanent or temporary pavement type.

b. Permanent or temporary structural cross section above the subgrade.

(6) The Department will decide whether or not to approve a CRI. If federally funded, the Department must receive concurrence of the FAA prior to acceptance to ensure federal funding eligibility. The Department will bear no liability for causing a delay to the project in considering a CRI or for refusing to approve a CRI. The Department may consider a non-compensable time extension as specified in 40.5.2(3). The

Department will consider no Contractor claims for additional costs related to the acceptance or rejection of a CRI, including loss of anticipated profits, or increased material or labor costs. The Department will reimburse the Contractor for the development costs of CRI proposals as specified in 40.5.4.1(3).

(7) A CRI, approved or not approved by the Department, applies only to the Contract for which the Contractor submits it. Impose no restrictions on the CRI for its use or disclosure. The Department has the right to use, duplicate, and disclose in whole or in part all data necessary for the utilization of the CRI. The Department may use an accepted CRI or part of an accepted CRI on other projects without obligation to the Contractor. This provision does not deny rights granted by law with respect to patented materials or processes. The Department will not use this provision as the basis for rejecting the Contractor's submittal of a CRI concept from past projects.

(8) Continue to perform the work as the Contract specifies until receipt of the Engineer's written acceptance or rejection of the CRI Proposal.

(9) Work produced under an approved CRI Contract Change Order is subject to the provisions of 50.3.2 for nonconforming work.

40.5.2 Submittal and Review of a CRI Concept

(1) Initially, submit a brief letter with graphics as necessary to the Engineer to describe and illustrate the CRI concept. Estimate the overall CRI savings and the costs to develop the CRI proposal specified in 40.5.3. The Engineer will use the Contractor's estimate of the CRI proposal development costs as specified in 40.5.4.1(3). Indicate whether adequate time is available in the project schedule for submitting a complete CRI proposal and for the Department's review before implementation.

(2) The Department will review the CRI concept and, within 10 business days of the Contractor's initial submittal, notify the Contractor in writing whether the CRI concept has merit and whether the Contractor should submit it as a CRI proposal. The Contractor and the Department can mutually agree to extend this five-day review requirement. The Department will notify the Contractor if a professional engineer should seal the CRI proposal. If the Department informs the Contractor to submit the CRI proposal, the Department will share in the cost for developing the CRI proposal as specified in 40.5.4.1(3).

(3) If the Department determines the time for response indicated in the CRI concept letter is insufficient for review, the Department may choose to evaluate the need for a non-compensable time extension to the Contract. The Department will base its evaluation on the additional time that the Department needs for its review of the CRI proposal and the effect on the Contractor's schedule caused by the added review time.

(4) If the Department has already taken action to implement revisions to the Contract subsequently proposed in a CRI concept, the Department may reject the CRI concept and revise the Contract without obligation to the Contractor.

(5) The Department may consider a CRI concept that addresses a potential Contract change situation as specified in 40.2.

(6) The department will not implement a contractor-initiated CRI concept, or portion of that concept, without sharing the cost savings with the contractor as specified in 40.5.4.2.

(7) The savings generated by the CRI must be sufficient to warrant its review and processing and offset the level of risk. The Department will assess the risk of the CRI relative to Departmental design policies and criteria for the project. The Department may reject a CRI concept for the following reasons:

a. It requires excessive time or costs for the Contractor to develop the CRI proposal.
b. It requires excessive time or costs for review, evaluation, investigation, or implementation.
c. It introduces an inappropriate level of risk.

40.5.3 Submittal of the CRI Proposal

(1) Within 10 business days after the Department has determined that the CRI concept has merit, submit the CRI proposal. The Contractor and Department can mutually agree to extend this 10-day submittal requirement. Ensure that the CRI proposal includes sufficient data for the Department to make an informed decision regarding the proposal and includes, at a minimum, the following information:

a. A statement that the proposal is submitted as a CRI.
b. A description of the difference between the existing Contract and the proposed change and the advantages and disadvantages of each, which may include effects on service life, economy of operations, ease of maintenance, benefits to the traveling public, desired appearance, and safety.
c. A complete set of Plans and Specifications showing the proposed revisions relative to the original Contract features and requirements. Support the proposed revisions with design computations as necessary for a thorough and expeditious evaluation.

d. A complete analysis indicating the final estimated costs and quantities to be replaced by the CRI compared to the new costs and quantities generated by the CRI. The Department will use these costs as specified in 40.5.4.2(1) to compute the proposed net savings.

e. A statement specifying the time within which the Department must make a decision.

f. A statement detailing the effect the CRI will have on interim completion dates and the time for completing the Contract.

g. A description of a previous use or testing of the CRI and the conditions and results. If the Contractor previously submitted the CRI on another Department project, the Contractor shall indicate the date, Contract number, and action taken by the Department.

h. A detailed statement that indicates the costs for developing the CRI proposal and implementing the changes. The Department will use these costs as the Contractor's CRI development and implementation costs as specified in 40.5.4.1(3) and 40.5.4.2(1).

i. Ensure that a registered professional engineer seals the CRI proposal if the Department requires it as specified in 40.5.2(2).

j. If proposing design changes, the Contractor may include with the additional information, results of field investigations and surveys, design computations, and field change sheets.

40.5.4 Acceptance, Rejection, and Payment

40.5.4.1 Acceptance, Rejection, and Payment of a CRI Proposal

(1) Within 10 business days of the Contractor's submission of the CRI proposal, the Department will if necessary, obtain FAA concurrence, and accept or reject the CRI proposal in writing. The Contractor and the Department can mutually agree to extend this 10-day review requirement. Provide requested additional information needed to evaluate the CRI proposal in a timely manner. The Department may reject a CRI proposal for untimely submittal of additional information.

(2) After accepting the CRI proposal, the Department will execute a change order reimbursing the Contractor for the cost of preparing the CRI proposal. The Department will limit reimbursement to the Contractor's estimate of the CRI proposal development costs provided in the CRI concept submittal. The change order will also state the conditions for the Department's acceptance and which of the following the net savings will be based on:

a. Agreed lump sum prices before the Contractor performs the CRI.

b. Agreed unit prices before the Contractor performs the CRI in conjunction with quantities that the Department will measure after the Contractor completes the CRI.

(3) If the Department informs the Contractor to submit a CRI proposal as specified in 40.5.2 and later rejects the CRI proposal, the Department will execute a Contract Change Order to adjust the Contract for the Contractor's development costs as listed in item 8 of 40.5.3(1). The Department will limit the Contract revision amount to the Contractor's estimate of the CRI proposal development costs provided in the CRI concept submittal. The Contract Change Order will terminate the Department's review of the CRI.

(4) Rejection of a CRI proposal is not an allowable basis for a claim against the Department for delay or for other costs.

40.5.4.2 Payment for the CRI Work

(1) The Department will pay for completed CRI work as specified for progress payments under 90.6. The Department will pay for CRI's under the Cost Reduction Incentive administrative item. When all CRI costs are determined, the Department will execute a Contract Change Order that does the following:

a. Adjusts the Contract time, interim completion dates, or both.

b. Pays the Contractor for the unpaid balance of the CRI work.

c. Pays the Contractor 50 percent of the net savings resulting from the CRI, calculated as follows:

NS = CW - CRW - CC - DC

Where:

NS = Net Savings

CW = The cost of the work required by the original Contract that is revised by the CRI. CW is computed at Contract bid prices if applicable.

CRW = The cost of the revised work, computed at Contract bid prices if applicable.

CC = The Contractor's cost of developing the CRI proposal.

DC = The Department's cost for investigating, evaluating, and implementing the CRI proposal.

(2) The Department is the sole judge of the acceptability of a CRI proposal and of the agreed net savings in construction costs from the adoption of all or part of the CRI proposal. The Department will not include time savings resulting from the CRI in the calculation of net savings.

40.6 Maintenance of Traffic

(1) It is the explicit intention of the Contract that the safety of aircraft, as well as the Contractor's equipment and personnel, is the most important consideration. The Contractor shall maintain traffic in the manner detailed in the Construction Safety Phasing Plan (CSPP). It is understood and agreed that the Contractor shall provide for the free and unobstructed movement of aircraft in the air operations areas (AOA) of the airport with respect to his/her own operations and the operations of all his/her subcontractors as specified in the 80.5. It is further understood and agreed that the Contractor shall provide for the uninterrupted operation of visual and electronic signals (including power supplies thereto) used in the guidance of aircraft while operating to, from, and upon the airport as specified in the 70.24.

(2) With respect to his/her own operations and the operations of all his/her subcontractors, the Contractor shall provide marking, lighting, and other acceptable means of identifying: personnel; equipment; vehicles; storage areas; and any work area or condition that may be hazardous to the operation of aircraft, fire-rescue equipment, or maintenance vehicles at the airport in accordance with the construction safety and phasing plan (CSPP) and the safety plan compliance document (SPCD)

(3) When the Contract requires the maintenance of vehicular traffic on an existing road, street, or highway during the Contractor's performance of work that is otherwise provided for in the Contract, Plans, and Specifications, the Contractor shall keep such road, street, or highway open to all traffic and shall provide such maintenance as may be required to accommodate traffic. The Contractor shall furnish erect, and maintain barricades, warning signs, flag person, and other traffic control devices in reasonable conformity with the manual of Uniform Traffic Control Devices (MUTCD) (http://mutcd.fhwa.dot.gov), unless otherwise specified. The Contractor shall also construct and maintain in a safe condition any temporary connections necessary for ingress to and egress from abutting property or intersecting roads, streets or highways. Unless otherwise specified, the Contractor will not be required to furnish snow removal for such existing road, street, or highway.

(4) The Contractor shall make his/her own estimate of all labor, materials, equipment, and incidentals necessary for providing the maintenance of aircraft and vehicular traffic as specified in this subsection.

(5) The cost of maintaining the aircraft and vehicular traffic specified in this subsection shall be measured and paid for under separate Pay Item or items as provided in the Contract, if no separate Pay Item is provided, the costs shall be considered incidental and included in the other various Contract items.

40.7 Removal of Existing Structures

(1) All existing structures encountered within the established lines, grades, or grading sections shall be removed by the Contractor, unless such existing structures are otherwise specified to be relocated, adjusted up or down, salvaged, abandoned in place, reused in the work or to remain in place. The cost of removing such existing structures shall not be measured or paid for directly, but shall be included in the various Contract items.

(2) Should the Contractor encounter an existing structure (above or below ground) in the work for which the disposition is not indicated on the Plans, the Engineer shall be notified prior to disturbing such structure. The disposition of existing structures so encountered shall be immediately determined by the Engineer in accordance with the provisions of the Contract.

(3) Except as provided in the subsection titled rights in and use of materials found in the work of this section 40.8, it is intended that all existing materials or structures that may be encountered (within the lines, grades, or grading sections established for completion of the work) shall be utilized in the work as otherwise provided for in the Contract and shall remain the property of the Owner when so utilized in the work.

40.8 Rights in the Use of Materials Found on the Project

(1) The Contractor may use on the project; stone, gravel, sand, or other material found within the vertical and horizontal excavation limits the Plans show. Ensure that the Engineer determines the material's suitability before using it. The Department will pay for both the excavation of these materials at the corresponding Contract bid price and the Pay Item for which the excavated material is used. The Department will not charge the Contractor for the materials found within the above described excavation limits and so used. Replace, at no expense to the Department, with other acceptable material all of the excavation material so removed and used for embankments, backfills, approaches, or otherwise.

(2) Do not excavate or remove material from within the airport property that is not within the vertical and horizontal excavation limits the Plans show without the Engineer's written authorization. Do not base

bids on the anticipated approval of a request to excavate or remove material that is not within the above described excavation limits.

(3) Take ownership of all materials required to be removed and not necessary for the work.

(4) Contractor may not make claim for delays by their choice to use materials found on site.

40.9 Final Cleanup

(1) Upon completion of the work and before the Department accepts the work as specified in 50.15.2 and makes final payment as specified in 90.7, the Contractor shall remove from the airport project site, and to the extent that the Contractor is responsible therefore, from the adjacent property, all surplus and discarded materials, rubbish, and temporary structures. Leave the airport project site in a neat and presentable condition. The Contractor shall restore, at no expense to the Department and in general conformity with the Contract for the Pay Item or Pay Items involved, all work completed under previous contracts that the Contractor has damaged.

(2) If the Contractor procures or produces material from a pit, quarry, or deposit which is not an active commercial source or is not naturally submerged, the Contractor shall do work as necessary and practical to shape, slope, and trim and drain the site, including associated haul roads and adjacent areas disturbed by the Contractor's operations, so that it presents a stable, neat, trimmed appearance and that no water collects or stands therein. Do not create or enlarge an area of open water except as allowed under 152.2.3.1.

(3) The cost of final cleanup is incidental to the Contract unless Pay Items for site finishing, are specifically identified in the Contract.

END OF SECTION 40

Section 50 - Control of Work

50.1 Engineer's Authority

(1) The Engineer decides all questions regarding:

a. Interpretation of the Contract.

b. The quantity, quality, and acceptability of materials furnished and work performed.

c. The manner and rate of progress and performance of the work.

d. Payment, Contract administration, and the acceptable fulfillment of the Contract.

e. Disputes.

f. Mutual rights under the Contract.

(2) The Engineer may suspend the work in writing for any reason at any time during the Contract. Except as specified in 40.2.2.3 for engineer-ordered suspensions, the Department will allow no additional payment or time extension due to a suspension of work.

(3) The Engineer will determine estimated quantities for progress payments as specified in 90.6.

(4) The Engineer does not have the authority to accept work that does not conform to specification requirements.

50.2 Supplemental Plans and Drawings

(1) Submit to the Engineer supplements to the approved Contract Plans, shop drawings, and the computations necessary to control the work. Do not change the approved Contract Plans without the Engineer's written authorization. Submit shop drawings and supplemental information in a timely and organized manner allowing the engineer sufficient time for review without causing a delay in the project.

(2) If sufficient detail is not provided on the Plans produced by the Department, submit to the Engineer plans, shop drawings, and the computations required to successfully prosecute the work.

(3) If required in the Contract, submit plans for temporary structures, cribs, cofferdams, falsework, shoring, and form work. Ensure that these plans and accompanying drawings and computations are signed and sealed by a registered professional engineer.

(4) Include a transmittal letter with each submittal made under 50.2. Indicate on shop drawings all deviations from the Contract drawings and itemize these deviations in the transmittal letter. The Department will file and may review these submittals. The Department’s review does not relieve the Contractor of the responsibility for obtaining satisfactory results, for the accuracy of dimensions and details, or for conformity of these drawings with the Contract. The Contractor may begin work on associated items without the Department's review.

(5) Include the cost of furnishing all shop drawings in the unit price for one or more associated Pay Item.

(6) Shop drawings or other required plans, drawings etc. submitted by the Contractor are returned by the Engineer indicating they are incomplete or insufficient, more than twice, the Contractor will be assessed one hundred dollars ($100) liquidated damage for each subsequent submittal beyond the second.

50.3 Conformity with the Contract

50.3.1 General

(1) Perform all work the Contract specifies. Produce quality work within limits of precision reasonably expected of good construction. Produce work conforming to the lines, grades, cross-sections, dimensions, and material requirements the Contract specifies or the Engineer establishes. Monitor construction operations to identify potential unacceptable work as defined in 10.2. Promptly remove and replace, or otherwise correct, unacceptable work at no expense to the Department.

(2) Work outside or in addition of the original scope of work, or changes to contract price, must be covered by contract change order or supplemental agreement as applicable.

(3) The Contract may specify specific values with allowable tolerances, ranges, minimums, or maximums. Control operations to produce work that falls within the specified tolerance or range, falls above a specified minimum, or falls below a specified maximum. If the Contract does not specify a tolerance, range, minimum, or maximum value, control operations to produce work conforming to the Contract within accepted manufacturing or construction industry standards.

(4) The Contract may specify standard manufactured items such as fences, wire, plates, rolled shapes, and pipe conduit. If these items are identified by gauge, unit weight, section, and dimensions, these identifications are nominal weights or dimensions.

(5) The Engineer will not be responsible for the Contractor's means, methods, techniques, sequences or procedures of construction of the safety precautions incident thereto.

50.3.2 Nonconforming Work

50.3.2.1 Engineer-Accepted Nonconforming Work

(1) If the work does not conform to the Contract, the Engineer, in consultation with the FAA, will determine the circumstances under which that nonconforming work may be accepted and allowed to remain in place. Consideration will include but not limited to the finished product having a level of safety, economy, durability and workmanship equal to or better than that intended by the original Contract and is found acceptable to the Department/Owner. The Engineer will document the basis of acceptance and may execute a Contract Change Order to adjust the Contract unit prices for the nonconforming work. If the Contract does not specify a price adjustment, the Engineer may adjust the price.

50.3.2.2 Unacceptable Work

(1) The Engineer will issue a written order to remove and replace or otherwise correct nonconforming work that the Engineer deems unacceptable as defined in 10.2 at no cost to the Department. If the Contractor does not comply with the Engineer's written order, the Engineer may effect a remedy and deduct the cost from payments due the Contractor.

(2) Unacceptable work may be identified by the Engineer any time prior to partial or final acceptance of the work as specified in 50.11.

50.3.2.3 Unauthorized Work

(1) Unauthorized work is work performed as follows:

a. Without the lines and grades being given.
b. Beyond the lines and grades the Contract shows or the Engineer provides.
c. Without the Engineer's prior approval.
d. After the Inspector has temporarily suspended the work in writing as specified in 50.8.
e. In violation of a written direction the Engineer issues.

(2) The Department may elect to not measure or pay for unauthorized work. The Engineer may issue a written directive to remove unauthorized work at no expense to the Department. If the Contractor does not comply with the Engineer's written directive, the Engineer may remove unauthorized work and deduct the cost from payments due the Contractor.

50.4 Coordination of the Contract Documents

(1) All documents included under the definition of Contract in 10.2 are essential parts of the Contract. A requirement occurring in one is binding as though occurring in all. These documents provide for and describe the complete Contract. These documents are available to the Contractor at no cost.

(2) During the progress of the work, the Contractor may request that the Engineer interpret or provide information relative to the Contract.

(3) If there is a discrepancy between documents, the governing order is as follows:

Discrepancy Between	And	Controlling Item/Document
Drawings	Figured dimensions	Figured dimensions over scaling unless obvious error
Supplemental Specifications	Standard Specifications	Supplemental Specifications
Plans	Standard Specification or Supplemental or Standard detail drawings	Plans
Special Provisions	Standard specification Supplemental Specification Plans	Special Provisions
Plan standard detail drawings	Typical Sections or details	Typical Sections or details
Special Provisions	Addenda	Addenda
Standard Specifications General Provisions	AIA Standard Provisions	Standard Specifications General Provisions
Electronic Files	Hard copy plans or documents	Hard copy plans or documents

(4) Neither the Contractor nor the Department may take advantage of an apparent error or omission in the Contract. Notify the Engineer immediately as specified in 40.3 upon discovering an error or omission. The Engineer will offer an interpretation and make the necessary corrections.

50.5 Coordination with the Contractor

50.5.1 Contractor Obligations

(1) Give the work the constant attention necessary to promote the progress of the work. Promptly supply the materials, tools, plant, equipment, labor, and incidental items required to perform the work.

(2) Cooperate with the Engineer and with third parties engaged upon or near the work.

(3) Maintain one copy each of the Plans and Specifications at the site of work at all times. The Engineer will supply the Contractor with copies of the Contract. If the Department has electronically computed estimated grading quantities, the Department will furnish that information to the Contractor upon request.

(4) Supervise and direct the work competently and efficiently. Devote the attention and apply the expertise necessary to perform the work as the Contract specifies. Monitor the work in progress to ensure that the work conforms to the Contract. The Contractor is solely responsible for the means, methods, techniques, sequences, and procedures of construction. The Contractor is not responsible for the negligence of others in the design or specification of specific means, methods, techniques, sequences, or procedures of construction described in and expressly required under the Contract.

(5) Employ a competent Superintendent or designate a representative for the duration of the project, capable of reading and understanding the Contract and experienced in the type of work being performed. The Superintendent or designated representative shall be employed by the prime Contractor subject to the approval of the Engineer, who will act as the authorized agent of the Contractor and shall have full authority to execute the Engineer's directions or instructions without delay. Ensure that the Superintendent or designated representative is on the project or accessible to the Engineer and available 24 hours a day and shall be on the construction site when there is any construction activity on the project. Notify the Engineer promptly when replacing the Superintendent or designated representative.

a. The responsibilities of the construction Superintendent include, but are not limited to: coordination with the Engineer, the airport, WisDOT-Bureau of Aeronautics, and all subcontractors; scheduling of

subcontractors; supervision of all construction; supervision of all signing, barricades and lighting; quality control, change order approval; scheduling and monitoring gate guards and haul routes; coordination with all utilities involved and attend all construction meetings.

b. During times shift work, or day and night work schedules, the Superintendent may appoint an additional Superintendent, as approved by the Engineer. At all times during construction, one of these approved Superintendents must be on the construction site, unless otherwise approved by the Engineer.

c. The Superintendent shall attend all periodic construction meetings unless otherwise authorized by the Engineer. Weekly construction meetings are anticipated however the Engineer may schedule more or less frequent meetings depending upon the nature of the anticipated construction activities.

d. No separate measurement or payment will be made if a construction trailer, phone services or utility services are used by the construction Superintendent if he deems one necessary. The Resident Engineer's field office shall not be used as the Superintendent's office.

e. Liquidated damages in the amount of five hundred ($500) per day will be assessed for each day there is construction activity on the project site without an approved construction Superintendent being available on-site. Liquidated damages will be accounted for and assessed by the Engineer separate from any other liquidated damages that may apply to the Contract and will be administered by the Department.

50.5.2 Cooperation Between Contractors

(1) The Department may, at any time, contract for or perform other work on or near the work covered under the Contract. Cooperate with other contractors engaged upon or near the work.

(2) The Contractor shall, or the Engineer may, direct the Contractor to:

a. Schedule and conduct the work to avoid interference with the operations of other contractors, the FAA or utilities engaged upon or near the work.

b. Perform the work in the proper sequence in relation to that of other work in the area.

c. Join the work to that of others (including FAA or utilities) in a manner consistent with accepted manufacturing or construction industry practices.

d. Conduct operations and maintain the work so that adequate drainage is provided at all times.

(3) The Contractor is responsible for damage done by the Contractor or the Contractor's agents to work performed by other contractors. Each Contractor involved shall assume all liability, financial or otherwise, in connection with their respective Contract and shall protect and save harmless the Department and the Owner, from any and all damages or claims that may arise because of inconvenience, delays, or loss experienced by them because of the presence and operations of other Contractors working within the limits of the same project. The Engineer will resolve disputes between two or more Contractors, engaged upon or near the work, regarding the rights of each under their respective contracts.

50.6 Construction Control and Staking

50.6.1 General

(1) Survey control for the project shall be based on the Primary Airport Control (PAC) monument, the Secondary Airport Control (SAC) monuments, and on other horizontal and vertical control monuments, which are shown on the Plans.

(2) Department is responsible for the accuracy of lines, slopes, and grades it provides. Engineer and Contractor shall agree on the meaning of all stakes, measurements, and marks before the Contractor begins work.

(3) Only control monuments shown on the Plans shall be used for construction, unless specified otherwise on the Plans or in the Special Provisions.

50.6.2 Engineer Responsibilities

(1) Furnish construction staking specifically designated on the Plans, Specifications, or Special Provisions.

(2) Provide construction staking upon a three working day notice from Contractor.

50.6.3 Contractor Responsibilities

(1) Provide and be responsible for all construction staking required to construct the project in accordance with the lines and grades shown on the Plans, except for control monuments and construction stakes which are specifically described in the Plans, Specifications, and Special Provisions.

(2) Maintain and protect all control monuments and construction stakes. Replace all construction stakes damaged by Contractor's operations. Control monuments disturbed by Contractor's operations shall be replaced by the Department and the cost shall be deducted from the payments due the Contractor.

(3) Notify the Project Engineer immediately if the Contractor believes an error in staking or adjustments to Department provided stakes are believed to be required. Contractor shall not take advantage of errors made by Department or Departments' agents.

(4) Provide three working day notice to Engineer when requesting Engineer provided construction staking.

(5) Provide supplemental staking and layout to transfer alignment and grades from stakes provided to the Work. If Contractor utilizes equipment controlled by Global Positioning Systems (GPS), Contractor shall assume all responsibility for the accuracy of the system and for confirming that electronic files obtained from the design engineer are interpreted and entered correctly, and the electronic data conforms to the design shown on the Plans.

50.7 Automatically Controlled Equipment.

(1) Whenever batching or mixing plant equipment is required to be operated automatically under the Contract and a breakdown or malfunction of the automatic controls occurs, the equipment may be operated manually or by other methods for a period 48 hours following the breakdown or malfunction, provided this method of operations will produce results which conform to all other requirements of the Contract.

50.8 Authority and Duties of Project Engineer

(1) As the Engineer's direct representative, the project engineer has immediate charge of the engineering details of each construction project. The project engineer is responsible for field administration of the project. The Engineer authorizes the project engineer to reject defective material and to suspend all work being improperly performed. The Engineer may delegate additional authority, granted under 50.1, to the project engineer.

50.9 Authority and Duties of Inspectors

(1) As the Engineer's authorized representatives, inspectors may inspect all work done and all materials furnished.

(2) The Department authorizes inspectors to:

a. Call the Contractor's attention to work or materials that do not conform to the Contract.

b. Reject materials until the Engineer is notified and decides all questions at issue.

c. Temporarily suspend work, in writing, until the Engineer is notified and decides all questions at issue.

(3) The Department does not authorize inspectors to do the following unless the Engineer specifically delegates:

a. Revoke, alter, or waive any requirements of the Contract.

b. Approve or accept any portion of the completed project.

c. Act as foreperson or perform other duties for the Contractor.

(4) The Engineer may delegate additional authority to the inspector.

50.10 Inspecting Work

(1) The Engineer may inspect, at any time, all materials and all parts of the work. This inspection may include the preparation, fabrication, or manufacture of materials or components on or off the project site. Allow the Engineer safe access to all parts of the work. Furnish the information and assistance needed to make a complete inspection.

(2) If the Engineer requests, uncover or remove portions of finished work for inspection. After inspection, restore that work to the Contract requirements. If the Department finds the work acceptable, the Department will pay for uncovering, removing, and restoring that work as extra work. If the Department finds the work unacceptable, the Contractor shall pay for uncovering, removing, and restoring that work.

(3) Failure to reject defective work or materials does not prevent the Department from rejecting defective work once it is discovered.

50.10.1 Inspection of Non-Airport Owned Facilities

(1) Should the Contract work include relocation, adjustment, or any other modification to existing facilities, not the property of the Owner (such as FAA owned facilities), authorized representatives of the Owners of such facilities shall have the right to inspect such work. Such inspection shall in no sense make any facility owner a party to the Contract, and shall in no way interfere with the rights of the parties to this Contract.

50.11 Removal of Unacceptable and Unauthorized Work.

(1) All work that does not conform to the requirements of the Contract, Plans, and Specifications will be considered unacceptable, unless otherwise determined acceptable by the Engineer as provided in the subsection 50.3.

(2) Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or any other cause found to exist prior to the final acceptance of the work, shall be removed immediately and replaced in an acceptable manner in accordance with the provisions of the subsection 70.17.

(3) No removal work made under provision of this subsection shall be done without lines and grades having been established by the Engineer. Work done contrary to the instructions of the Engineer, work done beyond the lines shown on the Plans or as established by the Engineer, except as herein specified, or any extra work done without authority, will be considered as unauthorized and will not be paid for under the provisions of the Contract. Work so done may be ordered removed or replaced at the Contractor's expense.

(4) Upon failure on the part of the Contractor to comply with any order of the Engineer made under the provisions of this subsection, the Engineer will have authority to cause unacceptable work to be remedied or removed and replaced and unauthorized work to be removed and to deduct the costs incurred by the Owner from any monies due or to become due the Contractor.

50.12 Load Restrictions

(1) The Contractor shall comply with all legal load restrictions in the hauling of materials on public roads beyond the limits of the work. A special permit will not relieve the Contractor of liability for damage that may result from the moving of material or equipment.

(2) The operation of equipment of such weight or so loaded as to cause damage to structures or to any other type of construction will not be permitted. Hauling of materials over the base course or surface course under construction shall be limited as directed by the Engineer. No loads will be permitted on a concrete pavement, base, or structure before the expiration of the curing period. The Contractor shall be responsible for all damage done by his or her hauling equipment and shall correct such damage as incidental unless paid for by specific Pay Items elsewhere in the Contract.

50.13 Maintenance During Construction

(1) The Contractor shall maintain the work during construction and until the work is accepted. Maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces so that the work is maintained in satisfactory condition at all times.

(2) In the case of a contract for the placing of a course upon a course or subgrade previously constructed, the Contractor shall maintain the previous course or subgrade during all construction operations.

(3) All costs of maintenance work during construction and before the project is accepted shall be included in the unit prices bid on the various Contract items, and the Contractor will not be paid an additional amount for such work.

50.14 Failure to Maintain the Work

(1) Should the Contractor at any time fail to maintain the work as provided in the subsection 50.13, the Engineer shall immediately notify the Contractor of such noncompliance. Such notification shall specify a reasonable time within which the Contractor shall be required to remedy such unsatisfactory maintenance condition. The time specified will give due consideration to the exigency that exists.

(2) Should the Contractor fail to respond to the Engineer's notification, the Owner may suspend any work necessary for the Owner to correct such unsatisfactory maintenance condition, depending on the exigency that exists. Any maintenance cost incurred by the Owner, shall be deducted from monies due or to become due, or recovered as liquidated damages against the Contractor.

50.15 Inspection and Acceptance

50.15.1 Partial Acceptance

(1) Upon completion of a portion of the work, the Contractor may request partial acceptance of that work. The Engineer will conduct an inspection to determine if the Contractor has satisfactorily completed operations in that area. Within 5 business days, the Engineer will grant, in writing, partial acceptance for that portion of the work or reject the Contractor's request. If the Engineer grants partial acceptance, the Engineer will, designate in writing, what portion of the work is partially accepted and the effective date for that partial acceptance.

(2) Partial acceptance will relieve the Contractor of maintenance responsibility for the designated portion of the work. By relieving the Contractor of maintenance, the Department does not relieve the Contractor of

responsibility for defective work or damages caused by the Contractor's operations. Do not construe partial acceptance to be final inspection, final acceptance of any part of the work, or a waiver of any legal rights specified under 70.19. This includes opening of and use of the various phases of the work that may be designated in the Contract Plans.

(3) The warranty period will begin for partially accepted work as specified in 60.7.

(4) In the event, or in lieu of a partial acceptance of a unit of work that is put into regular use by the Owner that is not part of the planned construction phasing, that portion of the work that is put into regular use will be deemed as partially accepted with regard to warranty related items as specified in 60.7. This portion of the work remains subject to final acceptance.

50.15.2 Project Acceptance

50.15.2.1 Inspection

50.15.2.1.1 General

(1) Notify the Engineer when the project is substantially complete as defined in 50.15.2.1.3. As soon as practicable, the Engineer will inspect the work and categorize it as one of the following:

a. Unacceptable or not complete.
b. Substantially complete.
c. Complete.

50.15.2.1.2 Unacceptable or Not Complete

(1) The Engineer will identify, in writing, work that is unacceptable or not complete. Immediately correct or complete that work. The Engineer will assess Contract time until the work is corrected or completed.

(2) Proceed as specified in 50.15.2.1.1 until the Engineer determines that the work is complete.

50.15.2.1.3 Substantially Complete

(1) The project is substantially complete and the Engineer will relieve the contractor of maintenance responsibility for the completed work and no longer assess Contract time if the Contractor has completed all Contract Pay Items and change order work, except for the punch-list. As applicable, the following must have occurred:

a. Full use of airport operational areas (AOA) or facilities are open for use.
b. All airfield electrical, navigational, signage, pavement marking and traffic control devices as appropriate are in place and operating properly.
c. All drainage, erosion control, excavation, and embankments are completed.
d. All safety appurtenances are completed.
e. For architectural projects, all code inspections have been satisfactorily completed and an occupancy permit without restrictions has been granted.

(2) The Engineer will provide a written punch-list enumerating work the Contractor must perform and documents the Contractor must submit before the Engineer will categorize the work as complete.

a. Punch-list work includes uncompleted cleanup work required under 40.9 and minor corrective work. Immediately correct or complete the punch-list work. The Engineer may restart Contract time if the Contractor does not complete the punch-list work within 5 business days after receiving the written punch-list. The Engineer and Contractor may mutually agree to extend this five-day requirement.
b. Punch-list documents include whatever Contract required documentation is missing. The Engineer may restart Contract time if the Contractor does not submit the punch-list documents within 15 business days after receiving the written punch-list. The Engineer and Contractor may mutually agree to extend this 15-day requirement.

(3) Proceed as specified in 50.15.2.1.1 until the work is complete.

50.15.2.1.4 Complete

(1) When the engineer determines that the project is complete, the engineer will give the contractor written notice. The project is complete when the Contractor has completed all Contract Pay Items, change order work, and punch-list work including the submission of all missing documentation.

50.15.2.2 Final Acceptance

(1) The Engineer will grant final acceptance in writing of the project after determining that all Contract work is complete; all Contract, materials, and payroll records are reviewed and approved; and the semi-final estimate quantities are final under 90.7.

(2) Failure to discover defective work or materials before final acceptance does not prevent the Department from rejecting that work or those materials later. The Department may revoke final acceptance if the Department discovers defective work or materials after it has accepted the work.

(3) The warranty period will begin on the date of Final acceptance unless otherwise partially accepted as specified in 60.7.

50.16 Claims Process for Unresolved Changes

50.16.1 General

(1) Before submitting a claim, the department and contractor can mutually agree to have the department get a third-party advisory opinion as specified in 40.3.6.

(2) The Department and Contractor can mutually agree to extend any time frame specified throughout 50.16 and can mutually agree to utilize an alternate dispute resolution method at any point before the Department renders its final decision.

(3) Costs related to referral to a dispute review board (DRB) are shared between the Department and the Contractor as prescribed in the Department's dispute resolution procedures.

50.16.2 Notice of Claim

(1) If the Contractor has followed the procedures for revising the Contract specified in 40.2 and provided the notification specified in 40.3, but still disagrees with the project engineer, the Contractor may pursue the issue as a claim. File a notice of claim with the project engineer concerning the disagreement within 14 calendar days of receiving the project engineer's decision under 40.3.6(1) or 40.3.6(3) whichever comes last. Update the previously submitted information if something has changed that may affect the project engineer's previous decision.

(2) The project engineer may deny the applicable portion of a claim if the Contractor does not do the following:

a. File the notice of claim within 14 calendar days as specified in 50.16.2(1).

b. Give the project engineer sufficient access to keep a record of the actual labor, materials, and equipment used to perform the claimed work.

(3) Upon filing the notice of claim, maintain records as specified for force account statements in 90.4.5.1(3). Unless the project engineer issues a suspension, the Contractor shall continue to perform the disputed work. The Department will continue to make progress payments to the Contractor as specified in 90.6.

50.16.3 Submission of Claim

(1) Submit the claim to the project engineer as promptly as possible following the submission of the Notice of Claim, but not later than the end of the time allowed under 90.7 for the contractor to respond in writing to the engineer issued semi-final estimate. If the Contractor does not submit the claim before final acceptance of the project, the Department will deny the claim.

(2) The department will not accept the submission of a claim until the resolution process in 40.3 has been completed and the contractor makes no further requests to submit updated information that may affect the region's final decision.

50.16.4 Content of Claim

(1) The final contractor written statement under 40.3.5 is considered the content of the claim. If the contractor makes a request to submit updated information that may affect the region's final decision under 40.3.8, submit the updated information as an amendment to the contractor written statement and continue the resolution process in 40.3 before submitting a claim.

(2) The Department may refer the claimant of a false claim to the appropriate authority for criminal prosecution. Certify the claim using the following form:

The undersigned is duly authorized to certify this claim on behalf of (the Contractor).

(The Contractor) certifies that this claim is made in good faith, that the supporting data are accurate and complete to the best of (the Contractor's) knowledge and belief, and that the amount requested accurately reflects the Contract adjustment for which (the Contractor) believes that the Department is liable.

(THE CONTRACTOR)

By: _____

(Name and Title)

Date of Execution: _____

50.16.5 Department Final Decision

(1) The department will have up to 28 calendar days, from the contractor's submission of the claim, to perform a final review of the claim and conduct all meetings. The department may request, in writing, that the contractor submit additional information related to the claim. Submit that additional information, or notify the department in writing to base its decision on the information previously submitted. Either the contractor or region may request a meeting to present their views. Before the meeting, both parties will agree upon written ground rules for the meeting.

(2) Upon completion of the 28 calendar days for the department's review and meetings, the department will have up to 21 calendar days to render a written decision. The department will consider written and oral submissions from the contractor and region, and may consider other relevant information in the project records.

(3) The Department will provide the following in its decision:

a. A concise description of the claim.

b. A clear, contractual basis for its decision that includes a reference to 40.2 on revisions to the Contract and as appropriate, specific reference to language regarding the Pay Items in question.

c. Other facts the Department relies on to support its decision.

d. A concise statement of the circumstances surrounding the claim and reasons for its decision. If the BOA rejects the claim in whole or in part, the BOA will explain why the claimed work is not a change to the Contract work.

e. The amount of money or other relief, if any, the BOA will grant the Contractor.

(4) If the contractor disagrees with the department's final decision, the contractor may initiate a legal action pursuant to state statutes.

50.16.6 Review by the Bureau Of Project Development (BPD)

50.16.6.1 General

(1) The BPD will act on claims either appealed or forwarded from the BOA level. The BOA will forward the claim to the BPD and give the BPD all documents and evidence regarding the claim previously submitted to the BOA. The Department will do one of the following:

a. Proceed with the BPD review.

b. Waive the BPD review and refer the claim directly to the review panel.

c. If the Department and Contractor mutually agree to a third party review, refer the claim to a neutral third party Dispute Resolution Board (DRB) for review according to the Department's dispute resolution procedures.

50.16.6.2 Bureau Project Development (BPD) Review

(1) In the initial review phase, the Contractor and the BPD will have up to 28 calendar days, from the date of the appeal, to submit all additional information required to review the claim and to conduct all meetings. The BPD may request, in writing, that the Contractor submit additional information related to the claim. The Contractor shall submit that additional information, or notify the BPD in writing to base its decision on the information previously submitted. Either party may request a meeting to present their views. Before the meeting, the BPD will distribute written ground rules for the meeting to both parties.

(2) Upon completion of the initial review phase, the BPD will notify the Contractor in writing that it has begun the decision phase.

(3) In the decision phase, the BPD will have up to 28 calendar days to render a written decision. The BPD will consider both parties' written and oral submissions, and may consider other relevant information in the project records. The BPD may affirm, overrule, or modify, in whole or in part, the BOA's decision.

(4) In the appeal phase, the Contractor will have up to 28 calendar days, from the date of the BPD decision, to appeal to the review panel. If the Contractor does not submit a written appeal to the BPD within those 28 days, the BPD decision is final. If the BPD does not render a decision within the 28-day period specified in 50.16.6.2(3), the BPD will forward the claim to the review panel as if the BPD had rejected the Contractor's claim.

50.16.6.3 Referred to Review Panel

(1) At any point in the BPD review the Department may unilaterally refer the claim directly to the review panel.

50.16.6.4 Referred to Dispute Review Board

(1) Either the Department or the Contractor may request in writing that the claim be referred to a neutral third party. The requesting party shall provide that request to the other party within 14 calendar days of

the BPD receipt of the claim from the BOA. The other party shall respond in writing by either accepting or rejecting the request within 14 calendar days of their receipt of the request.

(2) If the request for third party review is rejected, the BPD will proceed with their review.

(3) If the request for third party review is accepted, the BPD will give the third party all documents and evidence regarding the claim previously given to the BPD. The third party may request that the Contractor and the BOA submit additional evidence or documents related to the claim. The third party will consider both parties' written and oral submissions, and may consider other relevant information in the project records. The third party will review the claim and render a written recommendation.

(4) The third party recommendation is not binding on either party. The Department and the Contractor shall respond, in writing to each other, either accepting or rejecting the third party's recommendation within 14 calendar days of their receipt of the recommendation.

(5) Upon expiration of the 14 calendar days allowed for a response to the third party recommendation, the BPD has 28 calendar days to render a written decision that does one of the following:

a. Confirms the third party recommendation.

b. Overrules the third party recommendation.

c. Modifies, in whole or in part, the third party recommendation.

(6) If the Contractor disagrees with the BPD decision, the Contractor has 28 calendar days from receipt of that decision to appeal to the review panel. If the Contractor does not file a written appeal within those 28 calendar days, the BPD decision is final. If the BPD does not render a decision within the 28-day period specified in 50.16.6.4(5), the BPD will forward the claim to the review panel as if the BPD had rejected the Contractor's claim.

50.16.7 Review Panel

50.16.7.1 General

(1) The review panel will act on claims either appealed or forwarded from the BPD level. The BPD will forward the claim to the review panel along with all documents and evidence regarding the claim previously given to the BPD. The Department will do one of the following:

a. Proceed with the review panel review.

b. If either the Department or Contractor request a third party review and no formal third party review was conducted at the BPD level, refer the claim to a neutral third party DRB for review according to the Department's dispute resolution procedures.

50.16.7.2 Review Panel Review

(1) The review panel may request that the Contractor and the BOA submit additional evidence or documents related to the claim. The review panel will consider both parties' written and oral submissions, and may consider other relevant information in the project records.

(2) The review panel will conduct a hearing with the Contractor and the BOA. Before the hearing, the Department will distribute written ground rules for the hearing to both parties.

(3) The review panel may affirm, overrule, or modify, in whole or in part, the BOA decision or the BPD decision. The review panel will render a decision within 60 calendar days from the date of the appeal. Within 14 calendar days of the review panel's decision, the Contractor shall accept or reject their decision in writing. If the Contractor does not respond within those 14 calendar days, the review panel's decision is final.

(4) If the Contractor disagrees with the review panel's decision, the Contractor may initiate a legal action pursuant to state statutes.

50.16.7.3 Referred to Dispute Review Board

(1) Either the Department or the Contractor may request in writing that the claim be referred to a neutral third party. The requesting party shall provide that request to the other party within 14 calendar days of the review panel's receipt of the claim from the bureau.

(2) The review panel will give the third party all documents and evidence regarding the claim previously given to the review panel. The third party may request that the Contractor and the BOA submit additional evidence or documents related to the claim. The third party will consider both parties' written and oral submissions, and may consider other relevant information in the project records. The third party will review the claim and render a written recommendation.

(3) The third party recommendation is not binding on either party. The Department and the Contractor shall respond, in writing to each other, either accepting or rejecting the third party's recommendation within 14 calendar days of their receipt of the recommendation.

(4) Upon expiration of the 14 calendar days allowed for a response to the third party recommendation, the review panel has 28 calendar days to render a written decision that does one of the following:

a. Confirms the third party recommendation.

b. Overrules the third party recommendation.

c. Modifies, in whole or in part, the third party recommendation.

(5) The review panel's decision is the Department's final and standing decision regarding the claim. If the Contractor disagrees with the Department's final decision, the Contractor may initiate a legal action pursuant to state statutes.

END OF SECTION 50

Section 60 - Control of Materials

60.1 General

60.1.1 Materials

(1) Provide materials conforming to the Contract. Use new products and materials for items permanently incorporated into the work unless the Contract specifies or allows otherwise. Use materials the Contract specifies unless the Engineer authorizes substitutes under 60.2.3 or 80.8. Monitor construction operations to identify potential nonconforming materials and prevent their incorporation into the work.

(2) All materials are subject to the Engineer's approval before incorporation into the work. The Engineer may inspect or test all materials at any time during their preparation, storage, and use. Notify the Engineer of the proposed source of materials before delivering those materials to the project site. If the Engineer requests, provide samples of material and access to facilities that the Engineer needs to assess the acceptability of all materials. The Department will, on request, share with the Contractor available information on a source or material. The Department will maintain a web-based list of approved aggregate sources. Aggregate producers must provide test results as required in the Department policy for aggregate source approval to have their source approved and to keep that approval over time.

(3) For fabricated components, the materials and the fabricator are subject to the Department's approval before delivery of those components to the project site. The Engineer may require the Contractor to obtain components from another Department-approved source if the Department determines a fabricator's product does not conform to the Contract.

(4) Furnish airport lighting equipment that conforms to the requirements of cited materials specifications. In addition, where an FAA specification for airport lighting equipment is cited in the Plans or Specifications, furnish equipment that is:

a. Listed in the latest edition of FAA Advisory Circular (AC) 150/5345-53, Airport Lighting Equipment Certification Program, and Addendum that is in effect on the date of Advertisement; and,

b. Produced by the manufacturer as listed in the FAA Advisory Circular and Addendum cited above for the certified equipment part number.

(5) Do not incorporate materials into the work until the Engineer approves those materials. However, the Contractor may request permission to incorporate materials not already approved. The Engineer will grant this permission only if the Contractor can provide convincing evidence that the Engineer will subsequently find those materials conforming. Incorporation of materials before approval is at the Contractor's risk and permission to do so does not imply that the Department will subsequently approve those materials.

(6) Except as required under the Contract, ensure that products incorporated into the work, either temporarily or permanently, do not display advertising or messages not directly related to the manufacturer, properties, or function of those products; or advertising or messages in violation of state statutes.

60.1.2 Project Materials Coordinator

(1) Designate one person, either a member of the Contractor's own organization or acting as an agent for the Contractor responsible for the following:

a. Communicating Contract sampling and testing requirements to subcontractors at all tiers.

b. Reporting out-of-specification test results to the Department as soon as the information is available.

c. Providing certified reports of test or analysis and manufacturers' certificates of compliance from subcontractors at all tiers and maintaining certification records as specified in 60.3.3.2.

(2) Ensure that the Contractor's project materials coordinator submits materials information required under the Contract to a person the Engineer designates. Ensure that the Contractor's project materials coordinator communicates with their department counterpart weekly or at a frequency that is mutually agreed to between the Contractor and the Engineer.

60.2 Supply Source and Quality

60.2.1 Waste Materials

(1) The Department encourages the Contractor to incorporate material from the WDNR list of special wastes, cited in Section 895.58 of the Wisconsin statutes, into the work. The Department encourages use of the maximum amount of special waste consistent with the Contract and standard engineering practice.

http://docs.legis.wi.gov/statutes/statutes/895

(2) For materials used during construction but not incorporated into the work, use multiple-use or biodegradable products, if it is practical, to minimize the amount of solid waste generated during construction operations.

60.2.2 Preference for US-Made Materials

(1) On all projects, furnish materials manufactured to the greatest extent in the United States as provided in Wisconsin statute 16.754.

http://docs.legis.wi.gov/statutes/statutes/16

(2) On projects funded with Federal aid, Buy American clauses will apply as specified in the Contract Special Provisions. An *Agreement to Comply with Buy American Requirements* must be completed and submitted as specified in 30.1(4). Materials proposed that do not meet 100% U.S. manufactured product requirements, a waiver request by the Contractor is required to be completed and approval by the FAA is required prior to incorporation of the materials into the work. Abide by FAA waiver requirements and limitations.

60.2.3 Product Substitution

60.2.3.1 General

(1) Provide US standard system products as the Contract specifies. The Department may allow equivalent products if both of the following conditions are met:

a. The equivalent product is made from the same material as the original product, and complies with the corresponding specification requirements.

b. Dimensions of the equivalent product are essentially equal to dimensions of the original product. The Department will allow established manufacturing and fabrication tolerances unless the Contract specifies absolute maximum or minimum dimensions.

(2) Certify to the Engineer, in writing, that the substitute product complies with the requirements of 60.2.3.1(1). The Contractor shall not furnish the substitute product until the Engineer approves the substitution in writing. The Department will pay for the installed quantity of the substitute product at the Contract price for the original product.

60.2.3.2 Brand Name or Equal Substitutions

(1) The Plans or Specifications may call out brand name or equal products. A specification limited to one or more items by manufactures' name, make, model or catalog number to describe the standard or quality, performance and other salient characteristics needed to meet the Owner requirements and which provides for the submission of equivalent products. Prior to incorporation into the work, the Engineer must approve the equivalent product in accordance with 60.2.3 and 80.8.

60.2.4 Conditional Approval of Materials

(1) The Department may require, by Contract or at the discretion of the Engineer, inspection of materials at the point of manufacture or source of supply. The Department may conditionally approve materials found to be in compliance at the point of manufacture or source of supply.

(2) If inspection is required at a manufacturing or source plant, do the following:

a. Provide the Engineer with the results of relevant tests the Contractor or producer performs.

b. Cooperate with and assist the Engineer.

c. Secure for the Engineer full access to parts of the plant used to manufacture or produce materials when Contract work is in progress.

d. If the Engineer requires, secure acceptable working space in or near the plant.

e. Provide advance notice of production schedules as the Engineer requests.

f. Provide and maintain adequate safety measures at the plant for the Engineer.

(3) The Engineer may prohibit project site delivery of materials requiring inspection at the point of manufacture or source of supply until the Engineer grants conditional approval.

60.3 Approval of Materials

60.3.1 General

(1) The Department will approve materials or components demonstrated to conform to the Contract. The Department will base its approval on conformance with the Contract as close as it is practical to the point of incorporation into the work. The Department approves materials based primarily on the Engineer's tests, tests the Contractor performs under the quality management program, or tests the manufacturer performs and certifies. For materials conditionally approved at the point of manufacture or source of supply, the Engineer may:

a. Retest or re-inspect materials after delivery to the project site.

b. Reject material subsequently found to be non-complying.

(2) The Department may augment test results with documented performance history or inspection of processing, storage, handling, and construction operations. If the Contract requires or the Engineer requests, provide written documentation of the origin, composition, or process of manufacture of a material.

(3) Required samples of materials for testing will be provided without cost to the Department.

(4) Conform to manufacturer-recommended procedures for products incorporated into the work unless the Contract specifies otherwise. Provide copies of those procedures if the Engineer requests. The Contractor may request that the Department approve alternate procedures.

(5) The Department's approval of materials or components does not constitute acceptance of the work incorporating those materials or components.

60.3.2 Approved Product Lists (APL)

(1) The Department maintains product acceptability lists and other lists of approved products and approved manufacturers or suppliers. The Department includes products on these lists based on the results of prior testing and a satisfactory performance history on departmental projects. The Department may retest or re-inspect products after delivery to the project site to verify that they conform to the Contract. A product is nonconforming if verification test results indicate the product does not meet the requirements for inclusion in the Department's APL. Products on the APL have not been screened or approved for Buy American, evaluate any product used and include as necessary on a Buy American Waiver if required.

60.3.3 Approval by Certification

60.3.3.1 General

(1) For manufactured products or assemblies, the Department may base acceptance on a product certification or require both a product certification and production plant certification.

(2) Materials found not to be in conformity with Contract requirements will be subject to rejection whether in place or not.

60.3.3.2 Product Certifications

(1) For manufactured products or assemblies, the Engineer may accept a certified report of test or analysis, or a certificate of compliance instead of performing tests on samples. If not designated in the Contract for the specific material involved, the Engineer will determine the form and distribution of the required documents. Submit the number of copies of each document that the Engineer specifies.

(2) For testing documented by certificate, all sampling and testing procedures and testing facilities are subject to the review and approval of the Department. The Department may sample and test products to verify the certified test results. Provide samples at no cost as the Department directs.

(3) Create a file of manufacturers' certificates of compliance for the Contract. Maintain these certifications on file for a period of five years after completing the Contract work. If the Department requests, provide the requested certification within five-business days.

(4) Products are nonconforming if one or more of the following apply:

a. Certifications are not provided within the specified time or in the specified form.

b. Certified properties do not conform to the Contract.

c. Verification test results indicate the products do not conform to the Contract.

(5) The Engineer reserves the right to refuse permission for the use of materials or assemblies on the basis of certificates of compliance.

60.3.3.2.1 Materials Specified by Brand Name or Equal

(1) Materials or assemblies specified by brand name or equal where the Contractor elects to furnish the specified "brand name", the Contractor shall furnish the manufacturer's certificate of compliance for each lot of such material or assembly delivered. The certificate shall clearly identify each lot delivered and certify as to:

a. Conformance to the specified performance, testing, quality or dimensional requirements; and,

b. Suitability of the material or assembly for the use intended in the Contract work.

(2) Obtain approval of the Engineer for materials or assemblies furnished as an "or equal". Prior to incorporation into the work, provide the Engineer with the manufacturer's certificates of compliance as described in 60.3.3.2 for the proposed equivalent material or assembly. The Engineer shall be the sole judge as to whether the proposed "or equal" material or product is acceptable.

60.3.3.3 Plant Certifications

60.3.3.3.1 Precast Concrete Products

(1) The Department specifies precast concrete components and will allow precast alternates for cast-in-place concrete components. Ensure that precast concrete conforms to all of the following:

a. All specific Contract requirements for individual components.

b. Components are manufactured in a plant certified, at the time of the letting and during production of components provided under the Contract, to produce those specific components. Certification is provided by one of the following organizations:

i. Wisconsin Concrete Pipe Association.

ii. American Concrete Pipe Association.

iii. National Precast Concrete Association.

iv. Precast/Prestressed Concrete Institute.

v. Vendors included on the Departments approved vendor list available at:

https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/tools/appr-prod/default.aspx

c. Submit design and construction details to the Engineer for approval before installation.

60.3.3.3.2 Plant Inspection

(1) The Engineer or his or her authorized representative may inspect, at its source, any specified material or assembly to be used in the work. Manufacturing plants may be inspected from time to time for the purpose of determining compliance with specified manufacturing methods or materials to be used in the work and to obtain samples required for acceptance of the material or assembly.

(2) Should the Engineer conduct plant inspections, the following conditions shall exist:

a. The Engineer shall have the cooperation and assistance of the Contractor and the producer with whom the Engineer has contracted for materials.

b. The Engineer shall have full entry at all reasonable times to such parts of the plant that concern the manufacture or production of the materials being furnished.

c. If required by the Engineer, the Contractor shall arrange for adequate office or working space that may be reasonably needed for conducting plant inspections. Office or working space should be conveniently located with respect to the plant.

60.3.4 Approval By Sampling and Testing

60.3.4.1 General

(1) Except as specifically provided in the Contract, the Engineer will determine sampling and testing frequencies and sample locations, both on and off the project site.

(2) The Department will determine the sampling and testing methodology using the following order of precedence. The Department will:

a. Use specific methods the Contract references.

b. Use FAA specified methods on federally funded projects if the Contract does not reference specific methods.

c. Use CMM specified methods where appropriate if the Contract does not reference specific methods.

d. Use Department standard practices if the Contract does not reference specific methods and the CMM does not specify a method.

(3) The Department will maintain copies of all AASHTO and ASTM sampling and testing standards referenced in the Contract. Contractors, Bidders, or the suppliers of materials may examine those standards at the Department's central office in Madison. The Department will also make available for examination all other standards referenced in the Contract as well as the Department's sampling and testing standard practices.

(4) All Department and Contractor personnel engaged in sampling and testing of materials to be incorporated into the work must be qualified under a Department-accepted program for the specific tasks they are performing.

(5) All laboratory facilities employed in sampling and testing of materials to be incorporated into the work must be qualified, for the specific tests they are performing, by the Department under its laboratory qualification program.

60.3.4.2 Department's Material Testing Program

60.3.4.2.1 General

(1) Furnish without charge all samples that the Engineer requires and provide the facilities and staff required for collecting and forwarding them to the Department. The Department will, on request, share with the Contractor test results obtained on Contractor-furnished samples of materials.

60.3.4.2.2 Department-Approved Aggregates

60.3.4.2.2.1 General

(1) Coordinate with the Engineer to collect sample aggregates. The Engineer and Contractor will jointly obtain and split the sample. Ensure that the sampler is Wisconsin Highway Certification Program (HTCP) certified to sample aggregates. Costs associated with the required aggregate quality sampling and testing are incidental to the work.

(2) Test coarse aggregate sources a minimum of every five years for pits and a minimum of every three years for quarries. Source approval begins January 1 of the sampling year. If a source is sampled after October 15 and is not incorporated into a project the same year, source approval begins January 1 of the following year. Marginal sources; those with LA wear loss within 4.0 percent, sodium sulfate loss within 3.0 percent, or freeze-thaw soundless loss within 3.0 percent of a specification limit, may require annual testing. The Department and contractor will jointly obtain and split samples to test marginal sources. The Department maintains a list of current aggregate source test results at:

http://www.atwoodsystems.com/iibv2/default.cfm

(3) Ensure that testing is performed at a facility conforming to the Department's laboratory qualification program by a HTCP technician certified to test aggregate quality and that testing is performed.

(4) Perform testing on the split of the sample conforming to the following:

LA Wear (100 & 500 revolutions)	AASHTO T96
Sodium sulfate soundness (R-4, 5 cycles)	AASHTO T104
Fracture	CMM 8-60
Liquid limit [1]	AASHTO T89
Plasticity[1]	AASHTO T90
Coarse aggregate specific gravity and absorption	AASHTO T85
Lightweight Pieces in aggregate[2]	AASHTO T113

[1] Prepare samples according to AASHTO T146, Method A for the P-4 fracture.

[2] Required for aggregate sources used in concrete

(5) Provide test results to the Department's laboratory. The Department may perform testing on their split of the sample for verification.

60.3.4.2.2.2 Freeze-Thaw Soundness

(1) Perform freeze-thaw soundness testing according to AASHTO T103 as modified in CMM 860.2. Provide freeze/thaw soundness test results based on the fraction retained on the No. 4 sieve as follows:

a. Using virgin crushed stone aggregates produced from limestone/dolomite sources in one or more of the following counties or from out of state:

Brown	Columbia	Crawford	Dane	Dodge
Fond du Lac	Grant	Green	Green Lake	Iowa
Jefferson	Lafayette	Marinette	Oconto	Outagamie
Rock	Shawano	Walworth	Winnebago	

b. Using gravel aggregates produced from pit sources in one or more of the following counties or from out of state:

Dodge	Washington	Waukesha

(2) The Department may waive freeze/thaw testing for existing quarries determined to be in either the Silurian system or the Prairie du Chien group of the Ordovician system of rocks.

60.3.4.2.2.3 Quality Assurance

(1) The Department will approve an aggregate source and post contractor test results if either of the following conditions are met:

a. Both Contractor and Department results for split sample testing are within specifications.

b. Contractor results are within specifications and department split sample results are within tolerances.

(2) The Department will accept the Contractor's test results if department split sample results are within specified tolerances as follows:

TEST METHOD	TOLERANCE
LA wear (500 revolutions)	+/- 4.0%
Sodium sulfate soundness (R-4, 5 cycles)	+/- 3.0%
Coarse aggregate specific gravity	+/- 0.04
Coarse aggregate absorption	+/- 0.4%
Freeze-thaw soundness	+/- 3.0%

(3) The Contractor may request re-sampling and re-testing by both the Contractor and Department. If requesting a second re-test, submit a written description of corrective action and additional process control measures taken during production to change the resulting material properties.

(4) If the Contractor disputes the Department's test results, the Department will initiate the dispute resolution process.

60.3.4.2.2.4 Dispute Resolution

(1) The Department and Contractor will investigate discrepancies between Department and Contractor split sample test results.

(2) If the Department and contractor cannot resolve a discrepancy that could result in incorporating nonconforming work, the Department and the Contractor will use third-party tests by a mutually agreed on independent laboratory. The Department will obtain, maintain custody of, and send samples to a third party for testing. The Department and Contractor will abide by a third-party test result if within either the Department's or the Contractor's test result by the tolerance specified in 60.3.4.2.2.3(2). The party in error will pay independent laboratory costs.

(3) For non-conforming material placed before acceptance testing or completion of the dispute resolution process, the engineer will do one of the following:

a. Reject that material subject to the provisions of 50.3.2.2 for unacceptable work.
b. Approve those materials and adjust the contract price as provided in 50.3.2.1 for engineer-accepted nonconforming work.

60.3.4.3 Department's Quality Management Program

60.3.4.3.1 General

(1) Under the Contract QMP provisions, the Department will base approval of the covered materials on a combination of the results of the following:

a. Contractor quality control testing.
b. Optional Contractor assurance HMA testing.
c. Departmental verification testing.
d. Inspections of the materials production, storage, handling, and construction processes.
e. Dispute resolution procedures.

(2) Required sampling and testing methodologies and documentation are specified in CMM Chapter 8 or as otherwise specified or required by the FAA.

(3) If disputed, approval of materials and components, as well as acceptance of the work incorporating those materials or components, is subject to review under the QMP dispute resolution process.

60.3.4.3.2 Process Control

(1) Process control is the Contractor's responsibility. Perform and document inspections, additional testing, and corrective actions required to ensure materials incorporated into the work conform to the Contract. Make whatever process control information is collected available to the engineer. The Department will use Contractor generated process control information to help settle disputes.

60.3.4.3.3 Department Verification

(1) The Department may periodically conduct independent verification tests to validate the quality of the materials incorporated into the work.

60.3.4.3.4 Independent Assurance

(1) The Department may evaluate all personnel engaged in sampling and testing of materials to be incorporated into the work. The Department will base its evaluation on observation of procedures, required documentation, and spilt-sample testing.

(2) The Department may evaluate the Contractor's sampling and testing equipment. The Department will base its evaluation on visual inspection, calibration checks, or split sample or proficiency testing.

60.3.4.3.5 QMP Dispute Resolution

(1) The Engineer and Contractor should make every effort to avoid conflict by investigating substantive discrepancies in their respective test results.

(2) For potentially nonconforming materials, the Department and Contractor will thoroughly investigate to determine the quality and extent of material at risk. Provide available information, including test results the Contract does not require, control charts, records of corrective actions taken, and other information the Contractor generates as a part of an ongoing process control program.

(3) The Department and Contractor will review Contract required data as well as the Contractor's process control data, examine data reduction and analysis methods, evaluate sampling and testing procedures, and may perform additional testing. Use ASTM E178 to evaluate potential statistically outlying data.

(4) If project personnel cannot resolve a dispute that affects payment or could result in incorporating nonconforming work, the Department will resolve the dispute using third party testing by the Department's central office laboratory or a mutually agreed on independent laboratory. The Engineer and Contractor will abide by third party test results. The party in error will pay independent laboratory costs. The Department may use third party tests to evaluate questionable materials and determine appropriate payment. The Department will determine the final disposition of nonconforming material as specified in 60.5.

60.4 Storing and Handling Materials

(1) Store and handle materials to preserve their quality and fitness for the work. Provide easy access for the Department to inspect and test stored materials. Even if approved before storage, the Engineer may find materials nonconforming based on re-inspection before incorporation into the work.

(2) Materials stored on airport property shall not create an obstruction to air navigation nor shall they interfere with the free and unobstructed movement of aircraft. Unless otherwise shown on the Plans, the storage of materials and the location of the Contractor's plant and parked equipment or vehicles shall be as directed by the Engineer, or as shown on the CSPP.

(3) Private property shall not be used for storage purposes without written permission of the owner or lessee of such property. The Contractor shall make all arrangements and bear all expenses for the storage of materials on private property. Upon request, the Contractor shall furnish the Engineer a copy of the property owner's permission.

(4) All storage sites on private or airport property shall be restored to their original condition by the Contractor at his/her entire expense, except as otherwise agreed to (in writing) by the owner or lessee of the property.

60.5 Nonconforming Materials

(1) For nonconforming materials identified before incorporation into the work, the Engineer will do one of the following:

a. Reject those materials. Unless the Engineer allows otherwise, the Contractor shall remove rejected materials from the project site at no cost to the Department. The Engineer may allow the Contractor to correct rejected materials. The Contractor shall obtain the Engineer's approval for previously rejected, but subsequently corrected, materials before incorporating those materials into the work.

b. Approve those materials subject to potential reduced payment. The Engineer will determine the circumstances under which those nonconforming materials may be approved and incorporated into the work in accordance with 50.3.2.1 The Engineer will document the basis of approval and may execute a Contract Change Order to adjust the Contract unit prices for the nonconforming materials. If the Contract does not specify a price adjustment, the Engineer may adjust the price.

(2) For materials incorporated in the work and later found to be nonconforming, the Engineer will do one of the following:

a. Reject those materials subject to the provisions of 50.3.2.2 for unacceptable work

b. Approve those materials to remain in place, and adjust the Contract price as provided in 50.3.2.1 for engineer-accepted nonconforming work.

60.6 Airport Owner Furnished Materials

(1) The Contractor shall furnish all materials required to complete the work, except those specified, if any, to be furnished by the Owner.

(2) Owner-furnished materials shall be made available to the Contractor at the location specified.

(3) All costs of handling, transportation from the specified location to the site of work, storage, and installing Owner-furnished materials shall be included in the unit price bid for the Contract item in which such Owner-furnished material is used.

(4) After any Owner-furnished material has been delivered to the location specified, the Contractor shall be responsible for any demurrage, damage, loss, or other deficiencies that may occur during the Contractor's handling, storage, or use of such Owner-furnished material. The Owner will deduct from any monies due or to become due the Contractor any cost incurred by the Owner in making good such loss due to the Contractor's handling, storage, or use of Owner-furnished materials.

60.7 Construction Warranty - Correction of Work after Acceptance and Payment

(1) In addition to any other warranties in this Contract, the Contractor warrants that work performed under this Contract conforms to the Contract requirements and is free of any defect in equipment, material, workmanship, or design furnished, or performed by the Contractor or any subcontractor or supplier at any tier.

(2) This warranty shall continue for a period of one (1) year from the earliest date of:

a. The date of final acceptance of the work as accepted under 50.15.2.2.

b. The date of partial acceptance for that portion of the work partially accepted under 50.15.1.

c. The date the Owner takes possession and puts a specific portion of the work into regular service that is not part of planned construction phasing as identified in the Contract documents in accordance with 50.15(4). However, this will not relieve the Contractor from corrective items required by the final acceptance of the project work.

(3) Light sources other than incandescent and xenon for airport and obstruction lighting fixtures, requires that all light-emitting diode (LED) light fixtures with the exception of obstruction lighting, (Advisory Circular (AC) 150/5345-43) must be warranted by the manufacturer for a minimum of four (4) years after date of installation inclusive of all electronics.

(4) The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor shall remedy at the Contractor's expense any damage to Owner real or personal property, when that damage is the result of:

a. The Contractor's failure to conform to Contract requirements; or

b. Any defect of equipment, material, workmanship, or design furnished by the Contractor.

(5) The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for one (1) year from the date of repair or replacement.

(6) The Owner will notify the Contractor, in writing, within seven calendar days after the discovery of any failure, defect, or damage.

(7) If the Contractor fails to remedy any failure, defect, or damage within 14 calendar days after receipt of notice, the Owner shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.

(8) With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this Contract, the Contractor shall:

a. Obtain all warranties that would be given in normal commercial practice;

b. Require all warranties to be executed, in writing, for the benefit of the Owner, as directed by the Owner, and

c. Enforce all warranties for the benefit of the Owner.

(9) This warranty shall not limit the Owner's rights with respect to latent defects, gross mistakes, or fraud.

END OF SECTION 60

Section 70 - Legal Regulations and Responsibility to Public

70.1 Laws to be Observed

(1) At all times, observe and comply with all applicable federal and state laws and administrative rules, codes, local laws, ordinances, and regulations that affect the conduct of the work, and applicable orders or decrees of bodies or tribunals having jurisdiction or authority over the work. The Department will consider no plea of misunderstanding or ignorance thereof. The Contractor shall indemnify and save harmless the Owner and State and all of its officers, agents, and employees against any claim or liability arising from or based on the violation of any applicable law, ordinance, regulation, order, or decree, whether by the Contractor or the Contractor's employees, subcontractors, or agents.

(2) Comply with all applicable federal, state, and local health official rules and regulations governing safety, health, and sanitation. Provide all necessary safeguards, safety devices, and protective equipment. Take all other actions reasonably necessary to protect the life and health of employees on the project and the safety of the public.

70.2 Haul Road Notification

(1) Notify the Engineer in writing at least three business days before hauling project materials over a public road or street not a part of the state trunk highway system or over any airport road, street or airfield pavements. The Department will subsequently survey the existing condition of that haul route to establish a baseline for assessing damage that the Contractor's hauling operations might cause and may be paid under separate Pay Item P-646.

70.3 Permits and Licensing and Taxes

(1) Obtain all permits and licenses, pay all charges, taxes, and fees, and give all notices necessary to perform the work. The Contractor shall comply with all permit requirements whether the permit is issued to the Contractor, the state, the Owner, or other controlling authority having jurisdiction.

70.4 Patented Devices, Materials, and Processes

(1) Include in the bid prices royalties and costs arising from patents, trademarks, and copyrights. Before using a design, device, material, or process covered by letters, patents, or copyrights, provide for its use by suitable legal agreement with the patentee or owners. Provide proof of this agreement with the Engineer if necessary. The Contractor and the Contractor's surety shall provide indemnification from all claims for infringement of patents, trademarks, or copyrights as specified in 70.14.

70.5 Labor Compliance

(1) Comply with all Contract labor compliance provisions and take responsibility for subcontractor and lower tier subcontractor compliance. Submit Department-requested documentation within the time the Department specifies in a written notice. Resolve all labor compliance issues within 90 days after receiving the Department's first written notice. The Department and the Contractor can mutually agree to extend this 90-day requirement. Actively pursue resolution of Contract labor compliance issues and attend all Contract labor compliance meetings and hearings.

70.6 Restoration of Surfaces Disturbed by Others

(1) The Owner reserves the right to authorize the construction, reconstruction, or maintenance of any public or private utility service, FAA or National Oceanic and Atmospheric Administration (NOAA) facility, or a utility service of another government agency at any time during the progress of the work. To the extent that such construction, reconstruction, or maintenance has been coordinated with the Owner, such authorized work (by others) is identified in the Contract Plans and Special Provisions which will indicate as a minimum the following:

a. Owner (Utility or Other Facility)
b. Location (Shown on the Plans and/or in the Special Provisions.)
c. Person to Contact (Name, Title, Address and Phone)

(2) Except as listed above, the Contractor shall not permit any individual, firm, or corporation to excavate or otherwise disturb such utility services or facilities located within the limits of the work without the written permission of the Engineer. Costs associated with locating and marking public and private facilities will be considered incidental and the responsibility of the Contractor.

(3) Should the owner of public or private utility service, FAA, or NOAA facility, or a utility service of another government agency be authorized to construct, reconstruct, or maintain such utility service or facility during the progress of the work, the Contractor shall cooperate with such owners by arranging and performing the work in this Contract to facilitate such construction, reconstruction or maintenance by

others whether or not such work by others is listed above. When ordered as extra work by the Engineer, the Contractor shall make all necessary repairs to the work which are due to such authorized work by others, unless otherwise provided for in the Contract, Plans, or Specifications. It is understood and agreed that the Contractor shall not be entitled to make any claim for damages due to such authorized work by others or for any delay to the work resulting from such authorized work.

70.7 Federal Participation

(1) For AIP contracts, the United States Government has agreed to reimburse the Owner for some portion of the Contract costs.

(2) The work is subject to the inspection and approval of the duly authorized representatives of the FAA administrator, and is further subject to those provisions of the rules and regulation that are cited in the Contract, Plans, or Specifications.

(3) The work shall conform to the applicable federal, state statutes, local rules, and regulations and ordinances.

(4) No requirement of the USC, the rules and regulations implementing the USC, or this Contract shall be construed as making the United States a party to the Contract nor will any such requirement interfere, in any way, with the rights of either party to the Contract.

70.8 Nighttime Operations

(1) Do not perform work when there is insufficient light to conduct that work safely. If the Contract requires or the Engineer allows nighttime operations, provide artificial illumination as necessary to safely perform the work.

(2) During nighttime operations while the airfield remains open to air traffic, lighting shall be placed and directed in such a way as to minimize errant light emissions that could degrade pilot night vision. Provide lighting that is shielded and be aimed in a downward direction to minimize errant light emissions skyward. Locate work lights within and around the work zone in a way that provides adequate illumination to perform the work, makes the workers and construction operations visible to the workers and to the traveling public, and ensures that glare and brightness transition through the worksite does not interfere with pilot and construction worker's visibility.

(3) Provide additional hazard lighting on equipment as well as high visibility apparel conforming to ANSI/ISEA guidelines for workers.

70.9 Public Convenience and Safety

(1) Maintain the safety of the traveling public on road and airfield facilities and control traffic using barricades, warning signs, flaggers, and temporary barrier as specified in 40.6.

(2) If the Contract provides that the road or airport facilities or portions of roads or airport facilities are closed to public traffic during construction, the Engineer may direct or authorize the Contractor to temporarily open sections to public traffic before the work is completed as specified in 50.15.2.1.4.

a. Do not temporarily open the road or airport facilities to public traffic without the Engineer's written direction or written authorization.

b. By temporarily opening sections to public traffic, the Contractor is not relieved of performing the maintenance.

c. The Department will assume all costs for repair and maintenance solely attributable to public traffic use, and beyond the control and without fault of the Contractor. These maintenance expenses include costs associated with those traffic control devices or facilities specified. The Engineer's direction or authorization to temporarily open sections to public traffic does not constitute partial acceptance under 50.15.1 and waives no other Contract provisions.

d. Opening of traffic to the public, not part of a planned construction phase and put into regular use, as opposed to temporary opening, will constitute partial acceptance as specified in 50.15.1(4).

(3) When hauling materials on public roads or streets, or airport operations area (AOA), equip vehicles subject to spillage with tailgates and adequate sideboards. Use covers and other protective devices necessary to prevent spillage. The Contractor is responsible for removing spillage from the entire area within the right of way and air operations area (AOA) for the entire haul route. Immediately remove spillage that interferes with or creates a hazard for traffic.

(4) Notify the airport Owner at least 48 hours or as otherwise indicated in the Contract documents, before closing any airport operational area so the airport Owner may issue the appropriate Notice to Airmen to the FAA. The airport facility may not be closed until the Notice to Airmen has been published to alert pilots of the closure and construction activity.

(5) The Contractor shall maintain the free and unobstructed movement of aircraft and vehicular traffic with respect to his/her own operations and those of his/her subcontractors and all suppliers in accordance with 40.6 and shall limit such operations for the convenience and safety of the traveling public as specified in 80.5.

(6) Notify fire Department and police Department at least 24 hours before closing a road, street, highway or public airport ingress/egress to airport facilities occupied by the public.

(7) If excavating adjacent to a building or wall, give the property owner sufficient written notice of the impending excavation. The Contractor and the Contractor's surety shall hold the state and the municipality or airport Owner in which the work is done harmless from damage to the building or wall.

(8) Check for and comply with local ordinances governing the hours for operation of construction equipment. Obtain the Engineer's written approval for operations from 10:00 P.M. until 6:00 A.M.

(9) The Contractor shall remove or control debris and rubbish resulting from its work operations at frequent intervals, and upon the order of the Engineer. If the Engineer determines the existence of debris in the work site represents a hazard to airport operations and the Contractor is unable to respond in a prompt and reasonable manner to clear the debris, the Engineer reserves the right to assign the task of debris removal to a third party and recover the resulting costs as liquidated damage against the Contractor.

70.10 Contractor Use of Airport Property

(1) The Owner has sole authority to grant the Contractor permission to occupy and use airport property. All activity within the airport is subject to the Engineer's approval.

(2) If the Engineer allows, the Contractor may store materials and equipment or locate the Contractor's plant on portions of the airport not required for air or ground travel. Storage of materials or equipment may be limited in height so as to not create an obstruction or safety hazard to air navigation. If adjacent roads are to be used, post warning signs in advance of points of ingress and egress and provide other traffic control the Engineer deems necessary to minimize hazards to traveling public, pedestrians, and workers. Do not park vehicles or equipment, store materials, or create other obstructions where the Engineer determines the required safety measures may cause distraction.

(3) Areas proposed to be used beyond those identified in the Plans and Specifications, an airspace study may be required prior to approval for use.

70.11 Barricades, Warning Signs, and Hazard Marking

(1) The Contractor shall furnish, erect, and maintain all barricades, warning signs, and markings for hazards necessary to protect the public and the work. When used during periods of darkness, such barricades, warning signs, and hazard markings shall be suitably illuminated. Unless otherwise specified, barricades, warning signs, and markings for hazards that are in the air operations area (AOA's) shall be a maximum of 18 inches high. Unless otherwise specified, barricades shall be spaced not more than four feet apart.

(2) For vehicular and pedestrian traffic, the Contractor shall furnish, erect, and maintain barricades, warning signs, lights and other traffic control devices in reasonable conformity with the Manual of Uniform Traffic Control Devices (MUTCD).

(3) When the work requires closing an air operations area (AOA) of the airport or portion of such area, the Contractor shall furnish, erect, and maintain temporary markings and associated lighting conforming to the requirements of AC 150/5340-1, Standards for Airport Markings.

(4) The Contractor shall furnish, erect, and maintain markings and associated lighting of open trenches, excavations, temporary stock piles, and his/her parked construction equipment that may be hazardous to the operation of emergency fire-rescue or maintenance vehicles on the airport in reasonable conformance to AC 150/5370-2, Operational Safety on Airports During Construction.

(5) The Contractor shall identify each motorized vehicle or piece of construction equipment in reasonable conformance to AC 150/5370-2.

(6) The Contractor shall furnish and erect all barricades, warning signs, and markings for hazards prior to commencing work that requires such erection and shall maintain the barricades, warning signs, and markings for hazards until their dismantling is directed by the Engineer.

(7) Open-flame type lights shall not be permitted.

70.12 Use of Explosives

(1) Observe the utmost care when using explosives so as not to endanger life and property. Use, store, and handle explosives and highly inflammable materials conforming to applicable federal, state, and local laws and regulations including the rules of the Wisconsin Department of Commerce. Where no local

laws or ordinances apply, storage shall be provided satisfactory to the Engineer and, in general, not closer than 1,000 feet from the work or from any building, road, or other place of human occupancy.

(2) The Contractor shall be responsible for all damage resulting from the use of explosives. All explosives shall be stored in a secure manner in compliance with all laws and ordinances, and all such storage places shall be clearly marked. Where no local laws or ordinances apply, storage shall be provided satisfactory to the Engineer and, in general, not closer than 1,000 feet from the work or from any building, road, or other place of human occupancy.

(3) The Contractor shall notify each property owner and public utility company having structures or facilities in proximity to the site of the work of the Contractor's intention to use explosives. Such notice shall be given sufficiently in advance to enable them to take such steps as they may deem necessary to protect their property from injury.

(4) The use of electrical blasting caps shall not be permitted on or within 1,000 feet of the airport property.

70.13 Protecting and Restoring Property

70.13.1 General

(1) Notify, in writing, all public and private property owners whose property interferes with the work. Advise them of the nature of the interference, and arrange with them for the disposition of the property. Upon request, furnish the Engineer with copies of all notifications and final agreements.

(2) Use every reasonable precaution to prevent damage to all property including poles, trees, shrubbery, crops, and fences adjacent to or interfering with the work; all overhead structures including wires, cables, etc.; and all underground structures including water or gas shut-off boxes, water meters, pipes, conduits, etc.; within or outside the public right of way or Airport property.

(3) Assume liability for all damage to public or private property resulting from Contractor operations, defective work or materials, or non-execution of the Contract. Restore property, to a condition similar or equal to that existing before causing the damage, as the Engineer directs or in a manner acceptable to the property owner. If the Contractor fails to restore property within a reasonable time, the Department may, upon 48 hours written notice, restore that property as the Engineer deems necessary. The Department will deduct restoration costs from payments due the Contractor under the Contract.

70.13.2 Property Marks

(1) Protect and carefully preserve all known property and survey marks and land monuments, and notify the Engineer of the nature and location of these markers. Do not disturb or destroy markers until the Engineer has arranged for their referencing or perpetuation or replacement. Costs of replacement shall be paid by the Contractor.

70.13.3 Burning

(1) Burning will not be allowed on airport property without written permission of the Engineer. No burning can commence until Contractor has coordinated with Airport Manager and the Engineer and necessary NOTAMs have been issued.

(2) If permission to burn is granted, do not start fires without first securing the necessary permits and the approval of the local authority having jurisdiction, or the county forest ranger, or the WDNR bureau of forestry. Comply with applicable requirements of the WDNR's air pollution control rules, including the limitations on open burning. When burning brush, stumps, or rubbish, take care not to damage standing trees, shrubs, or other property. Assume liability for all damage caused by fires.

(3) When burning of material is permitted, it shall be burned under the constant overseeing of observation by a watchman to assure the surrounding vegetation and other adjacent property is not jeopardized.

(4) Burning shall be done in accordance with all applicable Federal, state and local laws, ordinances, and regulations. Contractor shall notify the agency having jurisdiction and obtain all approvals in writing before starting burning operations.

(5) For disposal by open burning, burn within the clearing limits when and in a manner that does not harm trees or shrubs to remain in place, create a nuisance, pose a hazard to traffic, or damage public or private property. Take care to avoid burning poison oak, poison ivy, poison sumac or other materials posing a health hazard when burned.

(6) Obtain burning permits required under local and state fire protection regulations and provide copies to the Engineer before burning. Comply with WDNR rule NR 429 regulating open burning which prohibits open burning in the Southeast Wisconsin Intrastate Air Quality Control Region (Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington, and Waukesha counties).

http://docs.legis.wisconsin.gov/code/admin_code/nr/400/429.pdf

(7) Do not use oily substances or other materials prohibited under NR 429 to start or maintain fires.

(8) Do not burn during weather conditions such as temperature inversions which can trap smoke near to the ground or create visibility or unacceptable air quality conditions.

(9) Cease burning operations, and extinguish fire immediately upon notification of the Engineer.

70.14 Responsibility for Damage and Tort Claims

(1) The Contractor and the Contractor's insurer shall defend, indemnify, and save harmless the airport Owner or owners, the governmental entities involved in the project, or in which all or a part of the project site is located, including the officers, agents except for consulting firms, and employees of any of the foregoing from suits, actions, or claims brought because of injuries or damages sustained by any person or property arising from one or more of the following:

a. Contractor operations.

b. Contractor neglect in safeguarding the work.

c. Contractor use of unacceptable materials in constructing the work.

d. Acts or omissions, neglect, or misconduct of the Contractor.

e. Claims or amounts recovered for an infringement by the Contractor of patent, trademark, or copyright.

f. Claims or amounts arising or recovered under the workers' compensation act, relating to the Contractor's employees.

g. The Contractor's noncompliance with a law, ordinance, order, or decree relating to the Contract.

(2) The Department may retain payments due the Contractor in amounts the Engineer deems sufficient to cover the cost of suits, actions, or claims caused by the reasons specified in 70.14(1). The Department will not release this retainage until the Contractor furnishes satisfactory evidence of one of the following:

a. The Contractor is adequately protected from the suits, actions, or claims with the insurance coverages specified in 70.28 or other insurance.

b. The parties have settled the suits, actions, or claims.

(3) The Owner and Department are not liable to the Contractor for damages or delays resulting from third party work, except for excusable delays as specified in 80.10.2 and 80.10.3. The state and the Owner are also exempt from liability to the Contractor for damages or delays resulting from injunctions or other restraining orders obtained by third parties except where the damage or delay is a direct result of an injunction or restraining order obtained by a citizen's action alleging violations of 42 U.S.C. 4331-4332, 23 U.S.C. 138, or public law 91-646.

70.15 Third Party Beneficiary

(1) This Contract does not create anyone as a third party beneficiary. This Contract does not authorize non-parties to the Contract to maintain actions for damages under the Contract or to authorize anyone not a party to the Contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of the Contract.

70.16 Opening Sections of the Work to Traffic.

(1) If is necessary for the Contractor to complete portions of the Contract work for the beneficial occupancy of the Owner prior to completion of the entire Contract, such "phasing" of the work must be specified in the Contract documents and indicated on the Plans and the approved Construction Safety and Phasing Plan (CSPP). When so specified, the Contractor shall complete such portions of the work on or before the date specified or as otherwise specified.

(2) Upon completion of any portion of the work, such portion shall be accepted by the Owner in accordance with the subsection 50.15.1.

(3) No portion of the work may be opened by the Contractor for public use until directed by the Engineer in writing. Should it become necessary to open a portion of the work to public traffic on a temporary or intermittent basis, such openings shall be made when, in the opinion of the Engineer, such portion of the work is in an acceptable condition to support the intended traffic and as specified in 70.9. Temporary or intermittent openings are considered to be inherent in the work and shall not constitute either acceptance of the portion of the work so opened or a waiver of any provision of the Contract. Any damage to the portion of the work so opened that is not attributable to traffic which is permitted by the Owner shall be repaired by the Contractor at their expense.

(4) The Contractor shall make their own estimate of the inherent difficulties involved in completing the work under the conditions herein described and shall not claim any added compensation by reason of delay or increased cost due to opening a portion of the Contract work.

(5) Contractor must conform to safety standards contained AC 150/5370-2 and those requirements as specified in the Contract documents and Construction Safety and Phasing Plan (CSPP).

(6) Contractor shall refer to the Construction Safety Phasing Plan (CSPP) included in the Plans to identify barricade requirements and other safety requirements including temporary and/or permanent markings and airfield lighting and guidance signs prior to opening up sections of work to traffic.

70.17 Contractor's Responsibility for Work

(1) Until the Engineer accepts the work as specified in 50.15 the Contractor shall maintain charge and care of the work except as otherwise specified. Within 70.17 the term “work” is redefined to mean “the work product that is completed in its final position and is incorporated in the project.” Protect all of the work against injury or damage caused by the action of the elements, or from any other cause, whether arising from the execution or non-execution of the work. Rebuild, repair, restore, and make good all injuries or damages to any portion of the work occasioned by the above causes at no additional cost to the Department.

(2) The Contractor shall not bear the expense for damage to the work caused by abnormal and unforeseeable occurrences beyond the control of, and without the fault or negligence of, the Contractor. These abnormal and unforeseeable occurrences include but are not limited to the following:

a. Cataclysmic phenomena of nature.
b. Acts of the public enemy.
c. Acts of government authorities.

(3) Before suspending the work, take the necessary precautions to prevent damage to the project, prevent aircraft or traffic accidents, and provide for normal drainage. Erect necessary temporary barrier, barricades, signs, or other facilities at no expense to the Department except as otherwise specified.

(4) During such period of suspension of work, the Contractor shall properly and continuously maintain in an acceptable growing condition all living material in newly established planting, seeding, and sodding furnished under the Contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury.

(5) The Contractor is responsible for all damages to equipment and supplies regardless of the circumstances.

(6) Insurance coverage must be maintained in accordance with 70.28.

70.18 Personal Liability of Public Officials

(1) In carrying out Contract provisions, or in exercising power or authority granted to them by or within the scope of the Contract, the Department/state and the Owner, the Engineer, or their authorized representatives have no liability, either personally or as officials of the Department/State and the Owner. In all of these matters, they act solely as agents and representatives of the Owner. The Contractor waives all rights of action against the Department/State and Owner, its agents, or employees.

70.19 No Waiver of Legal Rights

(1) The Department may correct a measure, estimate, or certificate at any time before or after final acceptance. The Department may recover from the Contractor, surety, or both, overpayments upheld for a breach (failure to fulfill Contract obligations). A waiver on the part of the Department of a breach of a part of the Contract is not a waiver of another or subsequent breach.

(2) The following Department actions do not waive the Department's rights or power under the Contract:

a. Payment for or acceptance of all or portions of the work.
b. Extension of Contract time.
c. Possession of the work.

(3) Assume liability for latent defects, fraud, gross mistakes as may amount to fraud, or as regards to the Department’s rights under a warranty or guaranty without prejudice to the terms of the Contract.

70.20 Environmental Protection

(1) Comply with all applicable federal, state, and local laws and regulations that control the prevention of pollution of the environment including those related to the introduction or spread of invasive species or pathogens in waterways.

(2) Comply with the pertinent requirements of laws relating to solid waste disposition and air pollution. Control and minimize the dispersion of dust and particulate matter and other pollutants into the atmosphere.

(3) Take all necessary precautions to prevent pollution of streams, lakes, wetlands, and reservoirs with fuels, oils, bitumens, calcium chloride, magnesium chloride, paint, or other harmful materials. Conduct and schedule work operations to avoid or minimize siltation of streams, lakes, and reservoirs. Protect drainage ways, culverts, and drainage structures from debris caused by a Contractor operation.

(4) Do not ford live streams unless a plan for the fording operation meets the Engineer's approval and results in minimum siltation to the streams. Do not operate machinery on the bed of live streams.

(5) Remove existing structures over live streams in large pieces, minimizing the number of smaller pieces that may drop into the water or wetlands. Remove from the water or wetlands all steel and all concrete pieces or other debris larger than 5 inches in any dimension.

(6) If work areas or pits are located in or adjacent to live streams, lakes, or wetlands, separate the work areas or pits from the stream, lake, or wetland by a dike, silt fence, or other barrier to keep sediment from entering these locations. Take care during the construction and removal of these barriers to minimize the siltation or filling of the stream, lake, or wetland.

(7) Treat water from aggregate washing or other sediment producing operations by filtration, a settling basin, or other means sufficient to reduce the sediment content to not more than that of the stream or lake into which the water is discharged.

70.21 Construction Over or Adjacent to Navigable Waters

(1) Within 70.21, the term "governmental authority" means the U.S. Army Corps of Engineers, the U.S. Coast Guard, the Wisconsin Department of Natural Resources, or other agency having jurisdiction over the navigable waters within the project limits and empowered to take the actions specified in 70.21.

(2) Conduct all work over, on, or adjacent to navigable waters so that free navigation of the waterways is not impeded and existing navigable depths are not impaired except as allowed by permit issued by the governmental authority. Obtain all permits before beginning construction.

(3) Obtain all permits required by 70.3. Submit applications for U.S. Coast Guard and WDNR permits to the boating law administrator of the WDNR bureau of law enforcement. Provide one copy of each permit to the project engineer for posting in the field office before construction activities affecting navigation begin.

(4) The governmental authority may supervise all construction and related operations as is customary for operations in navigable waters. Conform to special requirements or directions from the governmental authority.

(5) Ascertain from the governmental authority the minimum horizontal and vertical clearance requirements for navigation during construction, and maintain those clearances during the period of construction.

(6) If the governmental authority during progress of the work issues directions or orders affecting the Contractor's operations or order of procedure, the Contractor shall promptly file with the Engineer a written copy of the directions or orders.

(7) Should the Contractor during the progress of the work lose, dump, throw overboard, sink, or misplace material or equipment, which in the opinion of the governmental authority may interfere with or obstruct navigation, the Contractor shall promptly recover or remove the same. Give immediate notice with descriptions and locations of possible obstructions to the governmental authority. If the governmental authority requires, mark or buoy the obstructions until their removal. Should the Contractor refuse, neglect, or delay compliance with the above requirements, the governmental authority may remove the obstructions. The Department may deduct the cost of this removal from payments due to the Contractor, or may recover the cost under the bond deposited by the Contractor.

(8) During construction, provide temporary lights, waterway markers, other devices, or combination thereof as the governmental authority specifies and requires.

(9) All expenses the Contractor incurs to maintain navigation are incidental to the Contract cost.

70.22 Erosion Control

(1) Perform the temporary and permanent erosion control measures and the storm water management measures required by Trans 401 of the Wisconsin administrative code, the Contract, and as the Engineer directs.

(2) Coordinate temporary erosion control measures with the permanent erosion control measures to ensure economical, effective, and continuous erosion control.

(3) Submit an Erosion Control Implementation Plan (ECIP) for the project, including borrow sites and material disposal sites, according to Trans 401 of the Wisconsin administrative code. Prepare the ECIP according to CMM 645 and provide the information enumerated in Department worksheet DT1073. Perform the work according to the ECIP.

(4) The Engineer may limit the area of erosive land that the Contractor may expose to the elements by grubbing, excavation, borrow, or fill operations at any one time. Provide the shortest duration that is practical for this exposure before final trimming, finishing, and seeding, or application of temporary erosion control measures.

(5) Perform construction in and adjacent to rivers, streams, lakes, or other waterways in a manner to avoid washing, sloughing, or deposition of materials into the waterways that would obstruct or impair the flow of the waterways and thus endanger the roadway or stream banks, or that would result in undue or avoidable contamination, pollution, or siltation of these waterways.

(6) The Engineer has full authority to suspend or limit grading and other operations pending adequate performance of permanent erosion control measures, such as finish grading, topsoiling, mulching, matting, and seeding, and all temporary erosion control measures that the Engineer orders.

(7) Perform grubbing and grading operations in sequence with other work to minimize erosion. Construct intercepting ditches or dikes as soon as it is practical after completing clearing and grubbing operations and before or during the operations of excavating the cuts. Where erosion is likely to be a problem, provide the permanent erosion control measures immediately after performing grading operations, unless the Engineer authorizes temporary erosion control measures.

(8) Except as limited by State Highway Specifications Section 628 for borrow sites and material disposal sites, the Engineer will measure, and the Department will pay for, temporary and permanent erosion control as provided for by the various Contract Pay Items or as extra work, if this work is not specified in the Contract. However, the Department will not pay for this work if the Engineer requires temporary erosion control because of the Contractor's negligence, carelessness, or failure to install permanent controls.

70.23 Use of Fire Hydrants

(1) If the Contractor desires to use water from public hydrants, the Contractor shall make application to the proper authorities and shall conform to their ordinances, rules, and regulations concerning fire hydrant use.

(2) Ensure that fire hydrants are accessible at all times to the fire department. Do not place material or other obstructions closer to a fire hydrant than allowed by ordinances, rules, or regulations, or within 5 feet of a fire hydrant in the absence of specific ordinances, rules, or regulations.

70.24 Contractor's Responsibility for Utility Service and Facilities of Others.
70.24.1 Public and Private Utility Services

(1) As provided in 70.6, the Contractor shall cooperate with the owner of any public or private utility service, FAA or NOAA, or a utility service of another government agency that may be authorized by the Owner to construct, reconstruct or maintain such utility services or facilities during the progress of the work. In addition, the Contractor shall control his/her operations to prevent the unscheduled interruption of such utility services and facilities.

(2) To the extent that such public or private utility services, FAA, or NOAA facilities, or utility services of another governmental agency are known to exist within the limits of the Contract work, the approximate locations have been indicated on the Plans and the owners are indicated as follows:

a. Utility Service or Facility
b. Person to Contract (Name, Title, Address, & Phone)
c. Owner's Emergency Contact (Phone)

(3) It is understood and agreed that the Owner does not guarantee the accuracy or the completeness of the location information relating to existing utility services, facilities, or structures that may be shown on the Plans or encountered in the work. Any inaccuracy or omission in such information shall not relieve the Contractor of his/her responsibility to protect such existing features from damage or unscheduled interruption of service. Never hinder or interfere with utility representatives in the protection or operation of their facilities. Obtain all necessary information regarding existing facilities. Protect existing facilities from damage and unnecessary exposure. Any costs associated with locating and marking public and private facilities will be the responsibility of the Contractor.

(4) It is further understood and agreed that the Contractor shall, upon execution of the Contract, notify the owners of all utility services or other facilities of their plan of operations at least three business days prior to the start of construction activities. The notification shall be in writing addressed to the person to contact as provided in 70.24(2) and 70.6. A copy of each notification shall be given to the Engineer.

(5) It shall be the responsibility of the Contractor to keep each individual facility owner advised of changes in his/her schedule of operations that would affect the facility owner.

(6) Obtain all necessary information regarding the planned installation of new facilities identified in the Contract. Make proper provision and give proper notification so the utilities can install new facilities at the proper time without delay or unnecessary inconvenience. Do not pave over the location of a new underground facility, planned for installation concurrently with this Contract, before installing the facility.

(7) If the Contractor damages or interrupts service, the Contractor shall notify the utility or facility owner and the Engineer promptly. Coordinate and cooperate with the utility or facility owner in the repair of the facility. Determine who is responsible for repair costs according to Wisconsin statutes 66.0831 and 182.0175(2)

http://docs.legis.wi.gov/statutes/statutes/66

http://docs.legis.wi.gov/statutes/statutes/182

(8) If the Contractor finds active facilities not identified in the Contract, the Engineer will determine whether adjustment or relocation of the facility is necessary to accommodate Contract work. The Engineer will arrange with the utility/facility owner or the Contractor to adjust or relocate the facility. If deemed necessary, the Engineer will revise the Contract as specified in 40.2.

(9) Where the outside limits of an underground utility service have been located and staked on the ground, the Contractor shall be required to use hand excavation methods within three feet of such outside limits at such points as may be required to ensure protection from damage due to the Contractor's operations.

70.24.2 FAA and Airport Facilities and Cable Runs

(1) The Contractor is hereby advised that the construction limits of the project may include existing facilities and buried cable runs that are owned, operated and maintained by the FAA. The Contractor, during the execution of the project work, shall comply with the following:

a. The Contractor shall permit FAA maintenance personnel the right of access to the project work site for purposes of inspecting and maintaining all existing FAA owned facilities.

b. The Contractor shall provide notice to the FAA Air Traffic Organization (ATO)/Technical Operations/System Support Center (SSC) Point-of-Contact through the airport Owner a minimum of five business days prior to commencement of construction activities in order to permit sufficient time to locate and mark existing buried cables and to schedule any required facility outages.

c. If execution of the project work requires a facility outage, the Contractor shall contact the FAA Point-of-Contact a minimum of 72 hours prior to the time of the required outage.

d. Any damage to FAA cables, access roads, or FAA facilities during construction caused by the Contractor's equipment or personnel whether by negligence or accident will require the Contractor to repair or replace the damaged cables, access road, or FAA facilities to FAA requirements. The Contractor shall not bear the cost to repair damage to underground facilities or utilities improperly located by the FAA.

e. If the project work requires the cutting or splicing of FAA owned cables, the FAA Point-of-Contact shall be contacted a minimum of 72 hours prior to the time the cable work commences. The FAA reserves the right to have a FAA representative on site to observe the splicing of the cables as a condition of acceptance. All cable splices are to be accomplished in accordance with FAA specifications and require approval by the FAA Point-of-Contact as a condition of acceptance by the Owner. The Contractor is hereby advised that FAA restricts the location of where splices may be installed. If a cable splice is required in a location that is not permitted by FAA, the Contractor shall furnish and install a sufficient length of new cable that eliminates the need for a splice.

70.25 Antitrust Assignment Clause

(1) The Contractor hereby assigns to the Department/Owner all claims for overcharges resulting from antitrust violations as to goods and materials purchased in connection with this Contract, except as to overcharges that result from antitrust violations commencing after the price is established under this Contract and any change order. In addition, the Contractor warrants and represents that each of the Contractor's first tier suppliers and subcontractors shall assign all antitrust violation claims to the Department and Owner subject to the aforementioned exception.

70.26 Hazardous Substances

(1) Whenever the construction operations encounter or expose an abnormal condition that may indicate the presence of a hazardous substance, immediately discontinue construction operations near the abnormal condition and notify the Engineer. Treat all abnormal conditions with extreme caution. Abnormal conditions include, but are not limited to, the following:

a. The presence of a tank or barrel.

b. An obnoxious odor.

c. Excessively hot earth.

d. Smoke.

e. Visible fumes.

f. Discolored earth or sheen on groundwater.

(2) Do not resume construction operations in this area until the Engineer so directs. The Contractor may continue work in other areas of the project unless the Engineer otherwise directs.

(3) Take actions to prevent the hazardous substance from spreading into an uncontaminated area.

(4) Dispose of hazardous substances conforming to the requirements and regulations of the responsible state or federal agencies. If the Engineer requires the Contractor to dispose of the hazardous substance and the Contract does not provide for this work, the work is extra work as specified in 40.2. If the responsible state or federal agency requires special procedures for the disposal, the Department will arrange with qualified persons to dispose of the substance.

70.27 Archaeological and Historical Findings

(1) For construction operations on the Project, if encountering human remains or if encountering artifacts of potential archaeological or historical significance, immediately stop operations at the encounter site and notify the Engineer. Cooperate, as necessary, by moving construction operations from the encounter site and complying with the Engineer's directions. The Contractor may continue work elsewhere on the project unless the Engineer directs otherwise. Do not resume operations at the encounter site without the Engineer's permission.

(2) For operations on private property, if encountering human remains or if encountering artifacts of potential archaeological or historical significance, immediately stop operations at the encounter site and notify the Engineer and the responsible state agencies. Cooperate, as necessary, by moving construction operations from the encounter site and complying with the responsible state agencies' directions. Do not resume operations at the encounter site without the responsible state agencies' permission.

(3) If the Engineer orders a suspension of the Contractor's operations in order to protect an archaeological or historical finding, or order the Contractor to perform extra work, such shall be completed by:

a. By an appropriate Contract modification as provided in 40.2 extra work and may include an extension of Contract time as specified in 80.10.

b. By Force Account, as specified in 90.4.5 and may include an extension of Contract time as specified in 80.10. Extension of Contract time shall be by Contract Change Order.

70.28 Standard Insurance Requirements

(1) Maintain the following types and limits of commercial insurance in force until final acceptance as specified in 50.15.2.2.

TABLE 70-1 REQUIRED INSURANCE AND MINIMUM COVERAGES

TYPE OF INSURANCE	MINIMUM LIMITS REQUIRED[1]
1. Commercial general liability insurance endorsed to include blanket contractual liability coverage.[2]	$2 million combined single limits per occurrence with an annual aggregate limit of not less than $4 million.
2. Workers' compensation.	Statutory limits
3. Employers' liability insurance.	Bodily injury by accident: $100,000 each accident Bodily injury by disease: $500,000 each accident $100,000 each employee
4. Commercial automobile liability insurance covering all contractor-owned, non-owned, and hired vehicles used in carrying out the Contract.[2]	$1 million-combined single limits per occurrence.
5. Builders Risk Insurance for architectural building projects per 70.28(6)	100% of full replacement value of the work including Change orders.

Note: [1] The Contractor may satisfy these requirements with primary insurance coverage or with excess/umbrella policies.

Note [2] The Wisconsin Department of Transportation, and the airport Owner, its officers, agents, and employees shall be named as an additional insured under the general liability and automobile liability insurance.

(2) For a joint venture, limited liability company, or partnership; ensure that the bidding entity is the named insured and that coverages apply jointly and severally to its member entities.

(3) Obtain coverage from insurance companies licensed to do business in the state that have an A.M. Best rating of A- or better. The cost of providing the required insurance coverage and limits is incidental to the Contract.

(4) The Department may request proof of insurance at any time. Submit copies of insurance policies as well as associated certificates of insurance upon Department request.

(5) Notify the Department immediately upon cancellation or initiating cancellation, whichever is earlier, or any material change in coverage. Cease operations immediately if any insurance is cancelled or reduced. Do not resume operations until the required coverage is in force.

(6) Builders Risk Insurance:

a. It is the responsibility of the Contractor to provide Builder's Risk Insurance when the building is new construction of a freestanding structure or if the Contractor has complete control of the building or during these type of operations including but not limited to: new terminal buildings, renovating, expanding existing terminal buildings, hangars, equipment storage buildings etc.

b. The Contractor will provide and maintain "All Risks" Builders Risk insurance as indicated in table 70-1 The insurance shall be purchased by the Contractor, and name all sub-contractors of all tiers, Wisconsin Department of Transportation and the airport Owner or owners as insured's, and all others having an insurable interest in the Work (if any).

c. Insurance provided is to insure against "All Risks" of physical loss or Damage and be issued on an "All Risks" builders risk policy to apply to:

i. The "All risk" Builders Risk policy shall include coverage for all fixtures, materials, machinery, and equipment that constitute a permanent part of the structure. This coverage shall also include coverage for damage to foundations, including pilings, equipment, machinery and materials that have not been installed but which are destined to become a permanent part of the structure including property in transit.

(7) The above insurance requirements apply with equal force whether the Contractor or a subcontractor, or anyone directly or indirectly employed by either, performs work under the project.

END OF SECTION 70

Section 80 – Prosecution and Progress

80.1 Subletting the Contract

80.1.1 General

(1) Do not sublet, sell, transfer, assign, or otherwise dispose of the Contract, a portion of the Contract, or a right, title, or interest in the Contract without the Engineer's written consent. If the Engineer consents to the Contractor subletting a portion of the Contract, the Contractor is relieved of no responsibility for the fulfillment of the Contract or of no liability under the Contract and bond. Do not allow a subcontractor to proceed with work without the Engineer's written consent.

(2) Request permission in writing to sublet a portion of the Contract. If the Engineer requires, submit evidence that the proposed subcontractor is experienced and equipped for the work. The Engineer may also require submission of a copy of the proposed subcontract. Submit all subsequent changes in the terms of a subcontract for the Engineer's consent.

(3) If proposing to have a party other than a subcontractor perform work, notify the Engineer and submit details of this arrangement in writing. The Engineer will determine if that arrangement constitutes subcontracting. The Engineer may also require the Contractor to file, with the Engineer, copies of all other agreements between any parties regarding the performance of work under the Contract.

80.1.2 Prime Contractor Participation

(1) Perform at least 30 percent, except on architectural projects where the prime/general Contractor must perform at least 10 percent, of the original Contract amount with the Contractor's own organization, unless otherwise specified in the Special Provisions. The Contractor's own organization is defined as workers the Contractor employs and pays directly as well as equipment the Contractor owns or rents, either with or without operators. Submit documentation using a Department approved form to indicate what work the Contractor's own organization is performing and the dollar value of that work before Contract execution as specified in 30.6. Include a detailed computation showing the Contractor's share of work calculated as follows:

Contractor's share = P / (C - S)

Where:

P = Work the prime Contractor performs. The prime may include materials the prime purchases and installs or that the prime purchases but others install, and trucking the prime pays for directly. Do not include equipment and associated operators the prime leases to others performing work.

C = Total Contract amount.

S = Specialty work others perform. Specialty work includes only Pay Items specifically identified in the Plans, Specifications or Schedule of Prices as specialty work.

80.1.2.1 Lower Tier Subletting

(1) First tier subcontractors shall notify the Prime Contractor of their intent to further sublet a portion of the first tier subcontract work. The first tier sub cannot further sublet more than 50 percent of the portion of the first tier subcontractor's work to a second tier subcontractor.

(2) The prime Contractor will notify the Department of the second tier subcontracting arrangement and must be approved by the Engineer prior to the 2nd tier subcontractor providing work on the project.

(3) No third tier subcontracting will be allowed without written approval by the Department.

80.2 Start of the Work

(1) For the purpose of determining Contract time, the Contract starting date is defined as follows:

If the Contract provides for starting work not later than 10 calendar days after the date of written Notice To Proceed (NTP) from the Engineer, the Contract starting date will be the date construction operations are started or the tenth calendar day following the date of that notification, whichever is earlier.

(2) Written NTP will not be issued by the Engineer until:

a. All the required documentation has been provided and executed as specified in Section 30.

b. Contractor has provided and the Department has approved both the ECIP and SPCD.

80.3 Prosecution of the Work

(1) The Department will issue a written notification to begin or resume work for all working day, calendar day, and completion date contracts. Do not begin or resume work before receiving the Engineer's written notification. Notify the Engineer at least 3 business days before starting or resuming work. Notify the Engineer at least one business day before changing the schedule of work, such as working on Saturdays, Sundays, and department-specified holidays.

(2) Give the work the constant attention necessary to promote the progress of the work. Promptly supply the materials, tools, equipment, and incidental items required to perform the work. Employ an ample force of workers and provide a construction plant properly adapted to the work and of sufficient capacity and efficiency to accomplish the work in a safe and skillful manner as provided in the Contractor's progress schedule. Maintain all plants in good working order and make provisions for immediate emergency repairs.

(3) Take precautions necessary to protect the work as specified in 70.13. Include in the Contract price the cost for taking precautions and protecting the work. The cost of taking precautions and protecting the work is incidental to the work as specified in 90.2 and 90.6.1.

80.4 Progress Schedules

80.4.1 General

(1) Submit a bar chart progress schedule as specified in 80.4.2. The Contractor may alternatively submit one of the following:

a. A linear schedule conveying all the information specified in 80.4.2 for a bar chart.
b. A relationship bar chart (RBC) schedule as specified in 80.4.3.
c. A critical path method (CPM) schedule as specified in 80.4.4.

(2) If the Contract requires, submit an RBC schedule as specified in 80.4.3 or a CPM schedule as specified in 80.4.4, and do not submit a bar chart schedule.

(3) Plan and execute the work to meet the Contract-required interim completion dates and the specified Contract time or completion date. The Engineer will use the schedule to monitor the progress of the work. The schedule is not part of the Contract.

(4) Unless otherwise specified, progress schedules of any allowed type shall be provided as incidental cost to the Contract.

80.4.2 Bar Chart Progress Schedule

80.4.2.1 Initial Bar Chart Progress Schedule

(1) At least 14 calendar days before the preconstruction meeting, submit to the Engineer for review an initial bar chart progress schedule conforming to the following minimum requirements:

a. Include activities that describe essential features of the work and activities that might potentially delay Contract completion. Identify activities that are controlling items of work.
b. Identify the contemplated start and completion dates for each activity. Provide a duration, ranging from one to 15 working days, for each activity. Break longer activities into two or more activities distinguished by the addition of a location or some other description. Specify the sequencing of all activities.
c. Provide the quantity and the estimated daily production rate for controlling items of work.
d. Include a narrative that lists the work days per week, department-specified holidays, number of shifts per day, and number of hours per shift. For calendar day and completion date contracts, provide the estimated number of adverse weather days for each month consistent with the monthly-anticipated adverse weather days 80.10.2.2 shows.
e. Show completing the work within interim completion dates and the specified Contract time or completion date.

(2) In addition to the required activities, the Contractor is encouraged to include other activities such as:

a. The procurement of materials, equipment, articles of special manufacture, concrete curing time, etc.
b. The furnishing of drawings, plans, and other data required in the Contract for the Engineer's review.
c. The Department's inspections of structural steel fabrication, etc.
d. Third-party activities related to the Contract.

(3) Hand drawn schedules are acceptable. If the Contractor develops the initial schedule with scheduling software, the Contractor is encouraged to provide the Engineer a diskette of the schedule and the name of the scheduling software used.

(4) The Engineer and Contractor will review the initial schedule at the preconstruction meeting. Within five business days after the preconstruction meeting, the Engineer will accept the Contractor's initial

schedule or request additional information. Make the appropriate adjustments and resubmit the revised initial schedule within five business days after the Engineer's request. If the Engineer requests justification for an activity duration, provide information that may include estimated labor, equipment, unit quantities, and production rates used to determine the activity duration.

(5) The Department will only make progress payments for the value of materials, as specified in 90.6.3.2, until the Engineer accepts the initial schedule. The Engineer accepts the Contractor's initial schedule based solely on whether that schedule is complete as specified in 80.4.2.1(1). The Engineer's acceptance of the schedule does not modify the Contract or validate the schedule.

80.4.2.2 Monthly Progress Meetings and Bar Chart Progress Schedule Updates

(1) The Contractor and the Engineer will meet monthly to assess progress and jointly add update information to the initial schedule. At a minimum, updates will include the actual start and finish of each activity, percentage complete, and remaining durations of activities started but not yet completed.

80.4.2.3 Engineer's Right to Request Bar Chart Progress Schedule Revisions

(1) The Engineer will monitor the progress of the work and may request that the Contractor revise the schedule if project completion or interim completion targets are delayed 14 calendar days or more for calendar day or completion date contracts, or 10 working days or more for working day contracts. Submit the revised schedule within five business days after the Engineer's request.

80.4.2.4 Bar Chart Progress Schedule Documentation for Time Extensions

(1) Furnish documentation including schedule updates to support requests to extend interim completion dates, the specified Contract time, or the completion date.

(2) If the Contractor does not furnish documentation to support the additional time needed to complete work on increased quantities for an excusable delay that affects a controlling item of work, the Engineer may extend Contract time, rounded to the nearest 1/2 day, as follows:

$$TE = OT \times (ATC - OC)/OC$$

Where:

TE = Time extension

OT = Original time (original Contract time)

OC = Original cost (total bid amount)

ATC = Adjusted total cost (actual cost of all work minus the cost of change order work where Contract time was determined)

80.4.3 Relationship Bar Chart Progress Schedule

80.4.3.1 General

(1) If the Contract requires, submit a RBC Progress Schedule.

80.4.3.2 Initial RBC Progress Schedule

(1) At least 14 calendar days before the preconstruction meeting, submit to the Engineer for review an initial RBC schedule that meets the following minimum requirements:

a. Include activities that describe essential features of the work and activities that might potentially delay Contract completion. Identify activities that are controlling items of work.

b. Identify the contemplated start and completion dates for each activity. Provide a duration, ranging from one to 15 working days, for each activity. Break longer activities into 2 or more activities distinguished by the addition of a location or some other description.

c. Provide a logic diagram that shows the sequence of activities and the scheduling interrelationships among activities. Alternatively, the Contractor may identify the activity interrelationships in a tabular listing. Ensure all activity interrelationships are finish to start relationships with no leads or lags. Use only contractual constraints in the schedule logic. The Engineer may accept requested exceptions.

d. Provide the quantity and the estimated daily production rate for controlling items of work.

e. Include a narrative that lists the work days per week, department-specified holidays, number of shifts per day, and number of hours per shift. For calendar day and completion date contracts, provide the estimated number of adverse weather days for each month consistent with the monthly-anticipated adverse weather days 80.10.2.2 shows.

f. Show completing the work within interim completion dates and the specified Contract time or completion date.

g. Develop the RBC schedule using computerized scheduling software. Provide the Engineer with a paper copy of the information required in items three and five of 80.4.3.2(1). Submit a diskette of the schedule and identify the software used to prepare that schedule.

(2) In addition to the required activities, the Contractor is encouraged to include other activities such as:

a. The procurement of materials, equipment, articles of special manufacture, concrete curing time, etc.

b. The furnishing of drawings, plans, and other data required in the Contract for the Engineer's review.

c. The Department's inspections of structural steel fabrication.

d. Third-party activities related to the Contract.

(3) The Contractor may augment the initial submittal of the RBC schedule by submitting a linear schedule. The linear schedule must be generated from the RBC schedule.

(4) The Engineer and the Contractor will review the initial schedule at the preconstruction meeting. Within five business days after the preconstruction meeting, the Engineer will accept the Contractor's initial schedule or request additional information. Make the appropriate adjustments and resubmit the revised initial schedule within 5 business days after the Engineer's request. If the Engineer requests justification for an activity duration, provide information that may include estimated labor, equipment, unit quantities, and production rates used to determine the activity duration.

(5) The Department will only make progress payments for the value of materials, as specified in 90.6.3.2, until the Engineer accepts the initial schedule. The Engineer accepts the Contractor's initial schedule based solely on whether that schedule is complete as specified in 80.4.3.2(1). The Engineer's acceptance of the schedule does not modify the Contract or validate the schedule.

80.4.3.3 Monthly RBC Progress Schedule Updates and Progress Meetings

(1) Update the schedule monthly to show current progress. At a minimum, ensure that the update includes:

a. The actual start and finish of each activity, percentage complete, and remaining durations of activities started but not yet completed.

b. A narrative report that includes a listing of monthly progress, changes to the controlling items of work from the previous update, sources of delay, potential problems, work planned for the next 30 calendar days, and changes to the RBC schedule. Changes include, but are not limited to, changes in the method and manner of performing the work, changes in the Contract, extra work, changes in an activity duration, and changes to relationships between activities.

(2) For each schedule update, submit a diskette and an updated paper copy meeting the requirements in 80.4.3.2(1).

(3) Within five business days after submitting the monthly update, hold a job-site meeting with the Engineer to review the progress of the schedule. At that meeting, the Department will confirm the actual start and actual finish dates of completed activities, remaining durations of uncompleted activities, and changes to the controlling items of work.

80.4.3.4 Engineer's Right to Request RBC Progress Schedule Revisions

(1) Between monthly updates, the Engineer will monitor the progress of the work and may request that the Contractor revise the schedule for one or more of the following reasons:

a. The project completion or interim completion targets are delayed 14 calendar days or more for calendar day or completion date contracts, or 10 working days or more for working day contracts.

b. The Engineer determines the progress of the work differs significantly from the current schedule.

c. A Contract Change Order requires the addition, deletion, or revision of activities that causes a change in the Contractor's work sequence or the method and manner of performing the work.

(2) Submit the revised schedule within 5 business days after the Engineer's request.

(3) Within 5 business days after submitting the revised schedule, hold a job-site meeting to review the schedule revisions. At the meeting, the Engineer will accept the Contractor's schedule or request additional information. Make the appropriate adjustments and resubmit the newly revised schedule.

80.4.3.5 RBC Progress Schedule Documentation for Time Extensions

(1) Furnish documentation, including schedule updates, to support requests to extend interim completion dates, the specified Contract time, or completion date.

80.4.3.6 RBC Progress Schedule Measurement

(1) The Department will measure one RBC Progress Schedule for each contract acceptably completed.

80.4.4 Critical Path Method Progress Schedule

80.4.4.1 General

(1) If the Contract requires, submit a CPM Progress Schedule.

80.4.4.2 Initial Work Plan

(1) At least 14 calendar days before the preconstruction meeting, submit an initial work plan conforming to, as a minimum, the following requirements:

a. Include a detailed bar chart schedule, meeting the requirements of 80.4.2.1(1), for the first 60 calendar days of work. Ensure that all activities have durations of one to of 15 working days, unless the Engineer accepts requested exceptions. Show additional activities that require Department review or approval.

b. Include a summary bar chart schedule for the balance of the project. Summary activities may be greater than 15 working days.

c. Ensure the bar chart schedules show completing the work within the interim completion dates and specified Contract time or completion date.

(2) The Engineer and the Contractor will review the initial work plan at the preconstruction meeting. Within five business days after the preconstruction meeting, the Engineer will accept the Contractor's initial work plan or request additional information. The Engineer will use the detailed bar chart schedule to monitor the progress of the work until accepting the initial CPM schedule.

(3) Maintain and submit on a bi-weekly basis an updated version of the detailed bar chart schedule until the Department accepts the initial CPM schedule. Ensure that each schedule update includes the actual start and finish of each activity, percentage complete, and the remaining durations of activities started but not yet completed.

80.4.4.3 Initial CPM Progress Schedule

(1) Within 30 calendar days after the notice to proceed, submit to the Engineer for review an initial CPM schedule, beginning at the start of work date and conforming to the following minimum requirements:

a. Include activities that describe essential features of the work and activities that might potentially delay Contract completion. Identify activities that are controlling items of work.

b. Identify the contemplated start and completion dates for each activity. Provide a duration, ranging from one to 15 working days, for each activity. Break longer activities into 2 or more activities distinguished by the addition of a location or some other description.

c. Provide a logic diagram having a maximum of 50 activities for each 11 in. by 17 in. sheet. Ensure that each sheet includes title, match data for diagram correlation, and a key to identify all components used in the diagram. Show the sequence of activities and the scheduling interrelationships among activities. Ensure all activity interrelationships are finish to start relationships with no leads or lags. Use only contractual constraints in the schedule logic. The Engineer may accept requested exceptions.

d. Provide the quantity and the estimated daily production rate for controlling items of work.

e. Include a narrative that lists the work days per week, department-specified holidays, number of shifts per day, and number of hours per shift. For calendar day and completion date contracts, provide the estimated number of adverse weather days for each month consistent with the monthly-anticipated adverse weather days 80.10.2.2 shows.

f. Provide tabular sorts by:

i. Activity Identification/Early Start.

ii. Total Float.

iii. Predecessor/Successor.

iv. Responsibility/Early Start.

v. Area/Early Start.

g. Provide 60-day look-ahead bar charts by early start.

h. Show completing the work within interim completion dates and the specified Contract time or completion date.

i. Develop the CPM schedule using computerized scheduling software. Provide the Engineer with a paper copy of the information required in items three, five, six, and seven of 80.4.4.3(1). Submit a diskette of the schedule and identify the software used to prepare that schedule.

(2) In addition to the required activities, the Contractor is encouraged to include other activities such as:

a. Procurement of materials, equipment, articles of special manufacture, concrete curing time, etc.

b. Furnishing of drawings, plans, and other data required in the Contract for the Engineer's review.

c. Department’s inspections of structural steel fabrication, etc.

d. Third-party activities related to the Contract.

(3) Float is defined as the amount of time between the date when an activity can start, the early start, and the date when an activity must start, the late start. The Department and the Contractor agree that float is a shared commodity, and is not for the exclusive use or financial benefit of either party. Either party has the full use of the float until it is depleted.

(4) The Contractor may augment the initial submittal of the CPM schedule by submitting a linear schedule. The linear schedule must be generated from the CPM schedule.

(5) Attend a meeting to review the schedule. The Engineer will schedule the meeting within 10 business days after receiving the Contractor's initial CPM schedule submittal. Within 5 business days after the meeting, the Engineer will accept the Contractor's initial CPM schedule or request additional information. Make the appropriate adjustments and resubmit the revised initial CPM schedule within 10 business days after the Engineer's request. If the Engineer requests justification for an activity duration, provide information that may include estimated labor, equipment, unit quantities, and production rates used to determine the activity duration.

(6) The Department will only make progress payments for the value of materials, as specified in 90.6.3.2, until the Contractor has submitted the initial CPM schedule. The Department will retain 10 percent of each estimate until the Department accepts the initial CPM schedule.

(7) The Engineer accepts the Contractor's initial CPM schedule based solely on whether that schedule is complete as specified in 80.4.4.3(1). The Engineer's acceptance of the schedule does not modify the Contract or validate the schedule.

80.4.4.4 Monthly CPM Progress Schedule Updates and Progress Meetings

(1) Update the schedule monthly to show current progress. At a minimum, ensure that the update includes:

a. The actual start and finish of each activity, percentage complete, and remaining durations of activities started but not yet completed.

b. A narrative report that includes a listing of monthly progress, changes to the controlling items of work from the previous update, sources of delay, potential problems, work planned for the next 30 calendar days, and changes to the CPM schedule. Changes include, but are not limited to, changes in the method and manner of performing the work, changes in the Contract, extra work, changes in an activity duration, and changes to relationships between activities.

(2) For each schedule update, submit a diskette and an updated paper copy of the following:

a. Tabular sorts by:

i. Activity Identification/Early Start.

ii. Total Float.

b. If applicable, an updated logic diagram as the Engineer requires.

c. If augmenting the CPM schedule with a linear schedule, provide an update of the linear schedule.

(3) Within five business days after submitting the monthly update, hold a job-site meeting with the Engineer to review the progress of the schedule. At that meeting, the Department will confirm the actual start and actual finish dates of completed activities, remaining durations of uncompleted activities, changes to the controlling items of work, and the logic changes.

80.4.4.5 Engineer's Right to Request CPM Progress Schedule Revisions

(1) Between monthly updates, the Engineer will monitor the progress of the work and may request that the Contractor revise the schedule for one or more of the following reasons:

a. The project completion or interim completion targets are delayed 14 calendar days or more for calendar day or completion date contracts, or 10 working days or more for working day contracts.

b. The Engineer determines the progress of the work differs significantly from the current schedule.

c. A Contract Change Order requires the addition, deletion, or revision of activities that causes a change in the Contractor's work sequence or the method and manner of performing the work.

(2) Submit the revised schedule within 10 business days after the Engineer's request.

(3) Within five business days after submitting the revised schedule, hold a job-site meeting to review the schedule revisions. At the meeting, the Engineer will accept the Contractor's schedule or request additional information. Make the appropriate adjustments and resubmit the newly revised schedule.

(4) Furnish documentation, including schedule updates, to support request to extend interim completion dates, the specific contract time, or completion date.

(5) Providing CPM schedules is considered incidental unless otherwise measured and paid for under separate work item in the contract.

80.5 Limiting Operations

(1) The Contractor shall control their operations and the operations of their subcontractors and all suppliers to provide for the free and unobstructed movement of aircraft in the air operations areas (AOA) of the airport.

(2) When the work requires the Contractor to conduct their operations within an AOA of the airport, the work shall be coordinated with airport operations (through the Engineer) at least 48 hours prior to commencement of such work. The Contractor shall not close an AOA until so authorized by the Engineer and until the necessary temporary marking and associated lighting is in place as specified in section 70.11.

(3) When the Contract work requires the Contractor to work within an AOA of the airport on an intermittent basis (intermittent opening and closing of the AOA), the Contractor shall maintain constant communications as specified; immediately obey all instructions to vacate the AOA; and immediately obey all instructions to resume work in such AOA. Failure to maintain the specified communications or to obey instructions shall be cause for suspension of the Contractor's operations in the AOA until satisfactory conditions are provided. If there are portions of the AOA that cannot be closed to operating aircraft to permit the Contractor's operations on a continuous basis and will therefore be closed to aircraft operations intermittently, the Contract documents will identify as a minimum:

a. AOA
b. Time periods AOA can be closed
c. Type of communication(s) required when working in an AOA
d. Control authority

(4) Contractor shall be required to conform to safety standards contained in AC 150/5370-2, Operational Safety on Airports During Construction (see Special Provisions) and approved CSPP.

80.5.1 Operational safety on airport during construction.

(1) All Contractors' operations shall be conducted in accordance with the approved project Construction Safety and Phasing Plan (CSPP) and the Safety Plan Compliance Document (SPCD) and the provisions set forth within the current version of AC 150/5370-2. The CSPP included within the Contract documents conveys minimum requirements for operational safety on the airport during construction activities. The Contractor shall prepare and submit a Safety Plan Compliance Document (SPCD) that details how it proposes to comply with the requirements presented within the CSPP.

(2) The Contractor shall implement all necessary safety plan measures prior to commencement of any work activity. The Contractor shall conduct routine checks to assure compliance with the safety plan measures.

(3) The Contractor is responsible to the Owner for the conduct of all subcontractors it employs on the project. The Contractor shall assure that all subcontractors are made aware of the requirements of the CSPP and SPCD and that they implement and maintain all necessary measures.

(4) No deviation or modifications may be made to the approved CSPP or SPCD unless approved in writing by the Owner or Engineer. Deviations made may take considerable time to approve and may require FAA review and approval.

80.6 Character of Workers

(1) Provide personnel necessary to supervise and complete all Contract work as specified. Ensure workers have the experience and skills necessary to perform assigned work.

(2) Remove from the project all personnel performing in an unskilled manner or who are intemperate or disorderly. If the Engineer concludes that personnel are performing in an unskilled manner or are intemperate or disorderly, the Engineer may direct the Contractor, in writing, to remove them from the project. Do not allow removed personnel to return to the project without the Engineer's written consent.

(3) The Engineer may suspend the work in writing, withhold progress payments due the Contractor, or both for the following reasons:

a. The Contractor does not furnish suitable and sufficient personnel to perform the work.
b. The Contractor does not remove personnel from the project as specified in 80.6(2).

80.7 Methods and Equipment

80.7.1 General

(1) Use equipment of the capacity and mechanical condition necessary to perform work conforming to the Contract. Ensure that the equipment does not harm the roadway, pavement, structures, adjacent property, other highways, workers, or the public. Use equipment conforming to the specific Contract requirements for individual Pay Items or classes of work.

(2) If the Contractor does not provide adequate equipment, properly maintained, the Engineer may:

a. Order the Contractor to remove the equipment.
b. Suspend specific operations until the Contractor provides adequate equipment.

c. Determine that the Contractor is in default of the Contract.

(3) Equip each unit of motorized construction equipment with a muffler constructed to the equipment manufacturer's specifications. The Contractor may substitute other mufflers producing equivalent results. Maintain mufflers and exhaust systems in good operating condition, free from leaks and holes.

80.7.2 Moving Heavy Loads

(1) For all vehicles operated on completed subgrade, base, or pavement that will remain a permanent part of the project, do not exceed the legal loading defined in Wisconsin statutes for Class A highways without the Engineer's written permission. For structures, do not exceed that legal loading without written permission whether or not the structure will remain a permanent part of the project. Adhering to these requirements, or allowed variations, does not relieve the Contractor of liability for damage caused by those operations.

80.7.3 Loads on Structures

(1) Demonstrate that all loads on structures within the project limits throughout the duration of the Contract do not exceed the structural capacity of the structure. If the Engineer directs, submit stamped and signed copies of analyses and associated calculations performed by a professional engineer registered in the State of Wisconsin to the Engineer and to the Department's Bureau of Structures. Do not begin construction operations or move a heavy load across a structure without the Engineer's written authorization.

(2) If a PE's analysis is required, determine capacity at the operating load level using the same AASHTO specification the structure was rated under. Include materials, equipment, and other construction or vehicular loads in the analyses. If under public traffic, also include the Wisconsin standard permit vehicle (Wis-SPV) as shown in chapter 45 of the Department's bridge manual. The structure must be capable of carrying a Wis-SPV load equal to or greater than 100,000 pounds in addition to construction loads. The Engineer's written authorization must be accompanied by a copy of the analysis stamped accepted by Department's Bureau of Structures before proceeding.

(3) Except as required to accommodate public traffic or to complete the deck pour, do not operate heavy equipment or impose vehicular live loads on lanes adjacent to freshly placed concrete decks until it develops sufficient strength to open it to service under State Highway Specification (SHS) 502.3.10.1.

80.8 Equivalent Equipment, Methods, and Materials

(1) Use the equipment, methods, or materials specified in the Contract unless the Engineer authorizes equivalents. If the Contract does not specify equipment, methods, or materials, the Contractor may use those the Contractor demonstrates, to the Engineer's satisfaction, to produce conforming work.

(2) Obtain the Engineer's authorization before substituting for equipment, methods, or materials specified in the Contract. Submit a written request to the Engineer describing the equipment, methods, or materials proposed and the reasons for the change. The Engineer's authorization of an equivalent does not relieve the Contractor of the obligation to produce work conforming to the Contract as specified in 50.3.1.

(3) If after use of substituted equipment, methods, or materials, the Engineer finds the work nonconforming, the Contractor shall complete the remaining work with the specified equipment, methods, or materials. The nonconforming work is subject to the provisions of 50.3.2.

(4) The Department will pay for a substitute made under 80.8 at the Contract price for the original work. The Department will not extend Contract time for a substitute made under 80.8, except for time resulting from a cost reduction incentive as provided in 40.5.

80.9 Contract Time for Working Day, Calendar Day, and Completion Date Contracts

80.9.1 General

(1) Complete all or any portion of the project called for in the Contract within the time or times for completion of the Contract. All time limits in the Contract are crucial elements of the Contract.

(2) The proposal will specify the time for completion as a specific number of working days, calendar days, or as a given completion date.

80.9.2 Assessing Time Charges for Working Day Contracts

(1) For working day contracts, Contract time is the number of working days specified for completion. Beginning with the start of work specified in 80.2, the Engineer will assess working days for all days except:

a. Days excluded in 80.9.2(4).

b. Days if one or more of the following prevent the Contractor from working on the controlling item:

i. Earthquakes and other cataclysmic phenomena of nature the Contractor cannot foresee and avoid.
ii. Weather conditions.
iii. Job conditions caused by weather.
iv. Non-compensable delays as specified in Items 2 through 7 of 80.10.2.1(3).
v. Compensable delays as specified in Items 2 through 5 of 80.10.3(2).

(2) The Engineer will assess working days based on the number of hours the Contractor is able to work on the controlling item with full and normal efficiency. The Engineer will assess working days as follows:

a. Contractor can work less than four hours; no working day.
b. Contractor can work from four to less than eight hours; 1/2 working day.
c. Contractor can work eight hours or more; full working day.

(3) The Engineer will assess working days if the Contractor is not performing work on the controlling item of work, and that non-performance is due to delays the Contractor can foresee, control, or prevent.

(4) The Engineer will not assess working days on:

a. Saturdays, Sundays, and department-specified holidays.
b. Engineer-ordered suspensions for reasons other than Contractor negligence or non-compliance including winter suspensions before November 16 or after March 31.
c. Contract-identified, non-work days during the construction season.
d. Days from November 16 through March 31.

(5) The Engineer will continue to assess working days after November 15 if the Contractor has not completed the work to the stage the Contract requires to be completed by November 16.

(6) If the Engineer determines the Contractor shall not work during the period from November 16 through March 31, the Contractor is not entitled to claim for a delay, time extension, or other related damages.

(7) The Engineer will prepare a weekly statement showing days charged for the preceding week and days remaining on the Contract. The Engineer will make this statement available to the Contractor in a mutually agreeable location within five business days after the week covered in the statement. If the Contractor disagrees with the time assessed, the Contractor may give notice as specified in 40.3.

80.9.3 Contract Time for Calendar Day Contracts

(1) For calendar day contracts, Contract time is the number of calendar days specified for completion, including Saturdays, Sundays, and department-specified holidays, counted from the starting date specified in 80.2. Contract time includes Contract-identified non-work days during the construction season, but excludes Contract-identified winter suspension periods.

80.9.4 Contract Time for Completion Date Contracts

(1) For completion date contracts, Contract time begins with the start of work as specified in 80.2 and concludes on the specified completion date. Complete the Contract by that date.

80.10 Determining Contract Time Extensions and Payment for Excusable Delays
80.10.1 General

(1) The Department may extend Contract time by Contract Change Order. The Department will only extend Contract time if an excusable delay affects the controlling item of work. Excusable delays are unforeseen and unanticipated delays not resulting from the Contractor's fault or negligence. Provide documentation and schedule updates to support requested time extensions as specified:

a. In 80.4.2.4 for bar chart progress schedules.
b. In 80.4.3.5 for RBC progress schedules.
c. In 80.4.4.5 for CPM progress schedules.

(2) The Department may choose not to consider time extensions for delays unless the Contractor notifies the Engineer as specified in 40.3 and updates the schedule. The Engineer will evaluate the facts, pay adjustment, and time extension for the delay. The Engineer's findings are final and conclusive.

80.10.2 Excusable, Non-Compensable Delays

80.10.2.1 General

(1) Non-compensable delays are excusable delays not the Contractor's or the Department's fault. The Engineer will not pay for the delay costs listed in 90.4.7 for non-compensable delays.

(2) For non-compensable delays under calendar day and completion date contracts, the Engineer will extend Contract time if the conditions specified in 80.10.1 are met. The Department will relieve the

Contractor from associated liquidated damages, as specified in 80.11, if the Engineer extends time under 80.10.1.

(3) The following are non-compensable delays:

a. Delays due to earthquakes, other cataclysmic phenomena of nature the Contractor cannot foresee and avoid, severe weather or job conditions caused by recent weather as specified in 80.10.2.2.

b. Extraordinary delays in material deliveries the Contractor or their suppliers cannot foresee and forestall resulting from strikes, lockouts, freight embargoes, governmental acts, or sudden disasters.

c. Delays due to acts of the government, a political subdivision other than the Department, or the public enemy.

d. Delays from fires or epidemics.

e. Delays from strikes beyond the Contractor's power to settle not caused by improper acts or omissions of the Contractor, their subcontractors, or their suppliers.

f. Delays caused by non-completion of work by utilities or other third parties, if the Contract does not specify a number of days or a completion date for that utility or third-party work.

g. Altered quantities as specified in 90.3.

80.10.2.2 Extension of Contract Time for Severe Weather

(1) The Engineer will award a time extension for severe weather on calendar day and completion date contracts. Submit a request for severe weather days if the number of adverse weather days, as defined in 10.2, exceeds the anticipated number of adverse weather days tabulated below.

{NOTE: Final editing before publication may want to insert page break so the entire table shows up on a single page}

TOTAL ANTICIPATED ADVERSE WEATHER DAYS FOR EACH CALENDAR MONTH[2]

Time Period	Adverse Days	Time Period	Adverse Days
January	31[1]	August	3
February	28[1]	September	4
March	31[1]	October	5
April	5	Nov. 1 thru 15	2
May	4	Nov. 16 thru 30	15[1]
June	4	December	31[1]
July	3		

[1] *Includes an anticipated winter suspension from November 16 through March 31.*

[2] *The number of days may be modified in the Special Provisions for year-round and painting contracts.*

(2) Submit the request to the Engineer at the end of the month. Indicate the number of adverse weather days that occurred during that month. Provide progress schedule documentation to show that the controlling item of work was delayed. Show that the delay was beyond the control of the Contractor. The Engineer will assess the Contractor's submittal and indicate how many adverse weather days are confirmed.

(3) For each calendar month, the Engineer will grant a severe weather day for each confirmed adverse weather day that exceeds the number of anticipated adverse weather days 80.10.2.2(1) shows. When the Contractor requests severe weather days, the Engineer will give the Contractor a monthly written statement showing the number of days credited for severe weather. At the end of the project, the Engineer will extend time on calendar day and completion date contracts for the cumulative number of severe weather days credited each month.

80.10.3 Excusable Compensable Delays

(1) Compensable delays are excusable delays due to the Department's actions or lack of actions, or determined by judicial proceeding to be the Department's sole responsibility. The Engineer will grant a time extension for a compensable delay if the conditions specified in 80.10.1 are met.

(2) The following are compensable delays:

a. A Contract change for revised work as specified for extra work under 40.2.2.1, for a differing site condition under 40.2.2.2, or for significant changes in the character of the work under 40.2.2.4.

b. A Contract change for an Engineer-ordered suspension under 40.2.2.3.

c. The unexpected discovery of human remains, an archaeological find, or historical find consistent with 70.27.

d. The unexpected discovery of a hazardous substance consistent with 70.26.

e. The non-completion of work that utilities or other third parties perform, if the Contract specifies a number of days or a completion date for that utility or third-party work.

(3) For a compensable delay or a time extension, the Department will relieve the Contractor from associated liquidated damages under 80.11, and will pay the Contractor for delay costs determined as follows:

a. Adjust the Contract price as specified in 90.4.2 through 90.4.5 for delays under item one of 80.10.3(2).

b. Adjust the Contract price as specified in 90.4.7 for delays under items two through five of 80.10.3(2).

80.11 Liquidated Damages

(1) If the Contractor does not complete the work within the Contract time or within the extra time allowed under Engineer-granted time extensions, the Department will assess liquidated damages. The Department will deduct a specified sum from payments due the Contractor for every calendar day on calendar day contracts and completion date contracts, or for every working day on working day contracts, that the work remains uncompleted.

(2) This deducted sum is not a penalty but is a fixed, agreed, liquidated damage due the Department from the Contractor for the added cost of engineering and supervision resulting from the Contractor's failure to complete the work within the Contract time.

(3) Unless enhanced in the Special Provisions, the Department will assess liquidated damage amounts as shown in the table of the current edition (in effect when the contract was bid) of the State Highway Specifications Section 108. Except the modified contract amount as amended by contract modification or change order shall be used rather than original contract price.

(4) If the Engineer allows the Contractor to continue and finish the work or any part of it after the Contract time expires, the Department waives no rights under the Contract.

(5) Liquidated damages specified in the Plans or Special Provisions for specific phases or individual portions of work, will be calculated and assessed separately and in addition to those specified in this section.

80.12 Terminating the Contract for Default

(1) The Engineer, after giving written notice to the Contractor and the Contractor's surety, may take the prosecution of the work out of the hands of the Contractor or the Contractor's surety, or both, for one or more breach of the Contract the Contractor commits, as follows:

a. Failing to begin the work under the Contract within the time specified.

b. Failing to perform the work with sufficient workers, equipment, or materials to complete the work within the specified time.

c. Failing to complete the Contract within the Contract time specified, as extended by the Engineer.

d. Performing the work unsuitably, or not obeying an Engineer directive to remove and replace or otherwise correct unacceptable work.

e. Discontinuing the prosecution of the work before completion without the Engineer's permission.

f. Failing to resume work that the Engineer discontinued within a reasonable time after notice to do so.

g. Insolvency or bankruptcy, or committing an act of bankruptcy or insolvency.

h. Allowing a final judgment against the Contractor to stand unsatisfied for a period of 48 hours.

i. Making an assignment for the benefit of creditors.

j. Failing to comply with the provisions of the Contract relative to hours of labor, wages, equal opportunity, character and classification of workers employed.

k. Failing to acquire or maintain the required insurance.

l. Failing to carry on the work in an acceptable manner.

(2) The Engineer will give the Contractor and the Contractor's surety written notice specifying the delay, neglect, or default and the action required. If the Contractor or the Contractor's surety, within a period of 10 calendar days after that notice, fails to proceed satisfactorily in compliance therewith, the Department then has full power and authority to take the work out of the hands of the Contractor or the

Contractor's surety, or both; to use all suitable materials and equipment on the project; or to enter into contract, or use other methods that the Department requires to complete the work.

(3) If the Department takes over the incomplete work under 80.12, the Department will deduct all additional costs and damages and the costs and charges of completing the work under contract from payments due the Contractor. If the total of those damages, costs, and charges is less than the sum that would have been payable under the Contract if the Contractor had completed the work, then the Contractor is entitled to receive the difference subject to all claims for liens thereon that may be filed with the Department. If that total exceeds the sum that would have been payable under the Contract, the Department will consider the Contractor and the Contractor's surety liable, and the Contractor and the Contractor's surety shall pay to the Department the amount of that excess.

(4) The Department will not relieve the Contractor and the Contractor's surety of the liability for the assessment of liquidated damages under 80.11 because of the Contractor's default.

(5) The rights and remedies of the Department are in addition to all other rights and remedies provided by law or under the Contract and the bonds.

(6) If, after the Engineer gives notice of default as specified in 80.12(1), it is determined that the Contractor was not in default, the rights and obligations of the parties are the same as if the notice of termination had been issued as specified in 80.13.

(7) If a court finds the Department's default of the Contractor under 80.12 to be legally improper, the Department will treat the Contract as if the Department had terminated the Contractor for convenience as specified in 80.13. The Department will pay the Contractor as specified in 80.13.

80.13 Terminating the Contract for Convenience of the Department

(1) The Department may terminate the Contract or any part of the Contract for reasons beyond the control of the Department or Contractor after determining that termination is in the Department's or the public interest. Reasons for termination include, but are not limited to, one or more of the following:

a. A national emergency that creates a shortage of materials, labor, or equipment by: reason of war conditions involving the United States; reason of orders of the federal government or its duly authorized agencies; or executive orders with respect to prosecution of war or national defense.

b. Orders from duly constituted authorities relating to energy conservation.

c. An injunction or restraining order obtained by a citizen's action alleging violations of 42 U.S.C. 4331-4332, 23 U.S.C. 138, or public law 91-646.

(2) The Department will deliver to the Contractor a termination notice specifying the extent of termination and the effective date.

(3) Upon receipt of a termination notice, do not proceed with the affected Pay Items unless directed to do so in that notice. Complete all Pay Items specified in the termination notice. That work includes punch list items and all work necessary to ensure the safety of the public, to properly secure work already constructed or partially constructed, and to secure the project site. Perform this work, which may include Pay Items not in the original Contract, the Contract specifies. The Contract is sufficiently complete upon completion and acceptance of all Pay Items specified in the termination notice, except punch list items. After completion of the punch list items and all contract-required documents, the Department will terminate the Contract by issuing a final certificate and payment. The Department reserves the right to declare in default a Contractor who does not carry out the conditions of a termination for convenience.

(4) If the Department orders termination of the Contract for convenience, the Department will pay for all completed Pay Items as of that date at the Contract price. The Department will pay for partially completed Pay Items at agreed prices or by force account methods specified in 90.4.5 provided, however, that that payment does not exceed the Contract price for the Pay Item under which the work was performed. The Department will pay for Pay Items eliminated by the termination only to the extent provided in 90.5. The Department will pay for new items, if any, at agreed prices or paid for by force account methods specified in 90.4.5.

(5) The Department may allow the Contractor to purchase materials that the Department obtained for the work but that have not been incorporated into the work at actual cost delivered to a designated location or otherwise disposed of as mutually agreed.

(6) The Department may, at the Department's option, purchase unused materials that the Contractor has obtained and that the Department has inspected, tested, and accepted, at the points of delivery as the Department designates and at a cost shown by receipted bills or other proper evidence.

(7) If the Engineer directs, the Contractor shall promptly remove equipment and supplies from the project site or other Department property. If the Contractor does not remove the equipment and supplies as directed, the Engineer may do so at the Contractor's expense.

(8) Within 60 calendar days of the effective termination date, submit claims for additional costs actually incurred. Do not include claims for loss of anticipated profits on work not performed. The Contractor may claim one or more of the following:

a. Costs for reasonable idle equipment time or mobilization efforts.
b. Bidding and project investigative costs.
c. Overhead expenses attributable to the terminated project.
d. Subcontractor costs not otherwise paid for.
e. Actual idle labor cost if work is stopped before the termination date.
f. Guaranteed payments for private land usage as part of the original Contract.

(9) Make cost records available to the Department to the extent necessary to determine the validity and amount of each item claimed.

(10) The Department will not relieve the Contractor of contractual responsibilities for the work completed. The Department does not relieve the Contractor’s surety of its obligations for and concerning a just claim arising from work performed due to a termination of the Contract.

80.14 Terminating the Contractor's Responsibility

(1) The Contractor's responsibilities are terminated, except as set forth in the Contract Bond and specified in 70.19, when the Department grants final acceptance as specified in 50.15.2.

80.15 Work Area, Storage Area and Sequence of Operations

(1) The Contractor shall obtain approval from the Engineer prior to beginning any work in all areas of the airport. No operating runway, taxiway, or air operations area (AOA) shall be crossed, entered, or obstructed while it is operational. The Contractor shall plan and coordinate his or her work in such a manner as to ensure safety and a minimum of hindrance to flight operations. All Contractor equipment and material stockpiles shall be stored a minimum or 400 feet from the centerline of an active runway, unless otherwise specified in the Plans or Contract Documents. No equipment will be allowed to park within the approach area of an active runway at any time. No equipment shall be within 400 feet of an active runway at any time, unless otherwise specified in the Plans or Contract Documents.

END OF SECTION 80

Section 90 - Measurement and Payment

90.1 Measurement of Quantities

90.1.1 General

(1) The Engineer will use the US standard system to measure all work completed under the Contract. The Engineer will determine quantities of materials the Contractor furnishes and work the Contractor performs using measurement methods and computations conforming to standard engineering practice, modified to meet Department requirements. The Engineer will document these measurements using Department procedures.

(2) The Engineer will measure the work as the Contract measurement subsection for individual items specifies. The Department will measure the actual quantities of work the Contractor acceptably completes and make final payment based on those actual measured quantities except as follows:

a. If the measurement subsection for a Pay Item specifically restricts the quantity measured for payment or allows for use of conversion factors.

b. If the Engineer and Contractor execute a written supplemental Contract agreement stating that Contract quantities for specific Pay Items or portions of Pay Items substantially agree with their actual quantities, the Department will pay for those Contract quantities without measurement. That payment is full compensation for those Pay Items, or portions of Pay Items, as specified in 90.2.

c. If the Engineer executes a Contract Change Order modifying the method of measurement for specific Pay Items, the Engineer will measure the quantities of applicable Pay Items for payment using the change order methods.

90.1.2 Area

(1) If the Contract designates payment for a measured area, the Engineer will measure the length and width of the area actually constructed within Engineer-designated limits, or the final dimensions measured along the surface of the completed work within the neat lines the Plans show or the Engineer designates. The Engineer will use the method or combination of methods of measurement that reflect, with reasonable accuracy, the actual surface area of the finished work as the Engineer determines.

(2) If the Contract allows, the Engineer may weigh or determine a volume and convert to area for payment. The Engineer will determine the weight-to-area or volume-to-area conversion factors. The Engineer and Contractor must agree on the conversion factor before the Engineer converts a pay quantity.

90.1.3 Volume

(1) For material specified for measurement by volume in the vehicle, haul the material in Engineer-approved vehicles. Ensure that the vehicle body type allows for ready and accurate measurement of the contents.

(2) The Engineer will determine the approved capacity of vehicles to the nearest 1/10 cubic yard. Unless all Department-approved vehicles on a job have the same capacity, mark each vehicle with a plainly legible identification mark showing the approved capacity. Do not change capacity markings without the Engineer's consent.

(3) The Engineer will measure the material in the vehicle at the point of delivery. The Engineer will make no adjustment for the settlement of material during transit. The Engineer may reject loads not hauled in Department-approved vehicles.

(4) If the Contract allows, the Engineer may weigh material and convert to a volume for payment. The Engineer will determine the weight to volume conversion factors. The Engineer and Contractor must agree on the conversion factor before the Engineer converts a pay quantity.

(5) Excavation and Embankment measurement will use the average end area method to compute volume unless otherwise specified.

(6) Material placed without accepted measurement method by the Engineer may be subject to removal, or may be allowed to remain in place at no or reduced pay, at the discretion of the Engineer.

90.1.4 Weight

90.1.4.1 General

(1) For aggregates and asphaltic mixtures specified for measurement by weight, weigh the material on platform scales or other Engineer-approved scales. Include the cost to furnish scales in the Pay Item price. Furnishing scales is incidental to the work. Use scales that the Engineer has tested and determined to be satisfactory, or ensure that authorized testing firms or agencies test the scales as often as the Engineer deems necessary to ascertain their accuracy.

(2) If weighing materials in the hauling vehicle, check gross weights and determine the vehicle tare weight whenever the Engineer directs.

(3) If the Contract allows, the Engineer may measure the volume of material and convert to weight for payment. The Engineer will determine the volume to weight conversion factors. The Engineer and Contractor must agree on the conversion factor before the Engineer converts a pay quantity.

90.1.4.2 Load Tickets

(1) For weighed aggregates, submit a ticket for each load of material. Submit tickets daily as work is completed. Ensure that each ticket includes a unique ticket number, the project ID, material description, date & time measured, gross, tare & net weights, and truck ID.

(2) For asphaltic mixtures:

If not using automatic batch recording, install a digital recorder as part of the platform truck or storage silo scales. Ensure that the recorder can produce a printed digital record of at least the gross or net weights of delivery trucks. Provide gross, tare, net weights, load count, and the cumulative tonnage; the date, time, ticket number, WisDOT project ID, and mix 250 number; and the mix type including the traffic, binder, and mix designation codes. Ensure that scales cannot be manually manipulated during the printing process. Provide an interlock to prevent printing until the scales come to rest. Size the scales and recorder to accurately weigh the heaviest loaded trucks or tractor-trailers hauling asphaltic mixture. Ensure that recorded weights are accurate to within 0.1 percent of the nominal capacity of the scale.

Submit tickets daily as work is completed. Ensure that tickets identify additives not included in the mix design submittal or cold weather paving plan. Indicate on the ticket if the mixture is placed under a cold weather paving plan.

(3) For ready-mixed concrete:

With each load of ready-mixed concrete, provide a computer-printed batch ticket which includes load and truck identification, the actual batch weights of all materials in that load, the mixing time for central plant-mixed concrete or the start of the batch life as specified for transit-mixed concrete, and other pertinent data. Give batch tickets to the inspector upon arrival at the work site. The department will only accept loads that arrive in satisfactory condition and have a batch ticket. The engineer will only accept hand written batch tickets in remote locations where no computerized plant is available within deliverable distance of the work site.

Instead of requiring a batch ticket for each load, the engineer may accept central-mixed concrete used in pavement and associated bid items based on daily production records from a computer-controlled plant erected specifically for work under the contract. Submit a complete load-by-load written record that ties the truck IDs to the batch quantities and batch times for each day's production to the engineer at the end of each day's production. During concrete production, operate under a plan acceptable to the engineer that ties the truck ID to the batch quantities and batch time for each load. In that plan describe how that information will be made available to the engineer immediately upon request. The engineer may also require batch tickets to address short-term operational difficulties.

90.1.5 Lump Sum (LS)

(1) For work items measured by LS, the price includes all labor, materials and incidentals to complete the full unit of work in the plans and specifications, including fittings and fasteners and other assemblies necessary to fully complete the entire unit of work so measured.

90.1.6 Each (EA)

(1) For work items measured by each the price includes all labor, materials and incidentals to furnish and install the specified item of work shown in the plans and specifications, including fittings and fasteners and other assemblies necessary to fully complete the entire unit of work so measured.

90.2 Scope of Payment

(1) The Department will use the prices shown in the Schedule of Prices or prices subsequently modified by change Order to pay for the work.

(2) The Department will pay for the quantity of work acceptably completed and measured for payment as the measurement subsection for each Pay Item specifies. Within the Contract provide means to furnish and install the work complete and in-place. Payment is full compensation for everything required to perform the work under the applicable Pay Items including, but not limited to, the work elements listed in the payment subsection. Payment also includes all of the following not specifically excluded in that payment subsection:

a. Furnishing and installing all materials as well as furnishing the labor, tools, supplies, equipment, and incidentals necessary to perform the work.
b. All losses or damages, except as specified in 70.14, arising from one or more of the following:
    i. The nature of the work.
    ii. The action of the elements.
    iii. Unforeseen difficulties encountered during prosecution of the work.
c. All insurance costs, expenses, and risks connected with the prosecution of the work.
d. All expenses incurred because of an Engineer-ordered suspension, except as specified in 40.2.2.3.
e. All infringements of patents, trademarks, or copyrights.
f. All other expenses incurred to complete and protect the work under the Contract.

(3) The Department may withhold payments due under the Contract until the Contractor proves to the Department that the Contractor has paid for all labor and materials used in the work.

90.3 Payment for Altered Quantities

(1) If the measured quantity for a Pay Item varies from the quantity given in the proposal, the Department will pay at the original Contract bid price for the quantity measured as specified in 90.1.1(2). The Department will adjust payment for revisions in plans or quantities of work requiring Contract Change Orders as specified in 40.2.

(2) The Department will not pay the Contractor for loss of expected reimbursement or anticipated profits suffered or claimed by the Contractor. The Department will not make revisions to the Contract bid prices except as specified in 40.2.

90.4 Price Adjustments for Contract Revisions

90.4.1 General

(1) If the Department revises the Contract under 40.2, the Department will adjust the Contract price using the sequence specified in 90.4.2 through 90.4.5. This price adjustment includes payment for performing the revised work, delay costs, and all other associated costs the Engineer deems reasonable and not expressly precluded in 90.4.6. The Department may, at any time, direct the Contractor to perform all or part of the revised work under force account.

(2) If a Contract revision includes a time adjustment for compensable delays under items two through five of 80.10.3(2), the Department will adjust the Contract price for delay costs as specified in 90.4.7.

90.4.2 Contract Bid Prices

(1) Before proceeding to another pricing method, the Engineer will attempt to price revised work using Contract bid prices.

90.4.3 (Vacant)

90.4.4 Negotiated Prices

(1) The Engineer and Contractor will negotiate the price of a Contract revision for one or more of the following:

a. Adjustments in Contract bid prices are necessary due to a significant change as specified in 40.2.2.4.
b. The Engineer and Contractor cannot agree on a revised price under 90.4.2.

(2) Provide an estimate of the proposed unit prices or lump sum price for the Contract revision. Include the cost of performing the revised work, delay costs, all other associated costs, plus a reasonable allowance for profit and applicable overhead. The Engineer may request that the Contractor justify the estimate by providing one or more of the following:

a. Labor requirements by trade in hours for each task.
b. Equipment costs and time requirements.
c. Material costs.

(3) Provide the justification within five business days after the Department's request. The Department will respond to the estimate within five business days after receipt of the Contractor's justification. The Department and the Contractor can mutually agree to extend these five-day requirements.

(4) If the Department negotiates with the Contractor but does not agree on a price adjustment, the Engineer may direct the Contractor to perform all or part of the revised work under force account.

90.4.5 Force Account

90.4.5.1 General

(1) The Engineer may direct the Contractor to perform the revised work under force account. Submit a written proposal for the work including the planned equipment, materials, labor, and work schedule.

(2) The Department will pay the Contractor as specified in 90.4.5.2 through 90.4.5.6, as full compensation for performing the force account work, delay costs, and all other associated costs. At the end of each workday, the Contractor's representative and the inspector shall compare records of the work done under force account. The Department will make no force account payment before the Contractor submits an itemized statement of the costs for that work.

(3) Provide the following content in itemized statements for all force account work:

a. Name, classification, date, daily hours, total hours, rate, and amount for all labor. Include accumulation of wages to date for each employee performing force account work and identify allowable federal unemployment tax (FUTA) and state unemployment tax (SUTA) multipliers.

b. Designation, dates, daily hours, total hours of actual operation and stand-by operation, rental rate, and amount for each unit of equipment, or the applicable hourly equipment expense rate for each truck or other unit of machinery and equipment. Include the manufacturer's name or trademark, model number, and year of manufacture with the designation.

c. Quantities of materials and prices.

d. Transportation charges on materials, free on board (f.o.b.) at the job site.

e. Cost of property damage, liability, and workers compensation insurance premiums; unemployment insurance contributions; and social security tax.

f. Documentation showing payment for all invoiced work.

g. If materials are taken from Contractor’s stock and original receipted invoices for the materials and transportation charges cannot be provided, provide an affidavit and certify the following:

i. The materials were taken from the Contractor’s stock.

ii. The quantity shown was actually used for the force account work.

iii. The price and transportation costs represent the actual cost to the Contractor.

(4) The Department will pay for force account work based on the Engineer's review of the actual invoice costs the Contractor submits. The Engineer will approve payment for costs the Engineer deems reasonable based on experience or prevailing market rates. The Engineer may request that the Contractor provide additional evidence to support costs the Engineer questions. The Department will only pay for costs the Engineer approves.

90.4.5.2 Labor

(1) The Department will pay the Contractor's labor costs, at prevailing wage rates or at wage rates previously agreed upon with the Department in writing, for personnel directly involved in producing and supervising the force account work. The Department will only pay for hours that personnel are actually engaged in force account work. The Department will also reimburse the Contractor based on actual invoiced costs paid to, or on behalf of, workers for subsistence and travel benefits, health and welfare benefits, pension fund benefits, or other Contractor-paid benefits. The Department will pay an additional 35 percent markup of these wages and benefits.

(2) The Department will pay no part of wages or benefits for personnel connected with the Contractor's forces above the classification of foreman and having only general supervisory responsibility for the force account work.

90.4.5.3 Insurance

(1) The Department will pay the Contractor based on actual invoiced costs for property damage, liability, and workers’ compensation insurance premiums, unemployment insurance contributions, and social security taxes on force account work. The Department will pay an additional 15 percent markup of these costs. The Contractor shall furnish satisfactory evidence of the rates actually paid.

90.4.5.4 Materials

(1) The Department will pay the Contractor based on actual invoice costs, including applicable taxes and actual freight charges, for Engineer-approved materials the Contractor uses in force account work. The Department will pay an additional 15 percent markup of these costs. If the Contractor uses materials from the Contractor’s stock, the Department and the Contractor will agree on the price. Do not incorporate materials into the work without agreement.

(2) The Department reserves the right to furnish materials as it deems appropriate. Make no claims for costs, overhead, or profit on materials that the Department provides.

90.4.5.5 Equipment

90.4.5.5.1 General

(1) The Department will pay the Contractor's costs for equipment the Engineer deems necessary to perform the force account work for the time the Engineer directs or until the Contractor completes the force

account work, whichever happens first. The Department will pay the Contractor for equipment only during the hours that it is operated. The Department will pay for non-operating hours at the stand-by rate as specified in 90.4.5.5.3. Report equipment hours to the nearest 1/2-hour.

(2) The Department will pay for use of contractor-owned equipment the Engineer approves for force account work at published rates. The Department will pay the Contractor expense rates, as modified in 90.4.5.5, given in the Rental Rate Blue Book for Construction Equipment (blue book) published by Equipment Watch, Prism Business Media Inc. Base all rates on the blue book rental rate chapter revisions effective on January 1 for all equipment used in that calendar year.

(3) For each piece of equipment the Contractor uses, whether bought or rented, the Contractor shall provide the Engineer with the following information:

a. Manufacturer's name.
b. Equipment type.
c. Year of manufacture.
d. Model number.
e. Type of fuel used.
f. Horsepower rating.
g. Attachments required, together with their size or capacity.
h. All further information necessary to determine the proper rate.

(4) The Contractor shall provide for the Engineer's confirmation, the manufacturer's ratings, and manufacturer-approved modifications required to classify equipment for rental rate determination. For equipment with no direct power unit, use a unit of at least the minimum recommended manufacturer's rating.

(5) The Department will not pay rental for tools or equipment with a replacement value of $500 or less.

(6) Use Engineer-approved equipment in good working condition and providing normal output or production. The Engineer may reject equipment not in good working condition or not properly sized for efficient performance of the work.

(7) For equipment not listed in the blue book, provide an expense rate and furnish cost data to support that rate. Obtain the Engineer's written approval for the expense rate before using that equipment on force account work.

90.4.5.5.2 Hourly Equipment Expense Rates (Without Operators)

(1) The Contractor shall determine, and the Department will confirm, hourly equipment expense rates as follows:

$$\mathbf{HEER = [RAF \times ARA \times (R/176)] + HOC}$$

Where:

HEER = Hourly equipment expense rate.
RAF = Blue book regional adjustment factor.
ARA = Blue book age rate adjustment factor.
R = Current blue book monthly rate.
HOC = Blue book estimated hourly operating cost.

(2) The blue book hourly operating cost represents all costs of equipment operation, including fuel and oil, lubrication, field repairs, tires, expendable parts, and supplies.

90.4.5.5.3 Hourly Equipment Stand-By Rate

(1) For equipment that is in operational condition and is standing-by with the Engineer's approval, the Contractor shall determine, and the Department will confirm, the hourly stand-by rate as follows:

$$\mathbf{HSBR = RAF \times ARA \times (R/176) \times (1/2)}$$

Where:

HSBR = Hourly stand-by rate.
RAF = Blue book regional adjustment factor.
ARA = Blue book age rate adjustment factor.
R = Current blue book monthly rate.

(2) The Department will limit payment for stand-by to 10 hours or less per day up to 40 hours per week. The Department will not pay the Contractor for equipment that is inoperable due to breakdown. The

Department will not pay for idle equipment if the Contractor suspends work or if the Contractor is maintaining or repairing the equipment.

90.4.5.5.4 Hourly Outside-Rented Equipment Rate

(1) If the Contractor rents or leases equipment from a third party for force account work, the Contractor shall determine, and the Department will confirm, the hourly outside-rented equipment rate as follows:

$$\mathbf{HORER = HRI + HOC}$$

Where:

HORER = Hourly outside-rented equipment rate

HRI = Hourly rental invoice costs prorated for the actual number of hours that rented equipment is operated solely on force account work

HOC = Blue book hourly operating cost.

90.4.5.5.5 Owner-Operated Equipment

(1) For rental of equipment owned and operated by persons other than the Contractor or their subcontractors, the Department will pay the Contractor based on the actual paid invoice. Provide an invoice that includes all costs for furnishing and operating the equipment. Obtain the Engineer's written approval of the rental rates before starting the force account work.

(2) The Department will allow the Contractor to add a markup on the invoice for owner-operated equipment. Determine the markup in the same manner as specified in 90.4.5.6 for subcontractors.

90.4.5.5.6 Moving of Equipment

(1) The Department will pay the Contractor at the hourly equipment expense rate, as specified in 90.4.5.5.2, for time required to move needed equipment under its own power to the location of the force account work and to return it to its original location on the project. The Department will pay the Contractor at the hourly equipment expense rate, as specified in 90.4.5.5.2, for the transporting vehicle only if it is transporting equipment to, from, and within the project.

(2) The Department will pay the Contractor for actual freight costs of equipment moved by commercial carrier.

90.4.5.6 Force Account Work by Subcontractors

(1) If a subcontractor performs force account work, the Department will allow the Contractor a markup on work the subcontractor performs as follows:

a. Use a markup of 10 percent for the first $10,000 of work.

b. Use a markup of 2 percent for work in excess of $10,000.

90.4.6 Non-Allowable Charges for Adjustment of Contract Prices

(1) Whether Contract revision price adjustments are based on Contract bid prices, agreed lump sum prices, negotiated prices, or force account, the Department will not reimburse the Contractor for the following:

a. Profit in excess of that specified in 90.4.2 through 90.4.5.

b. Loss of anticipated profit.

c. Home office overhead.

d. Consequential damages, including loss of bonding capacity, loss of bidding opportunities, and insolvency.

e. Indirect costs.

f. Attorney's fees, claims preparation expenses, or costs of litigation.

g. Interest.

90.4.7 Price Adjustments for Delay Costs

90.4.7.1 General

(1) For a compensable delay under items 2 through 5 of 80.10.3(2), the Department will pay for the costs specified here in 90.4.7.2. The Department will not pay for non-allowable charges specified in 90.4.6 nor duplicate payment made under 90.4.2 through 90.4.5.

(2) The Department will only pay the Contractor for costs the Contractor actually incurs. The Department will make no payment for delay costs before the Contractor submits an itemized statement of those costs. Provide the content specified in 90.4.5.1(3), for the applicable items, in this statement.

90.4.7.2 Allowable Delay Costs

90.4.7.2.1 Extended Field Overhead

(1) The Department will pay the Contractor for extended field overhead costs that include costs for general field supervision, field office facilities and supplies, and for maintenance of field operations.

(2) General field supervision costs include, but are not limited to, field supervisors, assistants, watchman, and clerical and other field support staff. Compute these labor costs as specified in 90.4.5.2(1). For salaried personnel, calculate the daily wage rate actually paid by dividing the weekly salary by 5 days per week.

(3) Field office facility and supply costs include, but are not limited to, field office trailers, tool trailers, office equipment rental, temporary toilets, and other incidental facilities and supplies. Compute these costs on a calendar-day basis using actual costs incurred due to the delay to provide these services.

(4) Maintenance of field operations costs include, but are not limited to, telephone, electric, water, and other similar expenses. Compute these costs on a calendar-day basis using actual costs incurred due to the delay to maintain these services.

90.4.7.2.2 Extended Labor

(1) Compute labor costs during delays as specified in 90.4.5.2 for all non-salaried personnel remaining on the project as required under collective bargaining agreements or for other Engineer-approved reasons.

90.4.7.2.3 Escalated Labor

(1) To receive payment for escalated labor, demonstrate that the Department-caused delay forced the work to be performed during a period when labor costs were higher than planned at the time of bid. Provide adequate support documentation for the costs, allowances, and benefits specified in 90.4.5.2.

90.4.7.2.4 Equipment Stand-By or Equipment Demobilization

(1) The Department will pay the Contractor the stand-by rate calculated in 90.4.5.5.3 for equipment, other than small tools, that must remain on the project during delays. The Department will pay the Contractor's transportation costs to remove and return equipment not required on the project during delays.

90.4.7.2.5 Materials Escalation or Material Storage

(1) The Department will pay the Contractor for increased material costs or material storage costs due to the delay. Obtain the Engineer’s approval before storing material due to a delay.

90.5 Eliminated Items

(1) If the Department partially eliminates or completely eliminates a Pay Item as specified in 40.2.2.5, the Department will pay Contractor costs incurred due to that elimination. The Department will pay a fair and equitable amount covering all costs incurred as of the date the work was deleted. Immediately submit a certified statement covering all money expended for the eliminated Pay Item.

(2) The Department will execute a Contract Change Order for the following costs related to an eliminated Pay Item:

a. Preparation expenses defined as follows:

i. If preparation for the eliminated Pay Item has no value to other Contract Pay Items, the Department will reimburse the Contractor in full for that preparation.

ii. If preparation for work on the eliminated Pay Item would ordinarily be distributed over other Contract Pay Items, the Department will prorate reimbursement based on the value of the eliminated Pay Item compared to the total value of all associated Contract Pay Items.

b. All restocking and cancellation charges.

c. A reasonable allowance for applicable overhead.

(3) If the Department partially eliminates or completely eliminates a Pay Item, the Department may pay for, and take ownership of, materials or supplies the Contractor has already purchased.

90.6 Progress Payments

90.6.1 General

(1) The Department will first prepare a progress payment estimate as described in 90.6.3, and then will make a progress payment based on the Engineer's estimate of the quantities of work completed. Payment will be at the Contract or agreed unit or lump sum prices. The Department may suspend progress payments if the Contractor does not comply with the Engineer’s directions as the Contract specifies. The Department will notify the Contractor immediately whenever progress payments are suspended.

(2) The Department will restrict progress payments, as specified in 80.4, until the Engineer accepts the Contractor's progress schedule. Progress payment restrictions are specified in 80.4.2.1(5) for bar chart schedules, in 80.4.3.2(5) for RBC schedules, and in 80.4.4.3(6) for CPM schedules.

(3) The Department's payment of an estimate before conditional final acceptance of the work does not constitute the Department's acceptance of the work, and does not relieve the Contractor of responsibility for:

a. Protecting, repairing, correcting, or renewing the work.

b. Replacing all defects in the construction or in the materials used in the construction of the work under the Contract, or responsibility for damage attributable to these defects.

(4) The Contractor is responsible for all defects or damage that the Engineer may discover on or before the Engineer's conditional final acceptance of the work. The Engineer is the sole judge of these defects or damage, and the Contractor is liable to the Department for not correcting all defects or damage.

(5) The Department will take ownership of all material and work covered by progress payments. However, the Contractor remains solely responsible for all materials and work covered by progress payments and for the restoration of damaged work as specified in 70.17. Also, by making the progress payment, the Department waives no requirement, right, or term of the Contract as specified in 70.18.

90.6.2 Frequency

(1) The Department will make progress payments at least monthly, as feasible, if the Contractor is due a payment of $1000 or more. The Department may reduce this minimum payment due for contracts of $25,000 or less.

90.6.3 Preparation of Progress Payment Estimate

90.6.3.1 General

(1) The Department will compute quantities to reflect the approximate amount of work completed, or substantially completed, under the pertinent Contract Pay Items to the date of the progress payment estimate. The Department will adjust quantities to cover contingencies and costs for finishing or maintaining the work. If the Engineer bases the progress payment estimate on Contract quantities, the Department will adjust quantities to cover variations between the Contract and final quantities.

90.6.3.1.1 Pending Contract Change Order Work

(1) Between the times the Engineer authorizes a Contract Change Order and the Department executes it, the Engineer will include, in the progress payment estimate, the value of the acceptably completed change order work. The Department will pay at least 90 percent of the value of the work as it is completed under an unexecuted change order. After the Department executes the change order, the Department will deduct payments made on the unexecuted change order work from future payments due the Contractor.

90.6.3.2 Payment for Materials on Hand

90.6.3.2.1 General

(1) The Engineer may include in the progress payment estimate the value of materials prior to final incorporated into the work, that:

a. Are specifically manufactured, produced, or purchased for incorporation as a permanent part of the work.

b. Are delivered to the project or stored at a location acceptable to the Engineer and as specified in 60.4.

c. Are stored separately and irrevocably assigned to the project if stockpiled at plants or fabrication sites.

d. The Contractor provides the Engineer evidence the material so stored or stockpiled is insured against loss by damage to or disappearance of the materials prior to being incorporated into the work.

e. Are provided free of liens or encumbrances of any kind.

f. The quantity of materials paid shall not exceed the plan quantity, if the quantity is not specifically indicated, the maximum quantity as derived from the Plans as approved by the Engineer.

(2) The Engineer will require the Contractor to document costs for materials included in a progress payment estimate. Provide the required invoice, billing, title, or assignment documents including a complete material description, identification, and cost data.

(3) If the Contractor does not satisfy all vendor claims made against the Contractor for materials within 30 calendar days after receiving the progress payment, the Department may cancel the applicable materials payment in the next progress payment estimate.

(4) If making progress payments for materials, the Engineer will not exceed the delivered cost or Contract amount for the material complete in place. The Engineer will use those amounts paid for materials to reduce future payments due the Contractor for completed work incorporating those materials.

(5) No partial payment will be made for stored or stockpiled living or perishable plant materials.

(6) Payment for materials on hand will only be made for materials delivered 45 days or more prior to the estimated scheduled date of the materials to be incorporated into the work.

(7) Payment for material on hand shall not be construed as final acceptance of the material.

90.6.3.2.2 Structural Steel

(1) On contracts containing 250 tons or more of structural steel, the Engineer may also include in the progress payment estimate the value of Structural Steel Carbon or Structural Steel HS, or both, to be used in the completed work and that has been delivered to the fabricator.

(2) In addition to the information required in 90.6.3.2.1, provide the weights, dimensions, and heat and unit numbers.

(3) Store the structural steel separately. Use stored structural steel only for fabrication of structural components to be used on the Contract.

(4) Present acceptable evidence indicating satisfactory fabrication of structural steel. The Engineer may include, in the estimate prepared for progress payment, the value of this fabricated material, determined by multiplying the total unit weight of the material by 80 percent of the Contract unit price.

90.6.3.3 Payment Withholdings

90.6.3.3.1 Liquidated Damages and Claims

(1) The Department will withhold a portion of the payment from progress payment estimates for liquidated damages and claims including the following:

a. To provide for recovery of liquidated damages assessable against the Contract under 80.11.

b. To cover claims against the Contract filed with the Department under chapter 779 of the Wisconsin statutes.

http://docs.legis.wi.gov/statutes/statutes/779

c. To provide for recovery of damage and tort claims assessable against the Contract under 70.14.

(2) Liquidated Damages as assessed in 80.11 will be permanently withheld.

(3) The amount withheld for claims or recovery of damage for tort claims will be released in accordance with the resolution of the claim.

90.6.3.3.2 Retainage

(1) In addition to the withholding of 90.6.3.3.1, the Department will withhold retainage in accordance with State Statute 66.0901 as follows:

a. An amount equal to five percent of each estimate until 50 percent of the work has been completed. Thereafter the total amount of retainage will remain equal to five percent of the estimated completed cost shall continue to be retained while the project is progressing satisfactorily.

b. At 50% completion or any time thereafter when the work is not satisfactory, additional amounts may be retained, but the total retainage may not exceed 10% of the estimated completed Contract value.

(2) Retainage may be released upon substantial completion as specified in 50.15.2.1.3, except an amount equal to the estimated value of remaining work to be completed which shall be retained until final acceptance. After final acceptance has been granted as specified in 50.15.2.2, any remaining retainage shall be released.

90.7 Acceptance and Final Payment

(1) After the Engineer grants final acceptance of the work as specified in 50.15.2.2, and reviews required document submittals and materials test reports, the Engineer will issue the semi-final estimate.

(2) Within 30 calendar days after receiving the semi-final estimate, submit to the Engineer a written statement of agreement or disagreement with the semi-final estimate. For an acceptable statement of disagreement, submit an item-by-item list with reasons for each disagreement. If the Contractor does not submit this written statement within those 30 days, the Engineer will process the final estimate for payment. The Engineer and the Contractor can mutually agree to extend this 30-day submission requirement.

(3) If the Contractor submits an acceptable statement of disagreement, the Department will withhold payment of the final estimate and determine the validity of the Contractor's disagreement. After

considering the Contractor's statement, the Department may revise the final estimate based on the Engineer's judgment of the validity of the Contractor's disagreement.

(4) The Department will make final payment within one year after the date the Contractor provides the Department with written confirmation of the semi-final estimate, or within one year after expiration of the 30-day period specified in 90.7(2), whichever applies. If the Department does not pay as required, the Department will pay interest, compounded monthly, on the balance due at the rate specified in Section 66.0135 of the Wisconsin statutes.

http://docs.legis.wi.gov/statutes/statutes/66

(5) If the Department has been notified that there are multiple claims against the amount held and the Department concludes that it cannot appropriately choose between or among the conflicting claims, the Department may withhold payment of the amount at issue pending resolution of those conflicts. Upon resolution of all issues affecting rights to the amount held, the Department will pay the claimant or claimants.

(6) The Department may correct progress estimates and payments in the final estimate and payment.

(7) If approved by the division administrator, the Department may set off any sums the Department determines the Contractor owes the Department against any sums otherwise due and payable to the Contractor under this Contract or any previously executed or future contract with the Department. The Department will notify the Contractor when exercising this right and identify how the Department has or will make that equitable adjustment.

(8) Final payment will not be made until all the project documentation as required has been received and accepted.

90.8 No Assignment of Payments

(1) The Department will pay the Contractor all payments due under the Contract, or any part of the Contract, as specified in Section 90. The Department will recognize no Contractor-executed assignment or order directing payment of all, or any portion of, the funds to any other person or persons.

END OF SECTION 90

Part 2 – General Construction

Specification C100 - Contractor Quality Control Program (CQCP)

100.1 General

(1) Quality is more than test results. Quality is the combination of proper materials, testing, workmanship, equipment, inspection, and documentation of the project. Establishing and maintaining a culture of quality is key to achieving a quality project. The Contractor shall establish, provide, and maintain an effective Contractor Quality Control Program (CQCP) that details the methods and procedures that will be taken to assure that all materials and completed construction required by this Contract conform to Contract Plans, technical specifications and other requirements, whether manufactured by the Contractor, or procured from subcontractors or vendors. Although guidelines are established and certain minimum requirements are specified here and elsewhere in the Contract technical specifications, the Contractor shall assume full responsibility for accomplishing the stated purpose.

(2) The Contractor shall establish a CQCP that will:

a. Provide qualified personnel to develop and implement the CQCP.
b. Provide for the production of acceptable quality materials.
c. Provide sufficient information to assure the specification requirements can be met.
d. Document the CQCP process.

(3) The Contractor shall not begin any construction or production of materials to be incorporated into the completed work until the Contractor Quality Control Program has been reviewed and accepted by the Engineer. No partial payment will be made for materials subject to specific quality control requirements until the Quality Control Program has been reviewed and approved.

(4) The quality control requirements contained in this section and elsewhere in the Contract technical specifications are in addition to and separate from the quality assurance (QA) testing requirements. QA testing requirements are the responsibility of Engineer or Contractor as specified in the specifications.

(5) A Quality Control (QC)/Quality Assurance (QA) workshop with the Engineer, Resident Project Representative (RPR), Contractor, subcontractors, testing laboratories, and Owner's representative must be held prior to start of construction. The QC/QA workshop will be facilitated by the Contractor. The Contractor shall coordinate with the Airport and Engineer on time and location of the QC/QA workshop. Items to be addressed, at a minimum, will include:

a. Review of the CQCP including submittals, QC Testing, Action & Suspension Limits for Production, Corrective Action Plans, Distribution of QC reports, and Control Charts.
b. Discussion of the QA program.
c. Discussion of the QC and QA Organization and authority including coordination and information exchange between QC and QA.
d. Establish regular meetings to discuss control of materials, methods and testing.
e. Establishment of the overall QC culture.

100.2 Description of Program

100.2.1 General Description

(1) The Contractor shall establish a Contractor Quality Control Program to perform quality control inspection and testing of all items of work required by the technical specifications, including those performed by subcontractors. This Contractor Quality Control Program shall ensure conformance to applicable Specifications and Plans with respect to materials, off-site fabrication, workmanship, construction, finish, and functional performance. The Contractor Quality Control Program shall be effective for control of all construction work performed under this Contract and shall specifically include surveillance and tests required by the technical specifications, in addition to other requirements of this section and any other activities deemed necessary by the Contractor to establish an effective level of quality control.

100.2.2 Contractor Quality Control Program (CQCP)

(1) The Contractor shall describe the Contractor Quality Control Program in a written document that shall be reviewed and approved by the Engineer prior to the start of any production, construction, or off-site fabrication. The written Contractor Quality Control Program shall be submitted to the Engineer for review and approval at least fourteen calendar days before CQCP Workshop. The Contractor's Quality Control Plan and Quality Control testing laboratory must be approved in writing by the Engineer prior to the Notice to Proceed (NTP).

(2) Contractor Quality Control Program shall be organized to address, as a minimum, the following items:

a. Contractor Quality control organization and resumes of key staff

b. Project progress schedule
c. Submittals schedule
d. Inspection requirements
e. Quality control testing plan
f. Documentation of quality control activities and distribution of QC reports
g. Requirements for corrective action when quality control and/or acceptance criteria are not met
h. Material quality and construction means and methods. Address all elements applicable to the project that affect the quality of the pavement structure including subgrade, subbase, base, and surface course. Some elements that must be addressed include, but is not limited to mix design, aggregate grading, stockpile management, mixing and transporting, placing and finishing, quality control testing and inspection, smoothness, laydown plan, equipment, and temperature management plan.

The Contractor should add additional elements to the Contractor Quality Control Program that is necessary to adequately control all production and/or construction processes required by this Contract.

100.3 QCQP Organization

(1) The Contractor Quality Control Program shall be implemented by the establishment of a separate quality control organization. An organizational chart shall be developed to show all quality control personnel, their authority, and how these personnel integrate with other management/production and construction functions and personnel.

(2) The organizational chart shall identify all quality control staff by name and function, and shall indicate the total staff required to implement all elements of the Contractor Quality Control Program, including inspection and testing for each item of work. If necessary, different technicians can be used for specific inspection and testing functions for different items of work. If an outside organization or independent testing laboratory is used for implementation of all or part of the Contractor Quality Control Program, the personnel assigned shall be subject to the qualification requirements of 100.3 1 and 100.3 2. The organizational chart shall indicate which personnel are Contractor employees and which are provided by an outside organization.

(3) The quality control organization shall, as a minimum, consist of the following personnel:

100.3.1 Program Administrator

(1) The Contractor Quality Control Program Administrator (CQCPA) shall be a full-time employee of the Contractor, or a consultant engaged by the Contractor. The CQCPA shall have a minimum of five years of experience in airport and/or highway construction and shall have had prior quality control experience on a project of comparable size and scope as the Contract.

(2) Included in the five (5) years of paving/QC experience, the CQCPA must meet at least one of the following requirements:

a. Professional Engineer with one year of airport paving experience.
b. Engineer-in-training with two years of airport paving experience.
c. National Institute for Certification in Engineering Technologies (NICET) Civil Engineering Technology Level IV with three years of airport paving experience.
d. An individual with four years of airport paving experience, with a Bachelor of Science Degree in Civil Engineering, Civil Engineering Technology or Construction.

(3) The CQCPA shall have full authority to institute any and all actions necessary for the successful implementation of the Contractor Quality Control Program to ensure compliance with the Contract Plans and technical specifications. The CQCPA authority must include the ability to immediately stop production until materials and/or processes are in compliance with contract specifications. The CQCPA shall report directly to a responsible officer of the construction firm. The Program Administrator may supervise the Quality Control Program on more than one project provided that person can be at the job site within two hours after being notified of a problem.

100.3.2 Quality Control Technicians

(1) A sufficient number of quality control technicians necessary to adequately implement the Contractor Quality Control Program shall be provided. These personnel must be either Engineers, engineering technicians, or experienced craftsman with qualifications in the appropriate field equivalent to NICET Level II in Civil Engineering Technology or higher, or higher construction materials technician or highway construction technician and shall have a minimum of two years of experience in their area of expertise.

(2) The quality control technicians must report directly to the CQCPA and shall perform the following functions:

a. Inspection of all materials, construction, plant, and equipment for conformance to the technical specifications, and as required by subsection 100.6.

b. Performance of all quality control tests as required by the technical specifications and 100.8.

c. Performance of density tests for the Engineer when required by the technical specifications.

(3) Certification at an equivalent level of qualification and experience by a state or nationally recognized organization will be acceptable in lieu of NICET certification. Certification by the equivalent WisDOT HTCP is acceptable.

100.3.3 Staffing levels

(1) The Contractor shall provide sufficient qualified quality control personnel to monitor each work activity at all times. Where material is being produced in a plant for incorporation into the work, separate plant and field technicians shall be provided at each plant and field placement location. The scheduling and coordinating of all inspection and testing must match the type and pace of work activity. The Contractor Quality Control Program shall state where different technicians will be required for different work elements.

100.4 Project Schedule

(1) Critical QC activities must be shown on the project schedule as required by 80.4.

100.5 Submittals Schedule

(1) The Contractor shall submit a detailed listing of all submittals (for example, mix designs, material certifications) and shop drawings required by the technical specifications. The listing can be developed in a spreadsheet format and shall include:

a. Specification item number

b. Item description

c. Description of submittal

d. Specification paragraph requiring submittal

e. Scheduled date of submittal

100.6 Inspection Requirements

(1) Quality control inspection functions shall be organized to provide inspections for all definable features of work, as detailed below. All inspections shall be documented by the Contractor as specified by subsection 100.9.

(2) Inspections shall be performed as needed to ensure continuing compliance with Contract requirements until completion of the particular feature of work. Inspections shall include the following minimum requirements:

a. During plant operation for material production, quality control test results and periodic inspections shall be used to ensure the quality of aggregates and other mix components, and to adjust and control mix proportioning to meet the approved mix design and other requirements of the technical specifications. All equipment used in proportioning and mixing shall be inspected to ensure its proper operating condition. The Quality Control Program shall detail how these and other quality control functions will be accomplished and used.

b. During field operations, quality control test results and periodic inspections shall be used to ensure the quality of all materials and workmanship. All equipment used in placing, finishing, and compacting shall be inspected to ensure its proper operating condition and to ensure that all such operations are in conformance to the technical specifications and are within the plan dimensions, lines, grades, and tolerances specified. The Program shall document how these and other quality control functions will be accomplished and used.

100.7 Contractor Quality Control Testing Facility

100.7.1 Asphaltic Testing Facility

(1) For projects that include P401 the Contractor shall ensure facilities, including all necessary equipment, materials, and current reference standards, are provided that meet requirements in the following paragraphs of ASTM D3666, Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials:

a. 8.1.3 Equipment Calibration and Checks;

b. 8.1.9 Equipment Calibration, Standardization, and Check Records;

c. 8.1.12 Test Methods and Procedures

100.7.2 PCC Testing Facility

(1) For projects that include P501, the Contractor shall ensure facilities, including all necessary equipment, materials, and current reference standards, are provided that meet requirements in the following

paragraphs of ASTM C1077, Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation:

a. 7 Test Methods and Procedures
b. 8 Facilities, Equipment, and Supplemental Procedures

100.8 Quality Control Testing Plan

(1) As a part of the overall Quality Control Program, the Contractor shall implement a quality control testing plan, as required by the technical specifications. The testing plan shall include the minimum tests and test frequencies required by each technical specification Item, as well as any additional quality control tests that the Contractor deems necessary to adequately control production and/or construction processes.

(2) The testing plan can be developed in a spreadsheet fashion and shall, as a minimum, include the following:

a. Specification item number (for example, P401)
b. Item description (for example, Hot Mix Asphalt Pavements)
c. Test type (for example, gradation, grade, asphalt content)
d. Test standard (for example, ASTM or American Association of State Highway and Transportation Officials (AASHTO) test number, as applicable)
e. Test frequency (for example, as required by technical specifications or minimum frequency when requirements are not stated)
f. Responsibility (for example, plant technician)
g. Control requirements (for example, target, permissible deviations)

(3) The testing plan shall contain a statistically-based procedure of random sampling for acquiring test samples in accordance with ASTM D3665. The Engineer shall be provided the opportunity to witness quality control sampling and testing.

(4) All quality control test results shall be documented by the Contractor as required by subsection 100.8.

100.9 Documentation

(1) The Contractor shall maintain current quality control records of all inspections and tests performed. These records shall include factual evidence that the required inspections or tests have been performed, including:

a. Type and number of inspections or tests involved;
b. Results of inspections or tests;
c. Nature of defects, deviations, causes for rejection, etc.;
d. Proposed remedial action;
e. Corrective actions taken.

(2) These records must cover both conforming and defective or deficient features, and must include a statement that all supplies and materials incorporated in the work are in full compliance with the terms of the Contract. Legible copies of these records shall be furnished to the Engineer daily. The records shall cover all work placed subsequent to the previously furnished records and shall be verified and signed by the CQCPA.

(3) Contractor quality control records required for the Contract shall include, but are not necessarily limited to, the following records:

100.9.1 Daily Inspection Reports

(1) Each Contractor quality control technician shall maintain a daily log of all inspections performed for both Contractor and subcontractor operations. These technician's daily reports shall provide factual evidence that continuous quality control inspections have been performed and shall, as a minimum, include the following:

a. Technical specification item number and description
b. Compliance with approved submittals
c. Proper storage of materials and equipment
d. Proper operation of all equipment
e. Adherence to Plans and technical specifications
f. Summary of Results of QC tests and necessary actions
g. Safety inspection.

(2) The daily inspection reports shall identify inspections conducted, results of inspections, location and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed.

(3) The daily inspection reports shall be signed by the responsible quality control technician and the Program Administrator. The Engineer shall be provided at least one copy of each daily inspection report on the work day following the day of record. When QC inspection and test results are recorded and transmitted electronically, the results must be archived.

100.9.2 Daily Test Reports.

(1) The Contractor shall be responsible for establishing a system that will record all quality control test results. Daily test reports shall document the following information:

a. Technical specification item number and description
b. Test designation
c. Location
d. Date of test
e. Control requirements
f. Test results
g. Causes for rejection
h. Recommended remedial actions
i. Retests

(2) Test results from each day's work period shall be submitted to the Engineer prior to the start of the next day's work period. When required by the technical specifications, the Contractor shall maintain statistical quality control charts. When QC daily test results are recorded and transmitted electronically, the results must be archived.

100.10 Corrective Action Requirements

(1) The Contractor Quality Control Program shall indicate the appropriate action to be taken when a process is deemed, or believed, to be out of control (out of tolerance) and detail what action will be taken to bring the process into control. The requirements for corrective action shall include both general requirements for operation of the Contractor Quality Control Program as a whole, and for individual items of work contained in the technical specifications.

(2) The Contractor Quality Control Program shall detail how the results of quality control inspections and tests will be used for determining the need for corrective action and shall contain clear sets of rules to gauge when a process is out of control and the type of correction to be taken to regain process control.

(3) When applicable or required by the technical specifications, the Contractor shall establish and use statistical quality control charts for individual quality control tests. The requirements for corrective action shall be linked to the control charts.

100.11 Surveillance by the Engineer

(1) All items of material and equipment shall be subject to surveillance by the Engineer at the point of production, manufacture or shipment to determine if the Contractor, producer, manufacturer or shipper maintains an adequate quality control system in conformance with the requirements detailed here and the applicable technical specifications and Plans. In addition, all items of materials, equipment and work in place shall be subject to inspection and/or observation by the Engineer at the site for the same purpose.

(2) Inspection and/or observations by the Engineer does not relieve the Contractor of performing quality control inspections of either on-site or off-site Contractor's or subcontractor's work.

100.12 Noncompliance

(1) The Resident Project Representative (RPR) will provide written notice to the Contractor of any noncompliance with their CQCP. After receipt of such notice, the Contractor must take corrective action.

(2) When QC activities do not comply with either the CQCP or the contract provisions or when the Contractor fails to properly operate and maintain an effective CQCP, and no effective corrective actions have been taken after notification of non-compliance, the RPR will recommend the Owner take the following actions:

a. Order the Contractor to replace ineffective or unqualified quality control personnel or subcontractors.
b. Order the Contractor to stop operations until appropriate corrective actions are taken.

100.13 Measurement and Basis of Payment

(1) Contractor Quality Control Program shall be incidental work and the costs included in Pay Items for the corresponding types of Work, except when separate Pay Items are listed in the technical specifications for a particular item of Work, and the Pay Item is included in the Schedule of Prices.

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

National Institute for Certification in Engineering Technologies (NICET)

ASTM International (ASTM)

ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D3666	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

END OF SPECIFICATION C100

Specification C102 - Temporary Air and Water Pollution, Soil Erosion, and Siltation Control

102.1 Description

102.1.1 General

(1) This Work shall consist of temporary erosion control measures as shown on the Plans or as ordered by the Engineer during the life of a contract to control water pollution, soil erosion, and siltation through the use of silt fences, berms, dikes, dams, sediment basins, fiber mats, mulches, grasses, slope drains, and other erosion control devices or methods. Comply with the requirements of 70.20 and 70.22.

(2) Temporary erosion control shall be in accordance with the approved erosion control plan; the approved Construction Safety and Phasing Plan (CSPP) and AC 150/5370-2, *Operational Safety on Airports During Construction*. The temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this Contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.

(3) Temporary control may include work outside the construction limits such as borrow pit operations, equipment and material storage sites, waste areas, and temporary plant sites.

(4) Temporary control measures shall be designed, installed and maintained to minimize the creation of wildlife attractants that have the potential to attract hazardous wildlife on or near public-use airports.

https://www.faa.gov/airports/airport_safety/

102.1.2 State Highway Specifications and Erosion Control Plans

(1) The State of Wisconsin Department of Transportation Standard Specifications for Highway and Structure Construction (current edition) shall be referred to as the State Highway Specifications (SHS).

(2) An erosion control plan prepared in accordance with the State of Wisconsin Administrative Code-Trans401 is included in project Plans.

(3) Contractor shall prepare an Erosion Control Implementation Plan (ECIP) in accordance with the Wisconsin Administrative Code-Trans 401. Construction shall conform to the State Highway Specifications and in particular Section 628 Erosion Control of the SHS.

(4) Temporary erosion control shall be in accordance with the approved erosion control plan; the approved Construction Safety and Phasing Plan (CSPP) and AC 150/5370-2, Operational Safety on Airports During Construction.

102.2 Materials

102.2.1 General

(1) Materials for construction of erosion control siltation control items shall conform to Section 628 of the SHS and the Product Acceptability List (PAL) described in Section 628 of the SHS. All material shall comply with Federal Buy American requirements.

102.3 Construction

102.3.1 General

(1) In the event of conflict between these requirements and pollution control laws, rules, or regulations of other Federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

(2) Construction of erosion and siltation control items shall be in accordance with Section 628 of the SHS.

102.3.2 Schedule

(1) Prior to the start of construction, the Contractor shall submit schedules in accordance with the approved Construction Safety and Phasing Plan (CSPP) and the Plans for accomplishment of temporary and permanent erosion control work for clearing and grubbing; grading; construction; paving; and structures at watercourses. Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operation for the applicable construction have been accepted by the Department. These requirements shall be integrated into the ECIP.

102.3.3 Construction Details

(1) Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Except where future construction operations will damage slopes, Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available. Temporary erosion and pollution control measures will be used to correct conditions that

develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

(2) Where erosion may be a problem, clearing and grubbing operations should be scheduled and performed so that grading operations and permanent erosion control features can follow immediately if project conditions permit; otherwise, temporary erosion control measures may be required

(3) Limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current with the accepted schedule. If seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified.

(4) Contractor shall provide immediate permanent or temporary pollution control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment as directed by the Engineer. If temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or directed by the Engineer, the work shall be performed by the Contractor and the cost shall be incidental to this item.

(5) The Engineer may increase or decrease the area of erodible earth material that can be exposed at any time based on an analysis of project conditions.

(6) The erosion control features installed by the Contractor shall be acceptably maintained by the Contractor during the construction period.

(7) Whenever construction equipment must cross watercourses at frequent intervals, temporary structures should be provided. Comply with 70.21.

(8) Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into any waterways, impoundments or into natural or manmade channels.

102.4 Measurement
102.4.1 General

(1) Measurement for erosion control items shall be in accordance with Section 628 of the SHS.

102.5 Payment
102.5.1 General

(1) Pay Items and payment for erosion control items shall be in accordance with Section 628 of the SHS.

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5200-33 Hazardous Wildlife Attractants on or Near Airports

AC 150/5370-2 Operational Safety on Airports During Construction

ASTM International (ASTM)

ASTM D6461 Standard Specification for Silt Fence Materials

United States Department of Agriculture (USDA)

FAA/USDA Wildlife Hazard Management at Airports, A Manual for Airport Personnel

END OF SPECIFICATION C102

Specification C105 – Mobilization

105.1 Description
105.1.1 General

(1) This Specification describes the work and operations necessary to move personnel, equipment, supplies, and incidentals to the project site and to establish all of the contractor's offices, buildings, sanitary accommodations, and other facilities necessary to work on the project. It also includes all other work and operations whose performance is required, or for costs necessarily incurred before beginning work on various items on the project site.

105.1.2 Mobilization limit

(1) Mobilization shall be limited to ten percent of the total project cost.

105.1.3 Posted Notices

(1) Prior to commencement of construction activities the Contractor must post the following documents in a prominent and accessible place where they may be easily viewed by all employees of the prime Contractor and by all employees of subcontractors engaged by the prime Contractor: Equal Employment Opportunity (EEO) Poster "Equal Employment Opportunity is the Law" in accordance with the Office of Federal Contract Compliance Programs Executive Order 11246, as amended; Davis Bacon Wage Poster (WH 1321) - DOL "Notice to All Employees" Poster; and Applicable Davis-Bacon Wage Rate Determination. These notices must remain posted until final acceptance of the work by the Owner.

105.2 Measurement

(1) Measure Mobilization as a single complete unit of Work per lump sum.

105.3 Payment
105.3.1 General

(1) Payment for Mobilization is full compensation for supplying and providing all materials, facilities, and services, and for performing all work necessary to complete this Pay Item.

(2) Based upon the Contract lump sum price for Mobilization partial payments will be allowed as follows:

a. With first pay request, 25 percent.
b. When 25 percent or more of the original contract is earned, an additional 25 percent.
c. When 50 percent or more of the original contract is earned, an additional 40 percent.
d. After Final Inspection, Staging area clean-up and delivery of all Project Closeout materials, and final acceptance in accordance with 90.7, the final 10 percent.

(3) If the Contract does not include a separate Mobilization Pay Item, the work necessary for mobilization is incidental to work included under other Contract Pay Items.

105.3.2 Pay Items

(1) Payment will be made for measured quantities based on Contract unit prices for the following Pay Items.

Pay Item	Description	Unit
C105.010	Mobilization	Lump Sum (LS)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Office of Federal Contract Compliance Programs (OFCCP)

Executive Order 11246, as amended

EEOC-P/E-1 – Equal Employment Opportunity is the Law Poster

United States Department of Labor, Wage and Hour Division (WHD)

WH 1321 – Employee Rights under the Davis-Bacon Act Poster

END OF SPECIFICATION C105

Specification C110 - Method of Estimating Percentage of Material Within Specification Limits (PWL)

110.1 General

(1) When the Specifications provide for acceptance of material based on the method of estimating percentage of material within specification limits (PWL), the PWL will be determined in accordance with this section. All test results for a lot will be analyzed statistically to determine the total estimated percent of the lot that is within specification limits. The PWL is computed using the sample average (X) and sample standard deviation (S_n) of the specified number (n) of sub lots for the lot and the specification tolerance limits, L for lower and U for upper, for the particular acceptance parameter. From these values, the respective Quality index, Q_L for Lower Quality Index and/or Q_U for Upper Quality Index, is computed and the PWL for the lot for the specified n is determined from Table 1. All specification limits specified in the technical sections shall be absolute values. Test results used in the calculations shall be to the significant figure given in the test procedure.

(2) There is some degree of uncertainty (risk) in the measurement for acceptance because only a small fraction of production material (the population) is sampled and tested. This uncertainty exists because all portions of the production material have the same probability to be randomly sampled. The Contractor's risk is the probability that material produced at the acceptable quality level is rejected or subjected to a pay adjustment. The Owner's risk is the probability that material produced at the rejectable quality level is accepted.

(3) It is the intent of this section to inform the Contractor that, in order to consistently offset the Contractor's risk for material evaluated, production quality (using population average and population standard deviation) must be maintained at the acceptable quality specified or higher. In all cases, it is the responsibility of the Contractor to produce at quality levels that will meet the specified acceptance criteria when sampled and tested at the frequencies specified.

110.2 Method for Computing PWL.

(1) The computational sequence for computing PWL is as follows:

a. Divide the lot into n sublots in accordance with the acceptance requirements of the specification.

b. Locate the random sampling position within the sublot in accordance with the requirements of the specification.

c. Make a measurement at each location, or take a test portion and make the measurement on the test portion in accordance with the testing requirements of the specification.

d. Find the sample average (X) for all sublot test values within the lot by using the following formula:

$$X = (x_1 + x_2 + x_3 + \ldots x_n) / n$$

Where: X = Sample average of all sublot test values within a lot

$x_1, x_2, \ldots x_n$ = Individual sublot test values

n = Number of sublot test values

e. Find the sample standard deviation (S_n) by use of the following formula:

$$S_n = [(d_1^2 + d_2^2 + d_3^2 + \ldots d_n^2)/(n-1)]^{1/2}$$

Where: S_n = Sample standard deviation of the number of sublot test values in the set

$d_1, d_2, \ldots d_n$ = Deviations of the individual sublot values $x_1, x_2, \ldots$ from the average value X

that is: $d_1 = (x_1 - X)$, $d_2 = (x_2 - X) \ldots d_n = (x_n - X)$

n = Number of sublot test values

f. For single sided specification limits (that is, L only), compute the Lower Quality Index Q_L by use of the following formula:

$$Q_L = (X - L) / S_n$$

Where: L = specification lower tolerance limit

Estimate the percentage of material within limits (PWL) by entering Table 1 with Q_L, using the column appropriate to the total number (n) of measurements. If the value of Q_L falls between values shown on the table, use the next higher value of PWL.

g. For double-sided specification limits (that is, L and U), compute the Quality Indexes Q_L and Q_U by use of the following formulas:

$$\mathbf{Q_L = (X - L) / S_n}$$
and
$$\mathbf{Q_U = (U - X) / S_n}$$

Where: L and U = specification lower and upper tolerance limits

Estimate the percentage of material between the lower (L) and upper (U) tolerance limits (PWL) by entering Table 1 separately with Q_L and Q_U, using the column appropriate to the total number (n) of measurements, and determining the percent of material above P_L and percent of material below P_U for each tolerance limit. If the values of Q_L fall between values shown on the table, use the next higher value of P_L or P_U. Determine the PWL by use of the following formula:

$$\mathbf{PWL = (P_U + P_L) - 100}$$

Where: P_L = percent within lower specification limit
P_U = percent within upper specification limit

EXAMPLE OF PWL CALCULATION

Project: Example Project

Test Item: Item P-401, Lot A.

A. PWL Determination for Mat Density.

1. Density of four random cores taken from Lot A.

A-1 = 96.60
A-2 = 97.55
A-3 = 99.30
A-4 = 98.35
n = 4

2. Calculate average density for the lot.

$X = (x_1 + x_2 + x_3 + . . . x_n) / n$
X = (96.60 + 97.55 + 99.30 + 98.35) / 4
X = 97.95% density

3. Calculate the standard deviation for the lot.

$S_n = \mathbf{[}((96.60 - 97.95)^2 + (97.55 - 97.95)^2 + (99.30 - 97.95)^2 + (98.35 - 97.95)^2)) / (4 - 1)\mathbf{]}^{1/2}$
$S_n = \mathbf{[}(1.82 + 0.16 + 1.82 + 0.16) / 3\mathbf{]}^{1/2}$
$S_n = 1.15$

4. Calculate the Lower Quality Index Q_L for the lot. (L=96.3)

$Q_L = (X - L) / S_n$
$Q_L = (97.95 - 96.30) / 1.15$
$Q_L = 1.4348$

5. Determine PWL by entering Table 1 with Q_L= 1.44 and n= 4.

PWL = 98

B. PWL Determination for Air Voids.

1. Air Voids of four random samples taken from Lot A.

A-1 = 5.00

A-2 = 3.74

A-3 = 2.30

A-4 = 3.25

2. Calculate the average air voids for the lot.

$X = (x_1 + x_2 + x_3 \ldots n) / n$

$X = (5.00 + 3.74 + 2.30 + 3.25) / 4$

$X = 3.57\%$

3. Calculate the standard deviation S_n for the lot.

$S_n = [((3.57 - 5.00)^2 + (3.57 - 3.74)^2 + (3.57 - 2.30)^2 + (3.57 - 3.25)^2) / (4 - 1)]^{1/2}$

$S_n = [(2.04 + 0.03 + 1.62 + 0.10) / 3]^{1/2}$

$S_n = 1.12$

4. Calculate the Lower Quality Index Q_L for the lot. (L= 2.0)

$Q_L = (X - L) / S_n$

$Q_L = (3.57 - 2.00) / 1.12$

$Q_L = 1.3992$

5. Determine P_L by entering Table 1 with $Q_L = 1.41$ and n = 4.

$P_L = 97$

6. Calculate the Upper Quality Index Q_U for the lot. (U= 5.0)

$Q_U = (U - X) / S_n$

$Q_U = (5.00 - 3.57) / 1.12$

$Q_U = 1.2702$

7. Determine P_U by entering Table 1 with $Q_U = 1.29$ and n = 4.

$P_U = 93$

8. Calculate Air Voids PWL

$PWL = (P_L + P_U) - 100$

$PWL = (97 + 93) - 100 = 90$

EXAMPLE OF OUTLIER CALCULATION (REFERENCE ASTM E178)

Project: Example Project

Test Item: Item P-401, Lot A.

A. Outlier Determination for Mat Density.

1. Density of four random cores taken from Lot A arranged in descending order.

A-3 = 99.30

A-4 = 98.35

A-2 = 97.55

A-1 = 96.60

2. From ASTM E178, Table 1, for n=4 an upper 5% significance level, the critical value for test criterion = 1.463.

3. Use average density, standard deviation, and test criterion value to evaluate density measurements.

a. For measurements greater than the average:

If (measurement - average)/(standard deviation) is less than test criterion,

then the measurement is not considered an outlier

For A-3, check if (99.30 - 97.95) / 1.15 is greater than 1.463.

Since 1.174 is less than 1.463, the value is not an outlier.

b. For measurements less than the average:

If (average - measurement)/(standard deviation) is less than test criterion, then the measurement is not considered an outlier.

For A-1, check if (97.95 - 96.60) / 1.15 is greater than 1.463.

Since 1.435 is less than 1.463, the value is not an outlier.

Note: In this example, a measurement would be considered an outlier if the density were:

Greater than (97.95 + 1.463 × 1.15) = 99.63%

OR

less than (97.95 - 1.463 × 1.15) = 96.27%.

Table 1. Table for Estimating Percent of Lot Within Limits (PWL)

Percent Within Limits (P_L and P_U)	Positive Values of Q (Q_L and Q_U)							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
99	1.1541	1.4700	1.6714	1.8008	1.8888	1.9520	1.9994	2.0362
98	1.1524	1.4400	1.6016	1.6982	1.7612	1.8053	1.8379	1.8630
97	1.1496	1.4100	1.5427	1.6181	1.6661	1.6993	1.7235	1.7420
96	1.1456	1.3800	1.4897	1.5497	1.5871	1.6127	1.6313	1.6454
95	1.1405	1.3500	1.4407	1.4887	1.5181	1.5381	1.5525	1.5635
94	1.1342	1.3200	1.3946	1.4329	1.4561	1.4717	1.4829	1.4914
93	1.1269	1.2900	1.3508	1.3810	1.3991	1.4112	1.4199	1.4265
92	1.1184	1.2600	1.3088	1.3323	1.3461	1.3554	1.3620	1.3670
91	1.1089	1.2300	1.2683	1.2860	1.2964	1.3032	1.3081	1.3118
90	1.0982	1.2000	1.2290	1.2419	1.2492	1.2541	1.2576	1.2602
89	1.0864	1.1700	1.1909	1.1995	1.2043	1.2075	1.2098	1.2115
88	1.0736	1.1400	1.1537	1.1587	1.1613	1.1630	1.1643	1.1653
87	1.0597	1.1100	1.1173	1.1192	1.1199	1.1204	1.1208	1.1212
86	1.0448	1.0800	1.0817	1.0808	1.0800	1.0794	1.0791	1.0789
85	1.0288	1.0500	1.0467	1.0435	1.0413	1.0399	1.0389	1.0382
84	1.0119	1.0200	1.0124	1.0071	1.0037	1.0015	1.0000	0.9990
83	0.9939	0.9900	0.9785	0.9715	0.9671	0.9643	0.9624	0.9610
82	0.9749	0.9600	0.9452	0.9367	0.9315	0.9281	0.9258	0.9241
81	0.9550	0.9300	0.9123	0.9025	0.8966	0.8928	0.8901	0.8882
80	0.9342	0.9000	0.8799	0.8690	0.8625	0.8583	0.8554	0.8533
79	0.9124	0.8700	0.8478	0.8360	0.8291	0.8245	0.8214	0.8192
78	0.8897	0.8400	0.8160	0.8036	0.7962	0.7915	0.7882	0.7858
77	0.8662	0.8100	0.7846	0.7716	0.7640	0.7590	0.7556	0.7531
76	0.8417	0.7800	0.7535	0.7401	0.7322	0.7271	0.7236	0.7211
75	0.8165	0.7500	0.7226	0.7089	0.7009	0.6958	0.6922	0.6896
74	0.7904	0.7200	0.6921	0.6781	0.6701	0.6649	0.6613	0.6587
73	0.7636	0.6900	0.6617	0.6477	0.6396	0.6344	0.6308	0.6282
72	0.7360	0.6600	0.6316	0.6176	0.6095	0.6044	0.6008	0.5982
71	0.7077	0.6300	0.6016	0.5878	0.5798	0.5747	0.5712	0.5686
70	0.6787	0.6000	0.5719	0.5582	0.5504	0.5454	0.5419	0.5394
69	0.6490	0.5700	0.5423	0.5290	0.5213	0.5164	0.5130	0.5105
68	0.6187	0.5400	0.5129	0.4999	0.4924	0.4877	0.4844	0.4820
67	0.5878	0.5100	0.4836	0.4710	0.4638	0.4592	0.4560	0.4537
66	0.5563	0.4800	0.4545	0.4424	0.4355	0.4310	0.4280	0.4257
65	0.5242	0.4500	0.4255	0.4139	0.4073	0.4030	0.4001	0.3980
64	0.4916	0.4200	0.3967	0.3856	0.3793	0.3753	0.3725	0.3705
63	0.4586	0.3900	0.3679	0.3575	0.3515	0.3477	0.3451	0.3432
62	0.4251	0.3600	0.3392	0.3295	0.3239	0.3203	0.3179	0.3161
61	0.3911	0.3300	0.3107	0.3016	0.2964	0.2931	0.2908	0.2892
60	0.3568	0.3000	0.2822	0.2738	0.2691	0.2660	0.2639	0.2624
59	0.3222	0.2700	0.2537	0.2461	0.2418	0.2391	0.2372	0.2358
58	0.2872	0.2400	0.2254	0.2186	0.2147	0.2122	0.2105	0.2093
57	0.2519	0.2100	0.1971	0.1911	0.1877	0.1855	0.1840	0.1829
56	0.2164	0.1800	0.1688	0.1636	0.1607	0.1588	0.1575	0.1566
55	0.1806	0.1500	0.1406	0.1363	0.1338	0.1322	0.1312	0.1304
54	0.1447	0.1200	0.1125	0.1090	0.1070	0.1057	0.1049	0.1042
53	0.1087	0.0900	0.0843	0.0817	0.0802	0.0793	0.0786	0.0781
52	0.0725	0.0600	0.0562	0.0544	0.0534	0.0528	0.0524	0.0521
51	0.0363	0.0300	0.0281	0.0272	0.0267	0.0264	0.0262	0.0260
50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Percent Within Limits (P_L and P_U)	Negative Values of Q (Q_L and Q_U)							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
49	-0.0363	-0.0300	-0.0281	-0.0272	-0.0267	-0.0264	-0.0262	-0.0260
48	-0.0725	-0.0600	-0.0562	-0.0544	-0.0534	-0.0528	-0.0524	-0.0521
47	-0.1087	-0.0900	-0.0843	-0.0817	-0.0802	-0.0793	-0.0786	-0.0781
46	-0.1447	-0.1200	-0.1125	-0.1090	-0.1070	-0.1057	-0.1049	-0.1042
45	-0.1806	-0.1500	-0.1406	-0.1363	-0.1338	-0.1322	-0.1312	-0.1304
44	-0.2164	-0.1800	-0.1688	-0.1636	-0.1607	-0.1588	-0.1575	-0.1566
43	-0.2519	-0.2100	-0.1971	-0.1911	-0.1877	-0.1855	-0.1840	-0.1829
42	-0.2872	-0.2400	-0.2254	-0.2186	-0.2147	-0.2122	-0.2105	-0.2093
41	-0.3222	-0.2700	-0.2537	-0.2461	-0.2418	-0.2391	-0.2372	-0.2358
40	-0.3568	-0.3000	-0.2822	-0.2738	-0.2691	-0.2660	-0.2639	-0.2624
39	-0.3911	-0.3300	-0.3107	-0.3016	-0.2964	-0.2931	-0.2908	-0.2892
38	-0.4251	-0.3600	-0.3392	-0.3295	-0.3239	-0.3203	-0.3179	-0.3161
37	-0.4586	-0.3900	-0.3679	-0.3575	-0.3515	-0.3477	-0.3451	-0.3432
36	-0.4916	-0.4200	-0.3967	-0.3856	-0.3793	-0.3753	-0.3725	-0.3705
35	-0.5242	-0.4500	-0.4255	-0.4139	-0.4073	-0.4030	-0.4001	-0.3980
34	-0.5563	-0.4800	-0.4545	-0.4424	-0.4355	-0.4310	-0.4280	-0.4257
33	-0.5878	-0.5100	-0.4836	-0.4710	-0.4638	-0.4592	-0.4560	-0.4537
32	-0.6187	-0.5400	-0.5129	-0.4999	-0.4924	-0.4877	-0.4844	-0.4820
31	-0.6490	-0.5700	-0.5423	-0.5290	-0.5213	-0.5164	-0.5130	-0.5105
30	-0.6787	-0.6000	-0.5719	-0.5582	-0.5504	-0.5454	-0.5419	-0.5394
29	-0.7077	-0.6300	-0.6016	-0.5878	-0.5798	-0.5747	-0.5712	-0.5686
28	-0.7360	-0.6600	-0.6316	-0.6176	-0.6095	-0.6044	-0.6008	-0.5982
27	-0.7636	-0.6900	-0.6617	-0.6477	-0.6396	-0.6344	-0.6308	-0.6282
26	-0.7904	-0.7200	-0.6921	-0.6781	-0.6701	-0.6649	-0.6613	-0.6587
25	-0.8165	-0.7500	-0.7226	-0.7089	-0.7009	-0.6958	-0.6922	-0.6896
24	-0.8417	-0.7800	-0.7535	-0.7401	-0.7322	-0.7271	-0.7236	-0.7211
23	-0.8662	-0.8100	-0.7846	-0.7716	-0.7640	-0.7590	-0.7556	-0.7531
22	-0.8897	-0.8400	-0.8160	-0.8036	-0.7962	-0.7915	-0.7882	-0.7858
21	-0.9124	-0.8700	-0.8478	-0.8360	-0.8291	-0.8245	-0.8214	-0.8192
20	-0.9342	-0.9000	-0.8799	-0.8690	-0.8625	-0.8583	-0.8554	-0.8533
19	-0.9550	-0.9300	-0.9123	-0.9025	-0.8966	-0.8928	-0.8901	-0.8882
18	-0.9749	-0.9600	-0.9452	-0.9367	-0.9315	-0.9281	-0.9258	-0.9241
17	-0.9939	-0.9900	-0.9785	-0.9715	-0.9671	-0.9643	-0.9624	-0.9610
16	-1.0119	-1.0200	-1.0124	-1.0071	-1.0037	-1.0015	-1.0000	-0.9990
15	-1.0288	-1.0500	-1.0467	-1.0435	-1.0413	-1.0399	-1.0389	-1.0382
14	-1.0448	-1.0800	-1.0817	-1.0808	-1.0800	-1.0794	-1.0791	-1.0789
13	-1.0597	-1.1100	-1.1173	-1.1192	-1.1199	-1.1204	-1.1208	-1.1212
12	-1.0736	-1.1400	-1.1537	-1.1587	-1.1613	-1.1630	-1.1643	-1.1653
11	-1.0864	-1.1700	-1.1909	-1.1995	-1.2043	-1.2075	-1.2098	-1.2115
10	-1.0982	-1.2000	-1.2290	-1.2419	-1.2492	-1.2541	-1.2576	-1.2602
9	-1.1089	-1.2300	-1.2683	-1.2860	-1.2964	-1.3032	-1.3081	-1.3118
8	-1.1184	-1.2600	-1.3088	-1.3323	-1.3461	-1.3554	-1.3620	-1.3670
7	-1.1269	-1.2900	-1.3508	-1.3810	-1.3991	-1.4112	-1.4199	-1.4265
6	-1.1342	-1.3200	-1.3946	-1.4329	-1.4561	-1.4717	-1.4829	-1.4914
5	-1.1405	-1.3500	-1.4407	-1.4887	-1.5181	-1.5381	-1.5525	-1.5635
4	-1.1456	-1.3800	-1.4897	-1.5497	-1.5871	-1.6127	-1.6313	-1.6454
3	-1.1496	-1.4100	-1.5427	-1.6181	-1.6661	-1.6993	-1.7235	-1.7420
2	-1.1524	-1.4400	-1.6016	-1.6982	-1.7612	-1.8053	-1.8379	-1.8630
1	-1.1541	-1.4700	-1.6714	-1.8008	-1.8888	-1.9520	-1.9994	-2.0362

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM E178 Standard Practice for Dealing with Outlying Observations

END OF SPECIFICATION C110

Part 3 – Sitework

Specification P101 - Surface Preparation

101.1 Description

(1) This work shall consist of preparation of existing pavement surfaces for overlay, surface treatments, removal of existing pavement, and other miscellaneous items of work. The work shall be accomplished in accordance with these specifications, the Special Provisions, and the applicable drawings.

101.2 Equipment

(1) Equipment shall be suitable and adapted to complete the Work satisfactorily, and shall not cause damage to pavement or facilities intended to remain in place.

101.3 Construction

101.3.1 Existing Pavement Removal

(1) The Contractor's removal operation shall be controlled to not damage adjacent pavement structure, and base material, cables, utility ducts, pipelines, or drainage structures which are to remain under the pavement.

101.3.1.1 PCC Pavement

(1) Existing Portland Concrete Cement (PCC) pavement to be removed shall be freed from the pavement to remain by sawing through the full depth of the slab along the perimeter of the final removal limits. Pavement shall be carefully broken up and removed (full depth) using equipment which will not cause distress in the pavement which is to remain in place. If the removal limits are located on a joint, Contractor shall saw through the dowels at the joint, remove the pavement and install new dowels equal to the existing or as detailed on the Plan. Where the perimeter of the removal limits is not located on the joint and there are no dowels present, then the perimeter shall be saw cut the full depth of the pavement. The pavement inside the saw cut shall be removed by methods which will not cause distress in the pavement which is to remain in place. If the Plans or Special Provisions allow disposal of material on the airport site, it shall be reduced to a maximum size of six inches or as shown on the Plans. The Contractor's removal operation shall not cause damage to adjacent pavement which is to remain, to cables, utility ducts, pipelines, or drainage structures located under the pavement. Concrete slabs intended to remain in-place, which are damaged by breaking, shall be repaired or removed and replaced as directed by Engineer. Damage shall be repaired at the Contractor's expense.

101.3.1.2 Asphalt Concrete Pavement Removal

(1) Asphalt concrete pavement to be removed shall be saw cut to the full depth of the asphalt concrete pavement around the perimeter of the area to be removed. If the Plans or Special Provisions provide for disposal on the airport site, the pavement shall be broken to a maximum size of two inches.

101.3.2 Preparation of Joints and Cracks

(1) Remove all vegetation and debris from cracks to a minimum depth of one inch. If extensive vegetation exists and chemical treatment is required on the Plans or in the Special Provisions, treat the specific area with a concentrated solution of a water-based herbicide. Fill all cracks, ignoring hairline cracks (less than ¼-inch wide) with a crack sealant per ASTM D6690. Wider cracks (over 1-1/2-inch wide), along with soft or sunken spots, indicate that the pavement or the pavement base should be repaired. Excess joint or crack sealer on the surface of the pavement shall also be removed from the pavement surface.

101.3.3 Removal of Paint and Rubber

(1) Paint and rubber over one-foot wide that will affect the bond of the new overlay or seal-coat shall be removed from the surface of the existing pavement. High-pressure water (less than 10,000 psi), heater scarifier (asphaltic concrete only), cold milling, rotary grinding, or sandblasting may be used. Do not cause major damage to the pavement. Major damage is defined as changing the properties of the pavement or removing pavement over 1/8 inch deep. Removal methods and waste disposal must comply with the federal, state, and local environmental protection regulations. No material shall be deposited on the runway shoulders. All wastes shall be disposed of in areas shown on the Plans; or if not shown on Plans at a location provided by the Contractor.

101.3.4 PCC Spall or Failed Asphaltic Concrete Pavement Repair

(1) Repair PCC spalls in areas to be overlaid with asphalt. Contractor shall repair all spalled PCC concrete as shown on the Plans. The perimeter of the repair shall be saw cut a minimum of 2-inches outside the affected area and 2 inches deep. The deteriorated material shall be removed to a depth where the existing material is firm or cannot be easily removed with a hardened-steel pick weighing at least 24 ounces. The removed area shall be filled with asphaltic concrete meeting the specification for the

HMA overlay, except the aggregate size shall be appropriate for the depth of the removal. The material shall be compacted until the material is dense and no movement or marks are visible. The material shall not be placed in lifts over four inches in depth. This method of repair applies only to pavement to be overlaid.

(2) Asphaltic concrete pavement repair. The failed areas shall be removed as specified in 101.3.1.2. All failed material including surface, base course, subbase course, and subgrade shall be removed. The base course and subbase shall be replaced if it has been infiltrated with clay, silt, or other material affecting the load-bearing capacity. Materials and methods of construction shall comply with the other applicable specifications for subbase, base, and surface course.

101.3.5 Cold Milling

(1) Milling shall be performed with a power-operated milling machine or grinder, capable of producing a finished surface that provides a good bond to the new overlay. The milling machine or grinder shall operate without tearing or gouging the under laying surface. The milling machine or grinder shall be equipped with automatic grade and slope controls. The tolerances shall be maintained within +0 inch and -1/4 inch of the specified grade. All millings shall be removed and disposed of off Airport property, unless otherwise specified. If the Contractor mills or grinds deeper or wider than the Plans specify, the Contractor shall replace the material that was removed with new material at no additional cost to the Owner. Contractor shall provide milling equipment that does not damage the existing pavements or the pavement remaining after milling is completed. Contractor shall repair pavement damaged at Contractor's expense.

(2) Cold milling for patching shall be completed for areas shown on the Plans. The milling machine shall be capable of cutting a vertical edge without chipping or spalling the edges of the remaining pavement and it shall have a positive method of controlling the depth of cut. The tolerances shall be maintained within +0 inch and -1/4 inch of the specified grade. The Engineer shall layout the area to be milled with a straightedge in increments of one foot widths. The area to be milled shall cover only the failed area. Excessive area that is milled because the Contractor doesn't have the appropriate milling machine, or areas that are damaged because of his negligence, shall not be included in the measurement for payment.

(3) Cold milling for profiling, grade correction, or surface correction shall be completed at locations and according to the requirements shown on the Plans. The milling machine shall be equipped with electronic grade control devices that will cut the surface to the grade and tolerances specified. The machine shall cut vertical edges. A positive method of dust control shall be provided. The machine shall have the ability to remove the millings or cuttings from the pavement and load them into a truck.

(4) Contractor shall sweep the milled surface daily and immediately after the milling until all residual aggregate and fines are removed from the pavement surface. Prior to paving, the Contractor shall wet down the milled pavement and thoroughly sweep the surface to remove remaining aggregate and fines.

101.3.6 Preparation of Asphalt Pavement Surfaces

(1) Existing asphalt pavements indicated to be treated with a surface treatment shall be prepared as follows:

Patch asphalt pavement surfaces that have been softened by petroleum derivatives or have failed. Remove damaged pavement to the full depth of the damage and replace with new asphalt concrete similar to that of the existing pavement in accordance with 101.3.4.

(2) Repair joints and cracks in accordance with 101.3.2.

(3) Remove oil or grease that has not penetrated the asphalt pavement by scraping or by scrubbing with a detergent, then wash thoroughly with clean water. After cleaning, treat these areas with an oil spot primer.

(4) Clean pavement surface immediately prior to placing the surface treatment by sweeping, flushing well with water leaving no standing water, or a combination of both, so that it is free of dust, dirt, grease, vegetation, oil or other types of objectionable surface film.

101.3.7 Maintenance

(1) Contractor shall perform all maintenance work necessary to keep the pavement in a satisfactory condition until the full section is complete and accepted by the Engineer. The surface shall be kept clean and free from foreign material. The pavement shall be properly drained at all times. If additional cleaning is necessary or if the pavement becomes disturbed, perform tasks required to provide a surface suitable for finishing at the Contractor's expense.

101.3.8 Preparation of Joints in Rigid Pavement

(1) Pavement joints for application of sealing material should be dry, clean of all scale, dirt, dust, old sealant, curing compound, and other foreign matter. Contractor shall demonstrate, in the presence of the Engineer that the method used effectively cleans the joint and does not damage the joint.

101.3.8.1 Removal of Existing Joint Sealant

(1) All existing joint sealants will be removed by plowing or use of hand tools. Remove remaining sealant and or debris by use of wire brushes or other tools as necessary. Re-saw joints removing no more than 1/16 inch from each joint face. Immediately after sawing, flush out joint with water and other tools as necessary to completely remove the slurry. Allow sufficient time to dry out joints prior to sealing.

101.3.8.2 Cleaning Prior to Sealing

(1) Immediately before sealing, joints shall be cleaned by removing remaining laitance and other foreign material. Joint surfaces will be surface-dry prior to installation of sealant.

101.3.9 Preparation of Cracks in Flexible Pavement

(1) Pavement joints for application of sealing material should be dry, clean of all scale, dirt, dust, old sealant, and other foreign matter. Contractor shall demonstrate, in the presence of the Engineer, that the method used effectively cleans the joint and does not damage the joint.

101.3.9.1 Preparation of Crack

(1) Widen crack with router or random crack saw by removing a minimum of 1/16 inch from each side of crack. Immediately before sealing, joints will be blown out with a hot air lance combined with oil and water-free compressed air.

101.3.9.2 Removal of Existing Sealant

(1) Existing sealants will be removed by routing or random crack saw. Following routing or sawing remaining debris will be removed by use of a hot lance combined with oil and water-free compressed air.

101.4 Measurement

101.4.1 Pavement Removal

(1) The unit of measurement for pavement removal shall be the number of square yards removed by the Contractor. Pavement removed outside the limits of removal because the pavement was damaged by negligence on the part of the Contractor shall not be included in the measurement for payment.

101.4.2 Paint and Rubber Removal.

(1) The unit of measurement for paint and rubber removal shall be the square feet.

101.4.3 Spalled PCC and Failed Asphaltic Concrete Pavement Repair

(1) The unit of measure for PCC spall repair shall be the number of square feet.

(2) The unit of measure for failed asphaltic concrete pavement shall be square feet.

101.4.4 Cold Milling

(1) The unit of measure for cold milling shall be square yard.

101.5 Payment

101.5.1 General

(1) Payment shall be made at Contract unit price for the unit of measurement as previously specified. This price shall be full compensation for furnishing all materials and for all preparation, sawing, removing, disposal, hauling, furnishing and installing dowels as required, and placing of the material; and for all labor, equipment, tools, and incidentals necessary to complete this Work

(2) Measurement and payment will only be made for Pay Items included in the Schedule of Prices. The cost for all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

101.5.2 Pay Items

(1) Standard Pay Items for Work covered by this Specification are as follows:

Pay Item	Description	Unit
P101.010	Bituminous Pavement Removal	Square yard (SY)
P101.020	PCC Pavement Removal	Square yard (SY)
P101.040	Paint and Rubber Removal	Square Feet (SF)
P101.050	PCC Spall Repair	Square Feet (SF)
P101.052	Asphaltic Pavement Repair	Square Feet (SF)
P101.060	Cold Milling for Patching	Square Yard (SY)

P101.620	Cold Milling for Surface Correction	Square Yard (SY)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D6690 Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

END OF SPECIFICATION P101

Specification P151 - Clearing and Grubbing

151.1 Description

(1) This Work shall consist of clearing, clearing and grubbing, clearing for isolated trees, or topping trees including disposal of materials, for all locations designated on the Plans.

(2) Clearing shall consist of the cutting and removal of all trees, uprooted stumps, brush, logs, hedges, the removal of debris and other loose or projecting material from the designated areas. Grubbing stumps and roots, which were not previously uprooted, will not be required.

(3) Clearing for isolated trees shall consist of the cutting and removal of isolated single trees. Cutting of all the trees of this classification shall be in accordance with the requirements for the particular area being cleared, as shown on the Plans, or as specified in the Special Provisions. Clearing for isolated trees shall include grubbing stumps and roots unless specified otherwise on the Plans.

(4) Clearing and grubbing shall consist of clearing the surface of the ground of the designated areas of all trees, stumps, down timber, logs, snags, brush, undergrowth, hedges, heavy growth of grass or weeds, debris, and rubbish of any nature, natural obstructions or such material which in the opinion of the Engineer is unsuitable for the foundation of strips, pavements, or other required structures, including the grubbing of stumps, roots, matted roots, and the disposal from the project of all spoil materials resulting from clearing and grubbing. Removing fences, structures, and foundation shown within the clearing and grubbing limits and designated on the Plans shall also be included, except when separate Pay Items are included in the Schedule of Prices for those items of Work. Disposal shall be in accordance with 151.3.1.

(5) Topping shall consist of removal of a specified portion of the top of designated trees and disposal of removed material.

151.2 (Vacant)

151.3 Construction

151.3.1 General

(1) The areas denoted on the Plans to be cleared or cleared and grubbed shall be staked by the Engineer. The clearing and grubbing shall be done at a satisfactory distance in advance of the grading operations.

(2) Dispose of spoil materials removed by clearing, topping or by clearing and grubbing shall be disposed of outside the Airport's limits at a location provided by Contractor, or on the airport if a location is designated on the Plans. When burning of material is permitted, it shall be burned under constant observation by a watchman to assure the surrounding vegetation and other adjacent property is not jeopardized. Burning shall be done in accordance with all applicable Federal, state and local laws, ordinances, and regulations. Contractor shall notify the agency having jurisdiction and obtain all approvals in writing before starting burning operations. For disposal by open burning, burn within the clearing limits when and in a manner that does not harm trees or shrubs to remain in place, create a nuisance, pose a hazard to traffic, or damage public or private property. Take care to avoid burning poison oak, poison ivy, poison sumac or other materials posing a health hazard when burned. Obtain burning permits required under local and state fire protection regulations and provide copies to the Engineer before burning. Comply with WDNR rule NR 429 regulating open burning which prohibits open burning in the Southeast Wisconsin Intrastate Air Quality Control Region (Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington, and Waukesha counties). Do not use oily substances or other materials prohibited under NR 429 to start or maintain fires. Burning shall comply with 70.13.3 and NR 429.

http://docs.legis.wisconsin.gov/code/admin_code/nr/400/429.pdf

(3) The manner and location of disposal of materials shall be subject to the approval of the Engineer and shall not create an unsightly or objectionable view. When the Contractor is required to locate a disposal area outside the airport property limits, the Contractor shall obtain and file with the Engineer permission in writing from the property owner for the use of private property for this purpose.

(4) Blasting or the use of explosives shall not be allowed.

(5) When indicated on the Plans or in the Special Provisions, Contractor may bury spoil material or debris from open burning at approved locations on the Airport. Cover buried material with a minimum of one foot of earth and grade the surface to the previously existing elevations or to the proposed finish elevations.

(6) All cut surfaces and abrasions sustained by healthy oak trees and saplings between April 11th and September 30th as a result of the Contractor's operations shall be painted promptly and completely with asphalt base tree paint. The cut surfaces of the stumps of all healthy oak trees and saplings, whether they are to remain in place or to be grubbed shall likewise be painted.

(7) If the Plans or the Specifications require saving merchantable timber, trim the limbs and tops from designated trees, saw them into suitable lengths, and make the material available for removal by other agencies.

(8) Unless otherwise specifically provided in the Contract, all timber salvaged from the required clearing of designated areas and from clearing of trees acquired by and for the Sponsor in the acquisition of easements, shall become the property of the Contractor. Such timber may be disposed of by the Contractor off the Airport at locations provided by Contractor.

(9) Private owners holding underlying title to lands acquired or reserved for Airport purposes by easement or by use shall have a prior right to all timber from trees standing or lying thereon, except timber from trees that have been acquired by the Sponsor in the acquisition of the property interests. The Contractor shall make his own negotiations with property owners relative to disposal of trees cut on their land. Such trees or portions thereof claimed by the owners shall be removed from the property and disposed of in a manner which will not cause an unsightly appearance.

(10) For disposal by mechanical chipping, recover all material as it leaves the chipping machine. Stockpile and dispose of this material as specified on Plans, or if not shown on Plans at a location provided by Contractor.

(11) Obtain written permits for this disposal from the owner of the property where placing the material, unless disposing of this material at a licensed waste disposal operation. Provide copies of permits to the Engineer before disposal begins.

(12) Chip, burn, or bury under not less than one foot of earth all elm wood consisting of trees, logs, stumps, stubs, branches, or windfalls with adhering bark, and all elm bark and debris within clearing and grubbing limits or resulting from clearing and grubbing operations.

(13) Debark all elm logs salvaged, and all elm wood or stumps not disposed of by chipping, burning, or burying; and chip, burn, or bury the bark. For clearing and grubbing operations performed between April 1st and September 30th, perform final disposal of elm wood, bark, or debris within 30 days. For clearing and grubbing operations performed between October 1st and March 31st, perform final disposal of elm wood, bark, or debris before the succeeding May 1st.

(14) Dispose of all clearing and grubbing debris before proceeding with grading operations. If the Contractor intends to burn debris but cannot secure burning permits on schedule, do not delay removing clearing debris from areas affected by other operations. Do not create a safety hazard or stockpile an excessive quantity of material. While waiting to secure burning permits, pile clearing and grubbing debris beyond the limits affected by other work. Do not leave elm debris beyond the 30-day limitation previously specified.

151.3.2 Offsite Work

(1) Do not enter on any parcel or land not owned by the Airport Sponsor, to start Work, until receiving a written order from the Engineer that the land owner has been made aware of the expected date of commencement of the Work. Contractor shall keep his work forces informed of conditions or special considerations affecting offsite work, including, but not limited to: disposition of timber, wood, salvaged or waste materials, and the site restoration requirements.

(2) Neither the Contractor nor his subcontractors shall enter into agreements with land owners to change the conditions of the Contract without written approval of the Engineer.

151.3.3 Environmental Considerations

(1) Manage clearing or clearing and grubbing operations to minimize possible disturbance or pollution to the natural or manmade environment. Protect water sources and drainage courses against infiltration of soil, silt, debris, ashes, fuels, chemicals or other foreign matter. Avoid unnecessary destruction of wildlife and wildlife habitat.

(2) Notwithstanding other provisions regarding burning, comply with requirements of the Department of Natural Resources Air Pollution Control Rules, which prohibit the open burning of weeds, brush, logs, limbs, stumps, roots, lumber and debris from clearing and grubbing or from demolition in the Southeast Wisconsin Intrastate Air Quality Control Region, which includes the counties of Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington and Waukesha, or in other regions where such burning may be prohibited.

(3) Do not burn timber and debris until the Contractor has obtained a burning permit from the appropriate local authorities. Burning shall conform to the conditions of the burning permit. Control burning in a manner producing the least smoke or air pollutants. Do not create a hazard for operation of aircraft.

(4) Comply with regulatory requirements and permit conditions and restrictions on the timing and methods of clearing and grubbing and disposal of materials under this Specification. Comply with conditions included in the Special Provisions or indicated on the Plans. Utilize means and methods to minimize disturbance to environmental sensitive areas.

151.3.4 Clearing

(1) Contractor shall clear the staked or indicated area of all objectionable materials. Trees unavoidably falling outside the specified clearing limits must be cut up, removed, and disposed of in a satisfactory manner. To minimize damage to trees that are to be left standing, trees shall be felled toward the center of the area being cleared. Contractor shall preserve and protect from injury all trees not to be removed. The trees, stumps, and brush shall be cut flush with the original ground surface. The grubbing of stumps and roots will not be required.

151.3.5 Clearing and Grubbing

(1) In areas designated to be cleared and grubbed, all stumps, roots, buried logs, brush, grass, and other unsatisfactory materials shall be removed, except where embankments exceeding 3-1/2 feet in depth will be constructed outside of paved areas. Tap roots and other projections over 1-1/2 inches in diameter shall be grubbed out to a depth of at least 18 inches below the finished subgrade or slope elevation.

(2) All holes under embankment areas remaining after the grubbing operation shall have the sides of the holes flattened to facilitate filling with acceptable material and compacted as required in P152. The same procedure shall be applied to all holes remaining after grubbing in areas where the depth of holes exceeds the depth of the proposed excavation.

151.3.6 Topping

(1) Complete topping for trees designated on the Plans. Remove tree trunk and branches to a horizontal plane at a specified elevation or a specified distance below the top of the tree. Perform topping in accordance with accepted horticultural practices in a manner that will not damage portions of the tree intended to remain in place. Treat cut surfaces on oak trees in the manner previously specified. Dispose of removed material at a location off the Airport provided by Contractor.

151.4 Measurement

151.4.1 Clearing, or Clearing and Grubbing

(1) Quantities of clearing, or clearing and grubbing within the limits shown on the Plans shall be the number of acres or fractions thereof, of land specifically cleared, or cleared and grubbed. Areas identified and delineated on the Plans to be cleared, or cleared and grubbed per lump sum shall be measured as a complete unit for each area designated.

151.4.2 Clear Isolated Trees

(1) Isolated trees identified on the Plans to be removed shall be measured as a complete unit per each. Isolated trees designated for removal shall be categorized by diameter, according to the schedule of sizes as follows:

a. Less than two feet, butt diameter
b. From two to four feet, butt diameter
c. Greater than four feet, butt diameter

(2) Determine butt diameter by measuring the circumference four feet above existing ground level and dividing by 3.14. Round values for diameter to the nearest 1/10 of a foot.

151.4.3 Topping Trees

(1) Topping Trees shall be measured on a unit basis for each tree designated on the Plans to be topped.

151.5 Payment

151.5.1 General

(2) Payment for Clearing and Clearing and Grubbing items shall be full compensation for the following:

a. All clearing and all grubbing required under this section and performed at locations indicated on the Plans.
b. Handling, hauling, piling, burning, burying, trimming, chipping, wound treatment, re-handling, and disposing of wood material, waste, and debris.
c. Excavations made to bury clearing and grubbing material, backfilling these excavations, and disposing of excess excavated material.

d. Filling holes and excavations resulting from clearing and grubbing operations. Salvaging topsoil from adjacent areas and spreading and leveling the area disturbed by clearing and grubbing operations.

e. All costs for disposal off-site, including restoration, seeding, and erosion control shall be paid by Contractor.

f. Erosion control items and seeding, if required on the Airport site, will be paid under Pay Items contained in the Schedule of Prices; unless there are no separate Pay Items for erosion control work, then that work shall be incidental and the cost included in the price for Clearing or Clearing and Grubbing.

151.5.2 Clearing

(1) Payment shall be made at Contract price per lump sum for a designated area, or at the Contract unit price per acre for Clearing. This price shall be full compensation for furnishing all materials, removal and disposal and for all labor, equipment, tools, and incidentals necessary to complete the Work.

151.5.3 Clearing Isolated Trees and Topping Trees.

(1) Payment shall be made at the Contract unit price per each for Clearing Isolated Trees or for Topping Trees. This price shall be full compensation for furnishing all materials, removal, disposal, and for all labor, equipment, tools, and incidentals necessary to complete the Work.

151.5.4 Clearing and Grubbing.

(1) Payment shall be made at the Contract unit price per acre, or at the Contract lump sum price for a designated area for Clearing and Grubbing. This price shall be full compensation for furnishing all materials, removal and disposal and for all labor, equipment, tools, and incidentals necessary to complete the Work.

151.5.5 Pay Items

(1) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

(2) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P151.010	Clearing	Acre
P151.020 through P151.029	Clearing Area No. (location)	Lump Sum (LS)
P151.030	Clearing and Grubbing	Acre
P151.040 through P151.049	Clearing and Grubbing for Area No.(location)	Lump Sum (LS)
P151.050	Clearing Isolated trees, less than 2 feet diameter	Each (EA)
P151.051	Clearing Isolated trees, from 2 to 4 feet diameter	Each (EA)
P151.052	Clearing Isolated trees, greater than 4 feet diameter	Each (EA)
P151.060	Topping Trees	Each (EA)
P151.061 through 151.080	Topping Tree Location (location no.)	Lump Sum (LS)

END OF SPECIFICATION P151

Specification P152 - Excavation, Subgrade, and Embankment

152.1 Description

(1) This Work covers excavation, disposal, placement, and compaction of all materials within the limits required to construct safety areas, runways, taxiways, aprons, and intermediate areas as well as other areas for drainage, building construction, parking, or other purposes in accordance with these specifications and in conformity to the dimensions and typical sections and details shown on the Plans.

152.1.2 Classification

(1) All material excavated shall be classified as common excavation, rock excavation, muck excavation or borrow excavation.

152.1.2.1 Common Excavation

(1) Common Excavation shall include all materials not classified as rock or muck excavation. Boulders with a volume of one cubic yard or less shall be classified as Common Excavation. For contracts without the Rock Excavation Pay Item, remove and dispose of boulders having volume greater than one cubic yard and measure and pay for them under the Common Excavation Pay Item.

152.1.2.2 Rock Excavation

(1) Rock excavation shall include all solid rock in ledges, in bedded deposits, in unstratified masses, and conglomerate deposits which are so firmly cemented they cannot be removed without blasting or using rippers. If the Schedule of Prices includes a Pay Item for Rock Excavation, boulders containing a volume of more than one cubic yard will be classified as Rock Excavation.

152.1.2.3 Muck Excavation

(1) Muck Excavation when required, shall be measured and paid as Common Excavation, unless a Pay Item for Muck Excavation is included in the Schedule of Prices; in which case, it will be measured separately and paid as Muck Excavation. Muck excavation shall consist of the removal and disposal of deposits or mixtures of soils and organic matter not suitable for foundation material. Muck shall include materials that will decay or produce subsidence in the embankment. It may consist of decaying stumps, roots, logs, humus, or other material not satisfactory for incorporation in the embankment.

152.1.2.4 Borrow Excavation

(1) Borrow Excavation when required, shall be measured and paid as Common Excavation, unless a Pay Item for Borrow Excavation is included in the Schedule of Prices; in which case, it will be measured separately and paid as Borrow Excavation. Borrow excavation shall consist of approved material required for the construction of embankments or for other portions of the work in excess of the quantity of usable material available from required excavations. Borrow material shall be obtained from areas designated on the Plans within the limits of the airport property but outside the normal limits of necessary grading, or from areas outside the Airport boundaries.

152.1.3 Unsuitable Excavation

(1) Material containing vegetable or organic matter, such as muck, peat, organic silt, or sod shall be considered unsuitable for use in embankment construction. Material, suitable for topsoil may be used on the embankment (outside of the area of the pavement foundation) slope when approved by the Engineer.

152.1.4 Excavation Below Subgrade

(1) Excavation Below Subgrade (EBS) shall be classified as Common Excavation or Rock Excavation, whichever applies.

152.1.5 Construction Staking

(1) Contractor shall provide all construction staking in accordance with 50.6, except Engineer will provide staking as described on the Plans or specified in the Special Provisions.

152.2 Construction

152.2.1 General

(1) Before beginning excavation, grading, and embankment operations, the area shall be completely cleared and grubbed in accordance with P151.

(2) Suitability of material to be placed in embankments shall be subject to approval by the Engineer. Unsuitable material shall be placed in areas shown on the Plans for disposal of excess excavated material. Excess material disposal areas shall be graded to allow positive drainage of the area and of adjacent areas. The surface elevation of disposal areas shall not extend above the surface elevation of

adjacent areas of the airport intended for aircraft operations, unless specified on the Plans or approved by the Engineer.

(3) When the Contractor's excavating operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued and the Engineer notified in accordance with 70.27 of the General Requirements and Covenants. At the direction of the Engineer, the Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and allow for their removal. Such excavation will be paid for as extra work.

(4) Those areas outside of the limits of the pavement areas, where the top layer of soil material has become compacted by hauling or other Contractor activities, shall be scarified and disked to a depth of four inches, to loosen and pulverize the soil. Stones or rock fragments larger than 4 inches (100 mm) in their greatest dimension will not be permitted in the top 6 inches of the subgrade.

(5) If it is necessary to interrupt existing surface drainage, sewers or under-drainage, conduits, utilities, or similar underground structures, Contractor shall be responsible for, and shall take all necessary precautions, to preserve them or provide temporary services. When such facilities are encountered, Contractor shall notify Engineer, who shall arrange for their removal if necessary. Contractor shall repair or pay the cost of all damage to such facilities or structures due to construction operations.

152.2.2 Excavation

(1) No excavation shall be started until the work has been staked. Areas to be excavated shall be stripped of vegetation and topsoil. Topsoil shall be stockpiled for future use in areas within the construction limits which do not interfere with Airport operations or drainage. Suitable excavated material shall be used in the formation of embankment, subgrade, or other purposes shown on the Plans. Unsuitable material shall be disposed of as shown on the Plans; or if not shown on Plans, as directed by Engineer.

(2) When the volume of the excavation exceeds that required to construct the embankments to the grades indicated, the excess shall be used to grade the areas of ultimate development or transported, placed and graded as required on the Plans. When the volume of excavation is not sufficient for constructing the embankments to the grades indicated, the deficiency shall be obtained from borrow areas.

(3) Maintain surface grade so that the surface is well drained at all times. When necessary, install temporary drains and drainage ditches to intercept or divert surface water that may affect the work.

152.2.2.1 Selective Grading

(1) When selective grading is indicated on the Plans, the more suitable material designated on Plans shall be used in constructing the embankment or in capping the pavement subgrade. If, at the time of excavation, it is not possible to place this material in its final location, it shall be stockpiled in approved areas until it can be placed. The more suitable material shall then be placed and compacted as specified. Selective grading shall be considered incidental to the work involved. The cost of stockpiling and placing the material shall be included in the various pay items of work involved.

152.2.2.2 Undercutting

(1) Rock, shale, hardpan, loose rock, boulders, or other material unsatisfactory for safety areas, subgrades, roads, shoulders, or areas intended for turf shall be excavated to a minimum depth of 12 inches below the subgrade or to the depth specified by the Engineer. Muck, peat, matted roots, or other yielding material, unsatisfactory for subgrade foundation, shall be removed to the depth specified. Unsuitable materials shall be disposed of at locations shown on the Plans. The cost is incidental to this item. This excavated material shall be paid for at the Contract unit price per cubic yard for Common Excavation. The excavated area shall be backfilled with suitable material obtained from the grading operations or borrow areas and compacted to specified densities. The necessary backfill will constitute a part of the embankment. Where rock cuts are made, backfill with select material. Pockets created in the rock surface shall be drained.

(2) Perform Excavation Below Subgrade (EBS) to remove deposits of frost heave material, unstable silty soils, water bearing soils, topsoil containing detrimental quantities of humus or vegetable matter, or other undesirable foundation material from areas below the subgrade that form the Pavement Foundation, as specified elsewhere herein, or as shown on the Plans. Slope the bottoms of excavation to drain to prevent accumulation of water and saturation of the subgrade. Dispose of excavated material in designated disposal areas. Backfill the excavation with selected fill materials suitable for embankments.

152.2.2.3 Overbreak

(1) Overbreak, including slides, is that portion of material displaced or loosened beyond the finished work as planned. Overbreak shall be graded or removed by the Contractor and disposed of as directed by the Engineer. Engineer shall determine if the displacement of such material was unavoidable. Payment

will not be made for the removal and disposal of overbreak that the Engineer determines as avoidable. Unavoidable overbreak will be measured as “Common Excavation.” Backfilling overbreak areas is incidental and the cost shall be included in the Pay Item for Excavation.

152.2.2.4 Removal of Utilities

(1) The removal of existing structures and utilities required to permit the orderly progress of work will be accomplished by the appropriate utility company unless otherwise shown on the Plans. Existing foundations to be removed shall be excavated at least two feet below the top of subgrade or as indicated on the Plans, and the material disposed of as shown on the Plans, or if not shown, at a location provided by Contractor. All foundations thus excavated shall be backfilled with suitable material and compacted as specified for embankment.

152.2.2.5 Compaction Requirements

(1) The subgrade that forms the pavement foundation shall be compacted to the depths and densities of not less than the percent of maximum-density shown on the Plans or in the Special Provisions; or if not specified on the Plans or Special Provisions, then 95 percent of maximum-density. Areas outside the pavement foundation shall be compacted to 95 percent of maximum-density. The maximum-density shall be determined by ASTM D1557, or by ASTM D698 if indicated in the Special Provisions or on the Plans. The material to be compacted shall be within plus or minus two percent of optimum moisture content before being rolled to obtain the prescribed compaction. Tests for in-place field density and moisture shall be taken at the rate of one per every 1,000 square yards of subgrade that forms the pavement foundation. Compaction testing shall be completed by Contractor, unless Engineer testing is required on the Plans or Special Provisions. Compaction test locations shall be determined by Engineer. Contractor shall record the location of the tests and test results and provide a written copy to Engineer at the time of testing.

(2) The in-place field density shall be determined in accordance ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938. Remove stones or rock fragments larger than four inches in their greatest dimension from the top six inches of the subgrade. The finished grading operations, conforming to the typical cross-section, shall be completed and maintained at least 1,000 feet ahead of the paving operations or as directed by the Engineer.

(3) Areas not meeting density requirements shall be reworked, recompacted, and retested by Contractor until the density requirement is achieved.

(4) All loose or protruding rocks on the back slopes of cuts shall be pried loose or otherwise removed to the slope finished grade line. All cut-and-fill slopes shall be uniformly dressed to the slope, cross-section, and alignment shown on the Plans or as directed by the Engineer.

(5) The maximum-density this the maximum density of laboratory specimens prepared from samples of material taken from the site and is determined in accordance with ASTM D 1557 or ASTM D698. Tests for maximum-density in accordance with ASTM D1557 or ASTM D698 (if indicated) shall be completed by Contractor, unless otherwise stated on the Plans or in the Special Provisions. Tests shall be performed for each soil type found on the project. Engineer may perform verification testing, and if a one-point proctor indicates a different soil type, Contractor shall provide additional maximum-density tests at no additional cost. The subgrade will not be accepted until a valid maximum-density test is received.

(6) Control Strip. Contractor shall demonstrate that approved equipment and operations will uniformly compact the lift to the specified density. Engineer must witness this demonstration and approve the lift thickness prior to full production. The control strip shall be approximately 1000 square yards.

152.2.2.6 Proof Rolling

(1) The purpose of proof rolling the subgrade is to identify weak areas in the subgrade and shall not be a substitute for testing compaction of the subgrade. After the subgrade is shaped and constructed to the Plan elevations, and compaction is completed, the subgrade area shall be proof rolled in the presence of the Engineer with a tandem axle dual wheel dump truck loaded to the legal limit. Apply a minimum of one coverage to all areas below pavement. A coverage is defined as the application of one tire print over the designated area. Soft areas of subgrade that deflect more than one inch or show permanent deformation greater than one inch shall be removed and replaced with suitable material or reworked, at Contractor’s expense, to conform to the moisture content and compaction requirements in accordance with these specifications. Proof rolling and reconstruction of unacceptable subgrade shall continue until the subgrade is acceptable. This Work shall be incidental and the cost included in the prices bid for excavation.

152.2.2.7 Blasting and Explosives

(1) Blasting and use of explosives shall be in accordance with 70.12.

a. Blasting will be permitted only when proper precautions are taken for the safety of all persons, the work, and the property. All damage done to the work or property shall be repaired by the Contractor. The cost of repair is incidental to this item. All operations of the Contractor in connection with the transportation, storage, and use of explosives shall conform to all Federal, state and local regulations and explosive manufacturers' instructions, with applicable approved permits reviewed by the Engineer. Approvals by others shall not relieve the Contractor of the responsibility in blasting operations.

b. Where blasting is approved, the Contractor shall employ a vibration consultant, approved by the Engineer, to advise on explosive charge weights per delay and to analyze records from seismograph recordings. The seismograph shall be capable of producing a permanent record of the three components of the motion in terms of particle velocity, and in addition shall be capable of internal dynamic calibration.

c. In each distinct blasting area, where pertinent factors affecting blast vibrations and their effects in the area remain the same, the Contractor shall submit a blasting plan of the initial blasts to the Engineer for approval. This plan must consist of hole size, depth, spacing, burden, type of explosives, type of delay sequence, maximum amount of explosive on any one delay period, depth of rock, and depth of overburden. The maximum explosive charge weights per delay included in the plan shall not be increased without the approval of the Engineer.

d. Contractor shall keep a record of each blast: its date, time and location; the amount of explosives used, maximum explosive charge weight per delay period, and, where necessary, seismograph records identified by instrument number and location.

e. Blasting records shall be made available to the Engineer on a monthly basis or in tabulated form at other times as required

152.2.3 Borrow Excavation

(1) Borrow areas within the airport property are indicated on the Plans. Borrow excavation shall be made only at these designated locations and within the horizontal and vertical limits as staked or as directed by the Engineer.

152.2.3.1 Off-Site Borrow

(1) The Department may approve non-commercial borrow sources where the Contractor proposes to create or enlarge an area of open water if the Contractor submits a written request. Include with that request written evidence that the following conditions have been met:

a. The property owner has a valid and practicable plan for creating or enlarging a body of impounded water and that plan complies with all applicable ordinances or regulations.

b. If the proposed site is within five miles of a public-use airport, the airport manager and the Department's Bureau of Aeronautics have been contacted and confirm receipt of the following:

i. Contractor and landowner names and contact information including phone numbers.

ii. Scale map showing the location of the proposed site in relation to the airport.

a. Detailed reclamation plans showing the location, size, and outline of proposed new open water; slopes of the impoundment area; proposed re-vegetation plan; and other requested information.

c. WDNR and other federal and state agencies with jurisdiction have approved the plan.

d. The proposed plan is not contrary to the public interest and will not create a public nuisance or hazard.

(2) Improve the borrow site as specified for final cleanup in 40.9.

(3) When borrow sources are outside the boundaries of the airport property, it shall be the Contractor's responsibility to locate and obtain the borrow sources, subject to the approval of the Engineer. The Contractor shall notify the Engineer at least 15 days prior to beginning the excavation so necessary measurements and tests can be made. All borrow pits shall be opened up to expose the various strata of acceptable material to allow obtaining a uniform product. All unsuitable material shall be disposed of by the Contractor. Borrow pits shall be excavated to regular lines to permit accurate measurements, and they shall be drained and left in a neat, presentable condition with all slopes dressed uniformly.

152.2.4 Drainage Excavation

(1) Drainage excavation shall consist of excavating for drainage ditches such as intercepting; inlet or outlet ditches; for temporary levee construction; or for other types as shown on the Plans. The work shall be performed in sequence with the other construction. Intercepting ditches shall be constructed prior to starting adjacent excavation operations. All satisfactory material shall be placed in embankment fills; unsuitable material shall be placed in designated disposal areas. All necessary work shall be performed true to final line, elevation, and cross-section. The Contractor shall maintain ditches constructed on the

project to the required cross-section and shall keep them free of debris or obstructions until the project is accepted.

152.2.5 Preparation of Embankment Area

(1) Where an embankment is to be constructed to a height of four feet or less, all sod and vegetative matter and topsoil shall be removed from the surface upon which the embankment is to be placed. The cleared surface shall be broken up by plowing or scarifying to a minimum depth of six inches and shall then be compacted as indicated in 152.2.6.

(2) Salvage all suitable topsoil from areas beneath embankments as designated above and stockpile for use as salvaged topsoil. If topsoil salvaged is in excess of the quantities required for top soiling, dispose of the excess in disposal areas specified or indicated on the Plans. Contractor shall determine the quantities necessary to stockpile and to dispose of to avoid re-handling the material.

(3) When the height of fill is greater than four feet, sod not required to be removed shall be thoroughly disked and re-compacted to the density of the surrounding ground before construction of embankment.

(4) Sloped surfaces steeper than one-foot vertical to four feet horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill.

(5) No direct payment shall be made for the work performed to prepare the embankment area under this section. The necessary clearing and grubbing and the quantity of excavation removed will be paid for under the respective Pay Items of Work contained in the Contract.

152.2.6 Formation of Embankments

(1) Form embankments in successive horizontal lifts of not more than eight inches in loose depth for the full width of the cross-section, unless otherwise approved by the Engineer.

(2) The lifts shall be placed, to produce a soil structure as shown on the typical cross-section or as directed by the Engineer. Materials such as brush, hedge, roots, stumps, grass and other organic matter, shall not be incorporated or buried in the embankment.

(3) Earthwork operations shall be suspended when satisfactory results cannot be obtained due to rain, freezing, or other unsatisfactory weather conditions in the field. Frozen material shall not be placed in the embankment nor shall embankment be placed upon frozen material. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Contractor shall drag, blade, or slope the embankment to provide surface drainage at all times.

(4) The material in each lift shall be within plus or minus two percent of optimum moisture content before rolling to obtain the prescribed compaction. To achieve a uniform moisture content throughout the lift, the material shall be moistened or aerated as necessary. Contractor shall test for moisture and density for every 1,000 square yard placed per lift, at locations determined by Engineer. Based on these tests, the Contractor shall make the necessary corrections and adjustments in methods, materials or moisture content to achieve the specified embankment density. Contractor shall record the location of the tests and test results and provide a written copy to Engineer at the time of testing.

(5) The maximum-density is the maximum density of laboratory specimens prepared from samples of material taken from the site and is determined in accordance with ASTM D 1557 or ASTM D698. Tests for maximum-density in accordance with ASTM D1557 or ASTM D698 (if indicated) shall be completed by Contractor, unless otherwise stated in the Plans or the Special Provisions. Tests shall be performed for each soil type found on the project. Engineer may perform verification testing, and if a one-point proctor indicates a different soil type, Contractor shall provide additional maximum-density tests at no additional cost. The subgrade will not be accepted until a valid maximum-density test is received.

(6) Rolling operations shall be continued until the embankment is compacted to not less than 95 percent of maximum-density for non-cohesive soils, and 90 percent of maximum-density for cohesive soils as determined by ASTM D1557**,** unless ASTM D698 is indicated on the Plans or in the Special Provisions.

(7) Areas of the embankments that form the Pavement Foundation shall be compacted to depths and to densities of not less than the percent of the maximum-density shown on the Plans or in the Special Provisions; or if not specified on the Plans or in the Special Provisions, then to 95 percent of maximum-density in non-cohesive soil and 90 percent in cohesive soil. Areas outside the pavement foundation shall be compacted to 5 percent less than the maximum-density of the adjacent requirement for densities of material supporting pavements. The maximum-density shall be determined by ASTM D1557, or by D698 if indicated in the Special Provisions or on the Plans.

(8) On all areas outside of the pavement areas, no compaction will be required on the top four inches.

(9) The in-place field density shall be determined in accordance with ASTM 6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938. Contractor shall perform all density tests in the Engineer's presence and provide the test results upon completion to the Engineer for acceptance unless the Special Provisions indicate testing by Engineer.

(10) Compaction areas shall be kept separate, and no lift shall be covered by another lift until the proper density is obtained.

(11) During construction of the embankment, the Contractor shall route all construction equipment evenly over the entire width of the embankment as each lift is placed. Lift placement shall begin in the deepest portion of the embankment fill. As placement progresses, the lifts shall be constructed approximately parallel to the finished pavement grade line.

(12) When rock and other embankment material are excavated at approximately the same time, the rock shall be incorporated into the outer portion of the embankment outside of the Pavement Foundation and the other material shall be incorporated under the future paved areas. Stones or fragmentary rock larger than four inches in their greatest dimensions will not be allowed in the top 6 inches of the subgrade. Rock fill shall be brought up in lifts as specified or as directed by the Engineer and the finer material shall be used to fill the voids with forming a dense, compact mass. Rock or boulders shall not be disposed of outside the excavation or embankment areas, except at places and in the manner designated on the Plans or by the Engineer.

(13) When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in lifts of the prescribed thickness without crushing, pulverizing or further breaking down the pieces, such material may be placed in the embankment as directed in lifts not exceeding two feet in thickness. Each lift shall be leveled and smoothed with suitable equipment by distribution of spalls and finer fragments of rock. The lift shall not be constructed above an elevation four feet below the finished subgrade.

(14) There will be no separate measurement of payment for compacted embankment. All costs incidental to placing in lifts, compacting, disking, watering, mixing, sloping, and other operations necessary for construction of embankments will be included in the Contract price for Common Excavation, borrow, or other excavation items.

152.2.6.1 Proof Rolling

(1) The purpose of proof rolling the subgrade is to identify any weak areas in the subgrade and not for compaction of the subgrade. After compaction is completed, the subgrade area shall be proof rolled with a Tandem axle Dual Wheel Dump Truck loaded to the legal limit with tires inflated to a minimum of 80 psi in the presence of the Engineer. Apply a minimum of 2 coverage passes, or as specified by the Engineer, under pavement areas. A coverage is defined as the application of one tire print over the designated area. Soft areas of subgrade that deflect more than 1 inch (25 mm) or show permanent deformation greater than 1 inch (25 mm) shall be removed and replaced with suitable material or reworked to conform to the moisture content and compaction requirements in accordance with these specifications. Removal and replacement of soft areas is incidental to this item.

152.2.7 Finishing and Protection of Subgrade

(1) After the subgrade is substantially complete, Contractor shall remove soft or other unstable material over the full width of the subgrade that will not compact properly. All low areas, holes or depressions in the subgrade shall be brought to grade with suitable select material. Scarifying, blading, rolling and other methods shall be performed to provide a thoroughly compacted subgrade shaped to the lines and grades shown on the Plans.

(2) Grading of the subgrade shall be performed so that it will drain readily. Contractor shall protect the subgrade from damage and limit hauling over the finished subgrade to only traffic essential for construction purposes. All ruts or rough places that develop in the completed subgrade shall be graded and recompacted.

(3) No subbase, base, or surface course shall be placed on the subgrade until the subgrade has been approved by the Engineer.

(4) Finishing and protecting the subbase shall be incidental work and the cost included in prices bid.

152.2.8 Haul

(1) All hauling will be considered a necessary and incidental part of the work. Contractor shall include the cost in the Contract unit price for the Pay Items of Work involved. No payment will be made separately or directly for hauling.

152.2.9 Tolerances

(1) In those areas upon which a subbase or base course is to be placed, the top of the subgrade shall be of such smoothness that, when tested with a 12-foot straightedge applied parallel and at right angles to the centerline, it shall not show any deviation in excess of 1/2 inch, or shall not be more than 0.05 feet from true grade as established by grade hubs. Deviations in excess of these amounts shall be corrected by loosening, adding, or removing materials; reshaping; and recompacting.

(2) On safety areas, intermediate and other designated areas, the surface shall be of such smoothness that it will not vary more than 0.10 feet from true grade as established by grade hubs. Deviations in excess of this amount shall be corrected by loosening, adding or removing materials, and reshaping.

152.2.10 Salvaged Topsoil

(1) When salvaged topsoil is specified or required as shown on the Plans, it shall be salvaged from stripping or other grading operations. The salvaged topsoil shall meet the requirements of T905. If, at the time of excavation or stripping, the topsoil cannot be placed in its final section of finished construction, the material shall be stockpiled at approved locations. Stockpiles shall not be placed closer to active runways and taxiway than allowed on the CSPP or elsewhere on the Plans and shall not be placed on areas that subsequently will require excavation or embankment fill.

(2) Upon completion of grading operations, stockpiled topsoil shall be placed as required in T905.

(3) No direct payment will be made for topsoil under P152, except that the quantity removed and placed directly or stockpiled shall be included in the measurement for "Common Excavation." Refer to 905.4 and 905.5 for measurement and payment for topsoil.

(4) When stockpiled topsoil is later placed in its final position, the material re-handled shall be paid for at the Contract unit price per square yard for Salvaged Topsoil, as provided in T905.

152.3 Measurement

152.3.1 Excavation

(1) The quantity of all classes of excavation to be paid for shall be the number of cubic yards measured in its' original position, computed by the method of average end areas, except as provided herein.

(2) Where the quantity of Common Excavation to be excavated is less than 500 cubic yards and measurement of such minor quantity by the above method of average end areas would be impractical, the measurement may be made by the cubic yard in the vehicle, upon approval of the Engineer. The capacity of each vehicle used for hauling the material shall be determined by the Engineer to the nearest 1/10 cubic yard.

(3) Boulders and surface stone of one cubic yard or more in volume will be measured individually and the volume computed from average dimensions taken in three directions.

(4) Where slopes are undercut to provide for placing topsoil or salvaged topsoil, the quantity of undercut will not be measured for payment but will be considered incidental Work and the cost included as part of the Pay Items for Topsoil or Salvaged Topsoil.

(5) Muck excavation will be measured for payment in its original position by the average end area method, within the limits of excavation prescribed by the Plans or directed by the Engineer, to the extent that a reasonably well–defined trench of required cross section is excavated and formed, having relatively stable side slopes and the bottom of which is the bottom of the marsh or satisfactory support for the backfill and embankment. In those cases where the excavation does not result in a reasonably well defined measurable trench with relatively stable side slopes, the cross section area to be measured for payment shall be based on the lateral limits of the excavation prescribed by the typical section in the Plans and as staked in the field by the Engineer, and the depth between the original muck surface and the bottom of the placed fill determined by soundings taken during excavation of the muck or by borings taken through the completed fill. Material from outside the lateral limits defined above that is excavated or displaced by the fill will not be measured for payment.

(6) Where it is not feasible to compute volumes of the various classes of Excavation by the method of average end areas because of the erratic location of isolated deposits, such volumes may be computed by acceptable methods involving three–dimensional measurements as approved by the Engineer.

(7) Excavation below subgrade (EBS) will be measured as Common Excavation, provided Contractor requests such measurements in writing and provides the Engineer notice and access to make required measurements at the appropriate times during construction. Otherwise, excavation below subgrade will not be measured for payment.

(8) Measurement shall not include the quantity of materials excavated without authorization beyond normal slope lines, or the quantity of material used for purposes other than those directed.

152.3.2 Haul

(1) No separate measurement will be made for overhaul. The limits for free haul shall cover the entire Work unless otherwise shown on the Plans or specified in the Special Provisions.

152.3.3 Measurement Method

(1) For payment specified by the cubic yard, measurement for all excavation shall be computed by the average end area method. The end area is that bound by the original ground line established by field cross sections and the final theoretical pay line established by excavation cross sections shown on the Plans, subject to verification by the Engineer. After completion of all excavation operations and prior to the placing of base or subbase material, the final excavation shall be verified by the Engineer by means of field cross sections taken randomly at intervals not exceeding 500 linear feet subject to the following conditions.

(2) Final field cross sections will be employed if the following changes have been made:

a. Plan width of embankments or excavations are changed by more than plus or minus 1.0 foot; or

b. Plan elevations of embankments or excavations are changed by more than plus or minus 0.5 foot; or

c. The Engineer shall determine if verification is needed.

152.4 Payment

152.4.1 Common Excavation

(1) Common Excavation payment shall be made at the Contract unit price per cubic yard. This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the Work specified.

152.4.2 Rock Excavation

(1) Rock Excavation payment shall be made at the Contract unit price per cubic yard. This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the Work specified.

152.4.3 Muck Excavation

(1) Muck Excavation payment shall be made at the Contract unit price per cubic yard. This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the Work specified.

152.4.4 Borrow Excavation

(1) Borrow Excavation payment shall be made at the Contract unit price per cubic yard. This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the Work specified.

152.5 Pay Items

(1) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

(2) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P152.010	Common Excavation	Cubic Yard (CY)
P152.020	Rock Excavation	Cubic Yard (CY)
P152.030	Muck Excavation	Cubic Yard (CY)
P152.040	Borrow Excavation	Cubic Yard (CY)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))

ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2700 kN-m/m^3))

ASTM D6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

END OF SPECIFICATION P152

Specification P154 - Subbase Course

154.1.1 Description

(1) This Work shall consist of a subbase course composed of granular materials constructed on a prepared subgrade or underlying course in accordance with these Specifications, and in conformity with the dimensions and typical cross-section shown on the Plans.

154.1.2 Construction Staking

(1) Contractor shall provide all construction staking in accordance with 50.6, except Engineer will provide staking as described on the Plans or specified in the Special Provisions.

154.2 Materials

154.2.1 General

(1) The subbase material shall consist of hard durable particles or fragments of granular aggregates, recycled asphalt pavement (RAP), or recycled concrete pavement (RCO). The material may be obtained from gravel pits, stockpiles, or may be produced from a crushing and screening plant with proper blending. The materials from these sources shall meet the requirements for gradation, quality, and consistency. The material shall be free from vegetative matter, excessive amounts of clay, and other objectionable substances; uniformly blended; and be capable of being compacted into a dense, stable subbase.

(2) The subbase material shall exhibit a California Bearing Ratio (CBR) value of at least 20 when tested in accordance with ASTM D1883. The subbase material shall meet the gradation specified in the table below.

Table 154.2.1 Subbase Gradation Requirements

Sieve designation	Percentage by weight passing sieves		Contractor's Final Gradation	Job Control Grading Band Tolerances[1] (Percent)
	Subbase Aggregate Gradation No.1	Recycled pavement [2] (RAP or RCO) Gradation No. 2		
3 inch (75 mm)	100			0
1 1/2 inch (37.5 mm)		100		0
3/4 inch (19.0 mm)	70-100	70-100		±10
No. 10 (2.00 mm)	20-100	20-100		±10
No. 40 (425 µm)	5-60	5-60		±5
No. 200 (75 µm)	0-10	0-10		±5

[1]The "Job Control Grading Band Tolerances" shall be applied to "Contractor's Final Gradation" to establish the job control grading band.

[2] Gradation when recycled asphalt pavement (RAP) or recycled concrete pavement (RCO) is used.

(3) The portion of the material passing the No. 40 (425 µm) sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than six (6) when tested in accordance with ASTM D4318.

(4) The total amount of recycled asphalt pavement and asphalt millings shall not exceed 50 percent of the mixture.

154.2.2 Sampling and Testing

(1) **154.2.2.1 Pre-Construction.** Initial aggregate subbase material samples shall be taken by the Contractor per ASTM D75. Sample shall be tested by Contractor to determine that materials meet requirements for aggregate subbase requirements and gradation. Material shall meet the requirements in paragraphs 154.2.1. Contractor shall submit to Engineer certified test results one week prior to beginning construction showing that the aggregate meets the Material requirements of this section. Tests shall be representative of the material to be used for the project.

(2) **154.2.2.2 During Construction.** Contractor shall take at least one aggregate subbase sample per day in the presence of Engineer to check the final gradation. Samples shall be taken from the in-place, un-compacted material at sampling locations determined by Engineer on a random basis per ASTM D3665. Sampling shall be per ASTM D75 and tested per ASTM C136 and ASTM C117. Results shall be furnished to Engineer by Contractor each day during construction of Subbase. Subbase material shall meet the requirements in paragraph 154.2.1.

154.2.3 Separation Geotextile

(1) Geotextile separation fabric, if required, is shown on the project Plans and specified in the Special Provisions.

154.3 Construction Methods

154.3.1 General

(1) Place subbase course where designated on the plans or as directed by Engineer. Shaped and thoroughly compact the material within the tolerances specified.

(2) Granular subbases which, due to grain sizes or shapes, are not sufficiently stable to support the construction equipment without movement shall be mechanically modified to the depth necessary to provide stability, as directed by Engineer. Mechanical modification shall include the addition of a fine-grained medium to bind the particles of the subbase material sufficiently to furnish a bearing strength sufficient to prevent the course from deforming under construction equipment traffic.

154.3.2 Preparing Underlying Course

(1) Prior to constructing the subbase course, clean the underlying course or subgrade of all foreign substances. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances in accordance with Item P152. Correct ruts, soft yielding spots in the underlying courses, and subgrade areas having inadequate compaction and/or deviations of the surface from the specified requirements, by loosening and removing soft or unsatisfactory material, adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses or subgrades containing sands or gravels, as defined in ASTM D2487, the surface shall be stabilized prior to placement of the overlying course by mixing the overlying course material into the underlying course, and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements for the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until the overlying course is placed. The underlying course shall be checked and accepted by Engineer before placing and spreading operations are started.

(2) To protect the subgrade and to ensure proper drainage, spreading of the subbase shall begin along the centerline of the pavement on a crowned section or on the high side of pavements with a one-way slope.

154.3.3 Control Strip

(1) The first half-day of subbase construction (minimum of 250 cubic yards or the equivalent in tons) shall be considered as a control strip for Contractor to demonstrate, in the presence of Engineer, that the materials, equipment, and construction processes meet the requirements of this Specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The maximum compacted thickness may be increased to a maximum of 12 inches upon the Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the specified density. Engineer must witness this demonstration and approve the lift thickness prior to full production.

(2) Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not begin until the control strip has been accepted by Engineer. The Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by Engineer.

154.3.4 Placement

(1) The material shall be placed and spread on the prepared underlying layer by spreader boxes, graders, or other devices as approved by Engineer, to a uniform thickness and width. The equipment shall have positive thickness controls to minimize the need for additional manipulation of the material. Dumping from vehicles that result in aggregate segregation shall not be permitted. Hauling over the uncompacted base course shall not be permitted. The material shall not be placed when the underlying course is soft or yielding.

(2) The material shall meet gradation and moisture requirements prior to compaction. Material may be free-draining and the minimum moisture content shall be established for placement and compaction of the material.

(3) The material shall be constructed in lifts as established in the control strip, but not less than 4 inches nor more than 12 inches of compacted thickness.

(4) When more than one lift is required to establish the layer thickness shown on the plans, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. The Contractor shall rework, re-compact and retest any material placed which does not meet the specifications.

154.3.5 Compaction

(1) The subbase material shall be compacted, adjusting moisture as necessary, to be within plus or minus two percent of optimum moisture. The field density of the compacted material shall be at least 100 percent of the maximum density as specified in paragraph 154.3.9. If the specified density is not attained, the area of the lift represented by the test shall be reworked and re-compacted and additional random tests made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

154.3.6 Weather limitation

(1) Material shall not be placed unless the ambient air temperature is at least 40 degrees Fahrenheit and rising. Work on subbase course shall not be conducted when the subgrade is wet or frozen or the subbase material contains frozen material.

154.3.7 Maintenance

(1) No base or surface course shall be placed on the subbase until the subbase has been accepted by Engineer. Contractor shall maintain the completed course in satisfactory condition throughout placement of subsequent layers. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, Contractor shall verify that materials still meet all specification requirements before placement of additional material. Equipment may be routed over completed sections of subbase course, provided the equipment does not damage the subbase course and the equipment is routed over the full width of the completed subbase course. Damage to the subbase course from routing equipment over the subbase course shall be repaired by the Contractor at their expense.

154.3.8 Surface tolerance

(1) In those areas on which a subbase or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Areas lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least three inches, reshaped and re-compacted to grade until the required smoothness and accuracy are obtained and approved by Engineer. Contractor shall perform all smoothness and grade checks in the presence of Engineer. Contractor shall provide a straight edge approved by Engineer and test the surface for smoothness as required. Contractor shall provide survey for grade and shall provide survey notes with constructed elevations and deviations from Plan grade for the grid specified. Deviations in surface tolerances shall be corrected by Contractor at Contractor's expense.

a. Smoothness. The finished surface shall not vary more than plus or minus ½ inch when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12-foot straightedge for the full length of each line on a 50-foot grid.

b. Grade. The grade and crown shall be surveyed on a 50-foot grid and shall be within plus or minus 0.05 feet of the specified grade.

154.3.9 Acceptance sampling and testing.

(1) The aggregate base course shall be accepted for density and thickness on an area basis. One test shall be made for density and thickness for each 600 square yards. Sampling locations will be determined by Engineer on a random basis.

a. **Density.** Contractor's laboratory shall perform all density tests in Engineer's presence and provide the test results upon completion to Engineer for acceptance.

i. Each area shall be accepted for density when the field density is at least 100 percent of the maximum density of laboratory specimens compacted and tested per ASTM D1557or ASTM D698. The in-place field density shall be determined per ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938. If the specified density is not attained, the area represented by the failed test shall be reworked and/or recompacted and an additional random test shall be made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

ii. When the material has greater than 30 percent retained on the ¾ inch (19.0 mm) sieve, use methods in ASTM D698 or ASTM D1557 and the procedures in AASHTO T180 Annex for correction of maximum dry density and optimum moisture for oversized particles.

iii. ASTM D698 shall be used for pavement areas serving aircraft with gross weight 60,000 pound. or less. ASTM D1557 shall be used for pavement areas serving aircraft with gross weight above 60,000 pounds. Refer to designations in 154.5.1.

b. **Thickness.** The thickness of the base course shall be within plus zero and minus 1/2 inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of Engineer for each area. Where the thickness is deficient by more than 1/2-inch, Contractor shall correct such areas at no additional cost by scarifying to a depth of at least three inches, adding new material of proper gradation, and blend and recompact the material to grade. Contractor shall replace, at his expense, base material where depth tests have been taken. Thickness tests by Contractor will be waived when construction grade stakes have been placed by Engineer at the bottom and top of the subbase and Engineer has determined that the subbase has been construct to grade and the surface tolerance requirements in 154.3.8 have been met.

154.4 Measurement

154.4.1 Measurement by Cubic Yard

(1) Subbase course shall be measured by the number of cubic yards of virgin or composite subbase course material placed, compacted, and accepted in the completed course. The quantity of subbase course material shall be measured in final position based upon depth tests taken as directed by the Engineer, at the rate of one depth test for each 500 square yard of subbase. On individual depth measurements, thicknesses more than 1/4 inch `in excess of that shown on the Plans shall be considered as the specified thickness plus 1/4 inch in computing the yardage for payment. Recycled subbase materials shall not be included in other excavation quantities.

154.4.2 Measurement by Ton

(1) When a Pay Item per ton is provided in the Schedule of Prices, measurement for payment for subbase course shall be made by the number of tons of material placed, compacted, and accepted in accordance with this Specification. Truck scale weights as specified in Section 90, Measurement and Payment, will be used to determine the basis for tonnage. Subbase course material, measure by the ton, which contains total moisture in excess of the optimum moisture content, will have the weight of the excess water deducted from the measured weight. Determination of the moisture content of the aggregates will be based on percent of the dry weight of the aggregates.

154.5 Payment

154.5.1 General

(1) Payment shall be made at the Contract unit price per cubic yard or per ton as provided in the Schedule of Prices for subbase course. This price shall be full compensation for furnishing all materials and construction methods specified herein; for all preparation, hauling, and placing and compaction of these materials; for removal, transportation, processing, and placing of existing material as necessary; and for all labor, equipment, tools, testing and incidentals necessary to complete the Work.

(2) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

(3) Pay Items with the designation B60K in the description are to be compacted as specified in 154.3.9 for aircraft with gross weights of less than 60,000 pounds. Pay Items with the designation A60K in the description are to be compacted as specified in 154.3.9 for aircraft with gross weights of 60,000 pounds and greater.

(4) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P154.010	Subbase Course B60K Gradation No. 1	Cubic Yard (CY)
P154.012	Subbase Course B60K Gradation No. 1	TON
P154.014	Subbase Course A60K Gradation No. 1	Cubic Yard (CY)
P154.016	Subbase Course A60K Gradation No. 1	TON
P154.020	Subbase Course B60K Gradation No. 2	Cubic Yard (CY)
P154.022	Subbase Course B60K Gradation No. 2	TON
P154.024	Subbase Course A60K Gradation No. 2	Cubic Yard (CY)
P154.026	Subbase Course A60K Gradation No. 2	TON

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C117	Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))
ASTM D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D4759	Practice for Determining the Specification Conformance of Geosynthetics
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

American Association of State Highway and Transportation Officials (AASHTO)

M 288	Geotextile Specification for Highway Applications

END OF SPECIFICATION P154

Specification P159 - Site Finishing

159.1 Description

(1) On projects or portions of projects where grading and drainage or structures are a part of the Contract, this specification describes destroying noxious weeds, cleaning out drainage structures installed under the Contract, cleaning out material deposited in existing structures as a result of construction operations, removing and disposing of all litter and debris, and final trimming and dressing required to neatly and satisfactorily restore and complete the project.

(2) On projects or portions of projects where grading and drainage construction was or will be substantially completed under other contracts, this section describes destroying noxious weeds; removing and disposing of litter and debris; and the final shaping, finishing, trimming and dressing of shoulders, shoulder slopes and all other portions of the project disturbed by contractor operations, on contracts for grading constructing base, or surface course.

(3) On contracts where seeding was completed under a previous contract, the Contractor is responsible for all damage caused by its operations to the seeded areas or the vegetative covering within the project limits. Replace topsoil that was lost or contaminated with other materials, and reseed or restore all areas damaged by the contractor's operations.

159.2 (Vacant)

159.3 Construction

(1) Trim, shape, and restore the shoulders to the finished cross-section using graders and other equipment, supplemented by hand work, if necessary, to produce smooth surfaces and slopes and uniform cross-sections.

(2) Remove loose and waste stones not used in construction that fail to pass a 2-inch ring within all areas of the grading limits.

(3) In turf areas, remove all loose or waste stones that fail to pass a one-inch sieve from top soiled areas.

(4) Do not drag, push, or scrape material across or along the finished pavement or surface course.

(5) During the life of the Contract, destroy all noxious weeds within the construction limits by cutting or by other means and prevent the weed plants from maturing to the bloom or flower stage. The term "noxious weeds" as defined here consists of Canada thistle, leafy spurge, field bindweed, and other weeds that the governing body of the county or municipality where the project is located declares noxious, according to section 66.0407, Noxious Weeds, of the Wisconsin statutes.

http://docs.legis.wi.gov/statutes/statutes/66

(6) Before requesting acceptance of the work, if grading or structures are a part of the Contract, clean out all soil, silt, or debris, and fully restore the waterways of all drainage installations and structures constructed under the Contract. Remove all materials deposited or lodged in the waterways of all other drainage installations or structures due to contractor's operations.

(7) Trim and dress the slopes of the embankments and excavations to restore them to the established or specified lines and grades. Clear ditches and channels of debris and obstructions, and trim slopes and beds to true line and grade. Remove, shape, trim, and leave in a neat condition excess earth, debris, spoil banks, or other waste material next to culverts, bridges, ditches, channels, poles, posts, trees, or other objects. Remove stones, roots, or other waste materials exposed on embankment or excavation slopes that may become loosened and dislodged. Dispose of all slash and debris from clearing and grubbing operations, and leave the entire area in a neat condition. Fill holes and depressions that appear on the surface within the grubbing limits, caused by grubbing operations, with suitable material.

159.4 Measurement

(1) Site Finishing will be measured for payment as a single complete unit of Work per lump sum (LS).

159.5 Payment

159.5.1 General

(1) Payment will be made at the Contract lump sum price for Site Finishing, which shall be full compensation for furnishing materials, labor, transportation, and incidentals necessary to complete the item as specified. If the Contract does not include a separate Pay Item for Site Finishing, then the Work under this Specification shall be incidental and the cost included in Contract Pay Items for Excavation, Base Course, or Surface Course.

(2) Measurement and payment will be made only for Pay Items included in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

(3) Standard Pay Items for Work covered by the Specification are as follows:

Pay Item	Description	Unit
P159.010	Site Finishing	Lump Sum (LS)

END OF SPECIFICATION P159

Specification P160 - Remove Miscellaneous Structures

160.1 Description

(1) This section describes wholly or partially removing or abandoning existing miscellaneous structures, disposing of the resulting materials, or if required, salvaging and storing designated materials.

160.2 (Vacant)

160.3 Construction

160.3.1 General

160.3.1.1 General Requirements

(1) If retaining a portion of the existing structure, avoid damaging that portion during construction operations. Do not use equipment or devices that might damage structures, facilities, or property to be preserved and retained. Complete all operations necessary to remove or abandon an existing structure and that might endanger the new construction before constructing new work.

160.3.1.2 Backfilling

(1) Backfill all trenches, holes, and pits resulting from breaking down, removing, or abandoning miscellaneous structures. Use suitable material from excavation for backfill. Backfill all trenches resulting from removing or breaking down old culverts and bridges, and not occupied by new structures or required for waterways. Use either satisfactory soil or broken masonry and satisfactory soil. If the Contract specifies granular backfill, use backfill material conforming to P203. Place backfill material in layers no thicker than 8 inches. If using granular backfill, Contractor may place granular backfill in layers up to 12 inches thick. Thoroughly compact each layer using Engineer-approved tampers, rollers, or vibrators. If encountering water in an excavation, place backfill in a way that displaces the water and does not trap it.

(2) Unless the Contract specifies otherwise, backfill to the elevation of the natural ground, the proposed finished earth subgrade, or finished slopes, as necessary due to the location of the removed structure.

160.3.1.3 Salvaging or Disposing of Materials

(1) Carefully remove all materials designated for salvage to avoid damage. Place salvaged materials in neat piles at locations designated on the Plans. Stockpile ballast, gravel, and surfacing materials designated for salvage, without contaminating the material with dirt or foreign matter.

(2) Dispose of all concrete, stone, brick, and other material not designated for on-site disposal at a location provided by Contractor.

160.3.2 Breaking Down and Removing

160.3.2.1 General

(1) Unless specified otherwise, remove all structures that the Contract designates for removal or that interfere with the new construction as follows:

a. From within the construction limits shown on the Plans.

b. If the Contract specifies, also wholly or partially remove structural elements occurring outside the limits of construction.

(2) Unless the Plans show otherwise, remove entirely or break down all walls, piers, surface drains, foundations, and similar masonry structures as follows:

a. Beneath pavement to a depth at least two feet below the subgrade.

b. Areas within the grading limits, but not under pavement to a depth at least two feet below the finished grade.

c. At any location, to the extent required to avoid interfering with the work.

(3) If removing pavement, curb, gutter, sidewalk, crosswalk, and similar structures and portions of the existing structure are to remain in the surface of the finished work, remove the structure to an existing joint, or saw and chip the structure to a true line with a face perpendicular to the surface of the existing structure. Remove enough of the structure to provide proper grades and connection to the new work. Maintain drainage as specified for drainage during construction in 152.2.1.

(4) Contractor becomes the owner of the removed asphaltic pavement or surfacing and is responsible for its disposal unless it is designated to be incorporated into the Work.

160.3.2.2 Removal Items

160.3.2.2.1 General

(1) Under the Remove PCC Pavement Pay Item, remove concrete pavements, concrete alleys, concrete driveways, or rigid base including all surfaces or other pavements superimposed on them.

(2) Under the Remove PCC Pavement Butt Joints Pay Item, remove concrete pavements to allow the construction of butt joints. Remove existing pavement to the depth the Plans show by grinding, planning, chipping, sawing, or other engineer-approved methods.

(3) Under the Remove Asphaltic Surface Pay Item, remove all types of asphaltic pavement or surfacing not supported on rigid bases, or underlain by proposed excavation, or overlaid by proposed embankment. Also, remove asphaltic overlays of existing concrete pavements, or bases designated to remain in place.

(4) Under the Remove Asphaltic Surface Butt Joints Pay Item, remove asphaltic pavement or surfacing to allow the construction of butt joints. Remove existing asphaltic pavements or surfacing to the depth the Plans show by grinding, planning, chipping, sawing, or other engineer-approved methods.

(5) Under the Remove Concrete Sidewalk Pay Item, remove concrete sidewalk, crosswalk, and steps.

(6) Under the Remove Curb, Gutter, or Curb and Gutter Pay Item, remove to the limits shown on the Plans.

(7) Under the Remove Concrete Masonry and Bases Pay Item, break down and remove masonry structures shown on the Plans. Dispose of materials. Backfill the excavation.

(8) Under the Remove surface drains Pay Item, remove and dispose of drains as shown on Plans.

(9) Under the Remove Utility Pole Pay Item, remove and dispose of pole, backfill hole, and restore site.

(10) Under the Remove Manholes, Remove Catch Basins, and Remove Inlets Pay Items, rebuild, and properly reconnect all live sewers connected with them. Maintain satisfactory bypass service during these operations. Plug unused sewers as specified for abandoning pipes and structures under 160.3.3.1.

(11) Under the Remove Septic Tanks Pay Item, first completely remove the contents of the tank. Conform to the WDNR requirements for removal and disposal of these contents. Break down and remove the tank, to an elevation not less than two feet below the proposed ground surface, or two feet below the finished slopes or natural ground surface, as required due to the location of the tank. Before backfilling, break a hole in the bottom of remaining portion of the tank to allow drainage. Backfill as specified for trenches, holes, and pits in 160.3.1.2. If the septic tank disposal system includes a dry well, remove the dry well to not less than two feet below ground surface, and backfill it in the manner specified above for the septic tank.

(12) Under the Site Clearance Pay Items, remove building foundations and concrete slabs, backfill exposed openings, and clear the site within the area and at the locations the Plans show. Materials removed from building sites under this Pay Item become the Contractor's property. Clear the entire premises of all decomposable and combustible refuse, debris, and materials resulting from the removals and leave the premises in a neat condition.

(13) Under the Remove Storm Sewer Pay Items, remove and dispose of existing storm sewer. Backfill all resulting trenches with granular backfill.

160.3.2.2.2 Removing Asphaltic Surface Milling

(1) Under the Removing Asphaltic Surface Milling Pay Item, remove existing asphaltic pavement or surfacing by milling at the location and to the depth the Plans show. Contractor may incorporate suitable material into the work or dispose of it outside the project limits.

(2) If stockpiling material for subsequent incorporation into the work, store material at an Engineer-approved location that will minimize the hauling required to place the material. Prepare the stockpile foundation to minimize contamination. Ensure that the stockpile foundation is free of clods, lumps, or stones larger than two inches in any dimension.

(3) Remove the existing asphaltic pavement or surfacing without incorporating or damaging underlying material that will remain in place. Provide a uniform milled surface that is reasonably plane, free of large scarification marks, and has the grade and transverse slope the Plans show.

(4) Use a self-propelled milling machine with depth, grade, and slope controls. Shroud the drum to prevent discharging loosened material into adjacent work areas. Provide an Engineer-approved dust control system.

160.3.2.3 Remove Buildings

(1) Under the Remove Building and Remove Buildings Pay Items, remove buildings, dispose of all material and debris resulting from removing buildings, and backfill resulting holes.

(2) All buildings removed and all materials resulting from building removal become the Contractor's property unless the Contract specifies otherwise. Dispose of unclaimed and removed at location provided by Contractor.

(3) The Department assumes no responsibility for the condition of building. The Department makes or implies no guarantee that any building will remain in the condition the Bidder finds it in when the Bidder prepares the proposal.

(4) Obtain all permits necessary for removing buildings, including those necessary if the Contractor's operations obstruct streets or alleys.

(5) Remove buildings and building materials safely and according to the requirements of the Wisconsin Department of workforce development, applicable ordinances of the municipality where the building is located, and the WDNR. Pay close attention to the requirements regulating the handling and disposal of asbestos, lead paint, and other hazardous substances. If creating hazardous conditions incident to the contract operations, furnish, erect, and maintain suitable barricades to safeguard the public.

(6) Notify public utility companies serving the building in sufficient time, before removal operations, to allow them to disconnect and remove their facilities from the building.

(7) Shut off municipal water service lines at the curb boxes. Tightly plug or seal sewer connections. If municipal ordinances or permits specify the manner of sealing a sewer service connection, then perform the work accordingly.

(8) Unless the Contract specifies otherwise, when removing a building also remove that portion of its foundation, including masonry floors, to an elevation not less than 2 feet below the ground surface, the proposed finished earth subgrade, or finished slope grade, as necessary due to the location of the building.

(9) Remove heating units, plumbing fixtures, and similar appurtenances to the elevation of the basement floor.

(10) Before backfilling, remove all debris not suitable for backfilling. Break holes comprising at least 10 percent of the floor area in basement floors to allow drainage.

160.3.3 Abandoning Pipes and Structures

160.3.3.1 General

(1) If the Contract calls for abandoning manholes, catch basins, or inlets, clean them thoroughly. Plug the existing pipe connections with brick or concrete block masonry, or with any grade of concrete specified under 501.3.1.3, or any Engineer-approved commercial grade of concrete. Unless the Plans show otherwise, remove the walls of the structures as follows:

a. Beneath Pavement, to a depth at least two feet below the subgrade.

b. Beneath Subgrade, to a depth at least two feet below the finished grade.

c. At locations, to the extent required to avoid interfering with the work.

160.3.3.2 Abandoning, Closing, and Sealing Items

(1) Under the Abandoning Culvert Pipes Pay Item, plug both ends of the abandoned pipe as specified in 160.3.3.1.

160.3.3.3 Abandoning Wells

(1) Under the Abandon Wells Pay Item, fill and seal wells conforming to the Wisconsin administrative code as follows:

For monitoring wells ..... NR 141

For community wells or high capacity wells ..... NR 811

For private water supply wells ..... NR 812

160.4 Measurement

(1) Unless specified otherwise, the Department will measure this work in the original position of the removed structures. If the Contract does not include Pay Items for removing the listed miscellaneous structures, the Department will measure the excavation for those removals as common excavation. The Department will determine the volume of excavation for removing concrete structures as the area of the structure times the depth removed.

(2) The Department will measure Removing PCC Pavement, Removing PCC Pavement Butt Joints, Removing Asphaltic Surface, and Removing Asphaltic Surface Butt Joints by the square yard acceptably complete regardless of the depth or number of courses encountered. The Department will measure Removing Asphaltic Surface Milling by the square yard, or by the ton acceptably completed.

(3) If removing curb, gutter, or curb & gutter is required in conjunction with removing pavement, the Department will measure removing these structures by the square yard acceptably completed, under the Removing PCC Pavement Pay Item. If removing a rigid base with an asphaltic surface extending beyond the lateral limits of the rigid base, as in a widened pavement, the Department will measure only the area occupied by the rigid base under the Removing PCC Pavement Pay Item. The Department will measure the portion of the asphaltic surfacing beyond the rigid base removed under the Excavation Pay Items. The Department will make no deductions for any opening in the removed pavement having an area of three square yards or less.

(4) The Department will make no deductions from the volume measured under the Excavation Pay Items for pavement removed under the Removing Pavement Pay Item.

(5) If removing curb, gutter, or curb & gutter that is separate from and not removable in conjunction with removing pavement, the Department will measure Removing Curb, Removing Gutter, and Removing Curb & Gutter by the foot acceptably completed, measured along the flow line of gutter for gutter, or curb & gutter, and along face of curb for curb.

(6) Measure Removing PC Concrete Sidewalk by the square yard acceptably completed. Include steps based on the area of the horizontal projection of the steps.

(7) Measure Removing Fence by the linear foot acceptably completed.

(8) Measure Removing Concrete Slope Paving by the square yard acceptably completed, measured in the plane of the removal surface.

(9) Measure Removing Masonry by the cubic yard acceptably completed.

(10) Measure Removing Surface Drains as each individual surface drain acceptably completed.

(11) The Department will measure Removing Concrete Bases as each individual concrete base acceptably completed.

(12) Measure Removing Utility Poles as each individual pole, or pole stub acceptably completed, including all attached parts and connections.

(13) Measure Removing Manholes, Removing Catch Basins, and Removing Inlets as each individual manhole, catch basin, or inlet acceptably completed, including all attached parts and connections.

(14) Measure Removing Septic Tanks as each individual septic tank acceptably completed, including any dry wells in the tank's disposal system.

(15) Measure the Removing Building (location) Pay Items as a single lump sum unit for each building acceptably completed. The Department will measure the Removing Building (parcel) Pay Items as a single lump sum unit for all buildings within the specified parcel acceptably completed.

(16) Measure the Removing Storm Sewer and Culvert Pay Items by the linear foot acceptably completed, measured along the centerline of the pipe.

(17) Measure Abandoning Manholes, Abandoning Catch Basins, Abandoning Inlets, and Abandoning Wells as each individual manhole, catch basin, inlet, and well acceptably completed.

(18) Measure Abandoning Culvert Pipes, as each individual pipe acceptably completed, having both ends plugged.

160.5 Payment

160.5.1 General

(1) Payment for removing or abandoning miscellaneous structures is full compensation for breaking down, removing, closing, plugging, or sealing; for removing and disposing of headwalls; for obtaining any required work permits; for hauling and disposing of materials; for providing any required bentonite, soil, brick, concrete block, or concrete; for restoring the roadway cross-section; for any costs associated with contractor-caused damage; and, unless the Contract specifies granular backfill, for backfilling.

(2) If the Contract specifies or the Engineer directs backfilling with granular backfill, the Department will pay for that backfilling as follows:

a. If the Contract contains the Backfill Granular Pay Item; the Department will pay separately under the Backfill Granular Pay Item as specified in P203.

b. If the Contract as bid requires granular backfill but does not contain the Backfill Granular Pay Item, backfilling with granular backfill is incidental to the work.

c. If the Contract as bid does not require granular backfill and does not contain the Backfill Granular Pay Item, backfilling with granular backfill is extra work.

(3) Except for storm sewer, if the Contract does not include Pay Items for removing the listed miscellaneous structures from within the limits of grading, the Department will pay for these removals under the

Excavation Common Pay Item. The Department will pay for excavation for removing concrete structures exceeding one cubic yard, that were not specified for removal in the Contract, at five times the unit price bid for Excavation Common under the Removing Miscellaneous Concrete Structures administrative item. Other work involved in removing or abandoning miscellaneous structures within the roadway is incidental to the work.

(4) Except for storm sewer, if the Contract does not include a separate Pay Item for removing the miscellaneous structures listed above from beyond the grading limits all work involved in the removal, if the removal is specified in the Plans, is incidental to other Pay Items of work. If this removal is not shown but later found necessary and required, the Department will pay for all work involved in this removal as extra work.

160.5.2 Storm Sewer

(1) If the Contract or the Engineer requires storm sewer removal and the Contract does not include the Removing Storm Sewer Pay Item, the Department will pay for that removal as extra work.

160.5.3 Pay Items

(1) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

(2) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P160.100	Remove PCC Pavement	Square Yard (SY)
P160.105	Remove PCC Butt Joints	Square Yard (SY)
P160.110	Remove Asphalt Surface	Square Yard (SY)
P160.115	Remove Asphalt Surface Butt Joints	Square Yard (SY)
P160.120	Remove Asphalt Surface Milling	Square Yard (SY)
P160.125	Remove Asphalt Surface Milling	TON
P160.130	Remove PCC Curb	Linear Foot (LF)
P160.140	Remove PCC Gutter	Linear Foot (LF)
P160.150	Remove PCC Curb & Gutter	Linear Foot (LF)
P160.155	Remove PCC Sidewalk	Square Yard (SY)
P160.160 to P160.169	Remove Fence (type) (location)	Lineal Foot (LF)
P160.170	Remove Concrete Masonry	Cubic Yard (CY)
P160.180 to P160.189	Remove Concrete Masonry (location)	Lump Sum (LS)
P160.190	Remove Surface Drains	Each (EA)
P160.195	Remove Concrete Bases	Each (EA)
P160.200 to P160.209	Remove Utility Pole (location)	Each (EA)
P160.210	Remove Manhole	Each (EA)
P160.215	Remove Catch Basin	Each (EA)
P160.220	Remove Inlet	Each (EA)
P160.225 to P160.229	Remove Septic Tank (location designation)	Lump Sum (LS)
P160.230 to P160.234	Remove Building (location designation)	Lump Sum (LS)
P160.235 to P160.239	Site Clearance (location designation)	Lump Sum (LS)
P160.240 to P160.249	Remove Sewer (type) (size)	Lineal Foot (LF)
P160.250	Abandon Manhole	Each (EA)
P160.255	Abandon Catch Basin	Each (EA)
P160.260	Abandon Inlet	Each (EA)
P160.265	Abandon Well	Each (EA)
P160.270	Abandon Culvert Pipe	Each (EA)
P160.300	Remove Storm Sewer Under 30 Inch Diameter	Lineal Foot (LF)
P160.310	Remove Storm Sewer 30 to 42 Inch Diameter	Lineal Foot (LF)
P160.320	Remove Storm Sewer Over 42 Inch Diameter	Lineal Foot (LF)

P160.330 to P160.339	Remove Storm Sewer (size)	Lineal Foot (LF)
P160.340 to P160.349	Remove Storm Sewer (location)	Lineal Foot (LF)
P160.350	Remove Culvert Under 30 Inch Diameter	Lineal Foot (LF)
P160.360	Remove Culvert 30 to 42 Inch Diameter	Lineal Foot (LF)
P160.370	Remove Culvert Over 42 Inch Diameter	Lineal Foot (LF)
P160.380 to P160.389	Remove Culvert (size)	Lineal Foot (LF)
P160.390 to P160.399	Remove Culvert (location)	Lineal Foot (LF)
P160.400	Remove Wind Cone	Each (EA)
P160.410	Remove Wind Tee	Each (EA)
P160.420	Remove Segmented Circle	Each (EA)
P160.430	Remove Tie-Down Anchor	Each (EA)

END OFSPECIFICATION P160

Specification P190 – Foundation Preparation

190.1 Description

(1) This section describes restoring, correcting, strengthening, or otherwise preparing the pavement foundation to a condition suitable for constructing and supporting a subbase, base, or surface course. Perform the work described in this section whether or not the Contract contains the applicable Prepare Foundation bid items.

(2) The Department defines the pavement foundation as the finished earth subgrade, subbase, or base supporting subbase, base, or surface course.

190.2 (Vacant)

190.3 Construction

190.3.1 General

(1) Prepare and construct the foundation to uniform density throughout. Construct the foundation to the required alignment and cross-section with equipment and methods adapted for the purpose. After shaping and compacting, provide a smooth foundation, at required density, and at the proper elevation and contour, to receive the next course.

(2) If necessary to properly accomplish blading or to eliminate or prevent conditions of non-uniform stability or density, scarify the area forming the foundation to a uniform depth.

(3) Unless specified otherwise, fill all holes, ruts, and other depressions in the foundation with materials similar to those existing in the foundation. Excavate and remove high places to the required lines, grade, and section.

(4) Do not place materials on frozen earth subgrades.

(5) Excavate and backfill areas of yielding or unstable materials. Backfill with material specified, or if none is specified with material from the excavation.

(6) Engineer may make minor adjustments in the Plan finished grade line necessary to maintain the characteristics of a stabilized foundation by minimizing the amount of cutting into, or filling over the stabilized foundation, provided these adjustments do not impair the riding qualities, drainage, or appearance of the finished pavement.

(7) Prepare the foundation to conform to the specifications for the specific subbase, base, or surface course constructed.

190.3.2 Earth Subgrade

(1) If the foundation is an earth subgrade, constructed under this Contract or under a previous contract, prepare or restore the foundation by removing all vegetation; excavating and removing materials encountered above the required elevations; filling all depressions occurring below the required elevations; and smoothing, shaping, and compacting the subgrade to the required grade, section, and density.

(2) Scarify the subgrade to a depth necessary for the type of material encountered. Shape and compact the subgrade to the required lines, grade, cross-section, and uniform density. Remove stones over four inches in greatest dimension encountered during the operations.

(3) If the earth subgrade construction was substantially completed under a previous contract, do not presume that the previously completed work conforms to the requirements under this section.

190.3.3 Foundation for Non-Rigid Base

(1) Prepare the foundation by scarifying, blading, leveling, and rolling as required to bring the foundation to the required grade, cross-section, and density. Shape and compact the pavement foundation for the full width, to the required lines, grade, cross-section, and density sufficiently in advance of base laying operations. Unless specified otherwise, uniformly compact the foundation to not less than the density of the particular material existing in the foundation. Maintain the prepared foundation ahead of the base laying operations in a smooth condition and at not less than specified density. Remove ruts or surface irregularities produced by hauling or other equipment or other traffic. Correct all soft or yielding areas, holes, or other defects that occur due to traffic, hauling, poor drainage, unstable materials, or from other causes before placing the base. Do not place base on frozen subgrade.

(2) Bring the foundation for open graded base to the required grade and cross-section using a machine designed specifically for trimming foundations. The machine shall utilize automatic sensors to trim to the

required grade and cross-section. If trimmed material consists of crushed aggregate, salvage and use this material in the aggregate base for shoulder construction.

190.3.4 Foundation for Concrete Pavement and Concrete Base

190.3.4.1 General

(1) Prepare the foundation for concrete pavement or concrete base by restoring, preparing, and conditioning unstabilized base courses. For areas of the foundation impracticable to prepare by machine methods, prepare these areas by hand methods satisfactory to the Engineer.

(2) Ensure that the base course in all cases is in a moist but not saturated condition during concrete placement. Water the base course, if required, not less than six hours before placing the concrete. If the base course subsequently dries, moisten it by sprinkling water just before placing the concrete. Sprinkle the water to avoid forming pools.

(3) Trim and shape the base course for a concrete base or pavement for a width equal to the width of the intended base or pavement plus at least one foot on each side to approximately the required lines, grade, and cross-section; and then uniformly compact to the required density. Perform compaction with suitable rolling or other types of consolidating equipment. Unless specified otherwise, uniformly compact the foundation to not less than the density for standard compaction of earth subgrade, subbase, or base.

(4) Complete preparing the base course for at least 300 feet in advance of depositing concrete, unless the Engineer allows otherwise.

(5) Trim and smooth ruts and irregularities in the base course surface caused by trucks or other equipment. Compact these ruts and irregularities ahead of concrete placing operations. Excavate, fill with suitable material, and compact soft and yielding spots.

190.3.4.2 Slip-Form Methods

(1) If using slip-form methods, after satisfactorily compacting the base course, trim the area supporting the slip-form paver and where pavement will be placed to the required grade and cross-section using a machine equipped with automatic sensors and designed for trimming base course. If placing overlays on existing pavements, compact and bring shoulder areas supporting the slip-form paver to grade by similar means. Test these areas for compliance with the required grades and cross-section using Engineer-approved methods.

190.3.4.3 Form Methods

(1) After preparing the base course, set the forms and bring the base course to true section and elevation. Fill all depressions and remove excess material. Dispose of excess material beyond the forms in a way that does not interfere with concrete placing and finishing operations. After trimming, compact loose areas and keep the base course smooth and at the specified density until concrete placement.

(2) If the Engineer allows hauling or other equipment on the prepared base course, repair the foundation, as necessary, by methods and equipment the Engineer approves.

190.3.5 Foundation for Asphaltic Surfacing

190.3.5.1 General

(1) Prepare the foundation for asphaltic surfacing by restoring, preparing, and conditioning of aggregate bases, existing asphaltic pavement or surfacing, or concrete bases and pavements, in the manner specified for applying an asphaltic treatment or surface.

(2) Prepare the foundation sufficiently ahead of the surfacing operations to allow uninterrupted progress of these operations. Before applying the asphaltic surfacing, clean the surface of the prepared foundation by brooming off all dust, dirt, debris, or other foreign or loose material.

(3) For existing Airport roadway pavements where the drop-off at the edge of pavement is two inches or more, place shoulder material or bring the existing shoulder material flush with the pavement surface before placing asphaltic base, wedge, binder, or surface course.

(4) Prepare the foundation for asphaltic shoulders by excavating, shaping, and preparing the existing crushed aggregate shoulder before and after constructing new shoulders. Use the excavated material to shape the remaining aggregate shoulders or to widen the roadbed where possible.

190.3.5.2 Aggregate Base

(1) Scarify, shape, trim, and compact, where and as necessary, the surface of the aggregate base to produce the required cross-sectional contour; a profile free from abrupt changes in elevation; and a surface without pits, hollows, depressions, or projections.

(2) Perform shaping and trimming with long-wheel-base motor graders or subgrade finishers designed for the purpose.

190.3.5.3 Asphaltic Treated Surfaces and Pavements

(1) Remove areas that will cause raveling, shoving, or bleeding of the overlying pavement. If the Engineer directs, remove other areas the Engineer deems unsuitable. Remove protruding joint filler from cracks to at least the surface of the old pavement and remove excess joint filler and joint sealant materials from the pavement surface.

(2) Clean all loose material from holes in the existing asphaltic pavement or surfacing. Fill the holes with asphaltic surface mixture and consolidate the mixture over its full depth.

190.3.5.4 Concrete Pavements and Bases

(1) Remove all surplus crack and joint sealing material from the pavement surface. Remove all protruding joint materials, including fillers and sealers, from joints and cracks to at least the surface of the old concrete.

(2) Completely remove unstable patches of asphaltic surface used to fill localized pits, depressions, or badly spalled, or disintegrated areas of the old pavement to the underlying concrete. Remove loose concrete or concrete with developing spalling within or adjacent to these areas.

190.3.6 Incorporating or Disposing of Surplus or Unsuitable Material

(1) Dispose of all surplus or unsuitable material at locations shown on the Plans or if no location is shown, dispose off-site at a location provided by the Contractor.

190.3.7 Other Work

(1) Perform other preparatory work shown on the Plans, the Special Provisions, or as the Engineer directs. This preparatory work may consist of correcting the subgrade; removing existing asphaltic surface courses, curbs, gutters; widening or patching base or existing pavement; furnishing and placing additional base; and similar work or operations.

190.4 Measurement

(1) The Department will only measure work under the Prepare Foundation Pay Items for the Pay Items which are included in the Contract. If there are no Pay Items for Foundation Preparation in the Contract, the Work will be considered incidental and the cost included in other Pay Items. Work outside the limits the Plan designates is incidental to the Contract.

(2) The Department will measure the lump sum Prepare Foundation Pay Items under this section as a single lump sum unit for acceptably completing foundation preparation for each project.

190.5 Payment

190.5.1 General

(1) Payment is full compensation for the work required under this section, within the limits the Plan designates for the Prepare Foundation bid items, except as specified otherwise. Required work performed outside the limits the Plan designates for the Prepare Foundation Pay Items is incidental to the Contract. If the Contract does not contain a specific Prepare Foundation bid item, the work required under this section is incidental to the Contract.

(2) Payment also includes water for compaction and dust control, unless there is a separate Pay Item for water for dust control in the Schedule of Prices.

(3) The Department will pay separately for the following work under the pertinent Contract Pay Items, or absent the pertinent items, as extra work:

a. Excavating and backfilling areas of yielding or unstable materials.
b. Performing Engineer-ordered alterations of work previously completed.
c. Patching base or furnishing asphaltic surface mixtures for repair of asphaltic treated foundations.

190.5.2 Other Work

(1) The Department will pay separately for the preparatory work required in 190.3.7(1) under the pertinent Contract Pay Items, or absent the pertinent items, as extra work.

190.5.3 Pay Items

(1) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

(2) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P190.010	Prepare Foundation for Asphaltic Paving (location)	Lump Sum (LS)
P190.020	Prepare Foundation for PCC Paving (location)	Lump Sum (LS)
P190.030	Prepare Foundation for Concrete Base (location)	Lump Sum (LS)

END OF SPECIFICATION P190

Specification P203 - Granular Backfill

203.1 Description

(1) This specification describes furnishing processed or selected granular materials, where the Plans designate, as follows:

a. Backfilling excavations for frost heave or other unstable materials.
b. Backfilling for sewer and utility removals.
c. Filling areas associated with muck excavation.
d. Placing material for subgrade improvements.
e. Backfilling trenches for pipe culverts, storm sewers, underdrains, electrical conduit, and similar structures.

203.2 Materials

203.2.1 General

(1) Furnish virgin materials consisting of either sand-sized particles or sand-sized particles mixed with gravel, crushed gravel, or crushed stone. Do not use crushed concrete or reclaimed asphalt.

(2) Conform to the definitions under 301.2 of the SHS.

(3) Use either grade 1 or grade 2 material, unless the Contract specifies otherwise.

(4) Do not use materials with a liquid limit greater than 25 and a plasticity index greater than six.

203.2.2 Gradation

(1) For the entire sample, conform to the following:

SIEVE	PERCENT PASSING BY WEIGHT	
	GRADE 1	GRADE 2
6-inch	100	100
3-inch	85 – 100	85 - 100
No. 4	25 - 100	25 - 100

(2) For material passing the No. 4 sieve, conform to the following:

SIEVE	PERCENT PASSING BY WEIGHT	
	GRADE 1	GRADE 2
No. 4	100	100
No. 40	0 - 75	----
No. 100	0 - 15	0 - 30
No. 200	0 - 8.0	0 - 15.0

203.2.3 Sampling and Testing

(1) The Department will sample and test granular backfill conforming to the following:

Sampling [1] ..... AASHTO T2
Percent passing the 200 sieve [1] ..... AASHTO T11
Gradation [1] ..... AASHTO T27
Liquid limit ..... AASHTO T89
Plasticity index and plastic limit ..... AASHTO T90

[1] *As modified in CMM 860.*

(2) The Department may sample and test using other Engineer-approved field methods. Contractor shall provide samples for testing ten days in advance of placement.

203.2.4 Source

(1) Contractor is responsible for providing backfill material from a source provided by Contractor.

(2) Remove the granular backfill material and restore excavation to a final condition as specified for final cleanup in accordance with 40.9.

(3) In addition to removing the topsoil, substantially remove overburden of soil, or earthy materials passing the No. 200 sieve before excavating the granular backfill material.

(4) If the Department measures granular material for payment in its original position, trim and shape pits after removing overburden and before removing granular material to allow taking accurate measurements. After removing the required amount of granular material, repeat trimming and shaping of the areas to allow taking accurate measurements.

(5) Restore the site by replacing or disposing of the removed overburden and ensure that disposal sites are neatly constructed.

203.3 Construction

(1) If granular backfill is specified or required for backfilling trenches, place and compact as specified for the construction of work under the applicable specification section, or if no specification is provided compact to 95 percent of laboratory density determined by ASTM D1557.

203.4 Measurement
203.4.1 General

(1) The Department will not pay separately for granular backfill material specifically designated as incidental to other Contract Pay Items.

(2) The Department will pay for erosion control, fertilizing and seeding of pits and associated areas separately as specified for borrow sites and material disposal sites.

(3) The Department will not measure granular backfill placed outside the designated fill limits or specifically designated as incidental to other Contract Pay Items.

203.4.2 Measured in Final Position

(1) For backfilling pipe culverts, the Department will compute the volume from the dimensions of the limits of excavation and depth of backfill the Plans show or the Engineer requires, less the included structure volume.

203.5 Payment
203.5.1 General

(1) Payment for Backfill Granular is full compensation for providing all granular backfill material; for excavating, loading, hauling, placing, compacting, and finishing the material; for stripping, clearing, grubbing, shaping, trimming and cleaning up the pits; for salvaging, stockpiling, re-handling, and spreading salvaged material over excavated pit areas; and for disposing of surplus materials.

(2) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

203.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P203.010	Backfill Granular	Cubic Yard (CY)

END OF SPECIFICATION P203

Specification P205 - Select Crushed Material

205.1 Description

(1) This specification describes providing select crushed material and placing and compacting the material on a prepared subgrade in accordance with the Plans or as directed by Engineer.

205.2 Materials

(1) Furnish crushed rock or concrete from a Department-approved source substantially free of unconsolidated overburden materials, topsoil, organic materials, and other deleterious materials.

(2) Department-approved source shall meet the following requirements:

a. Mined or quarried rock that, is hard, durable, and when processed through a primary crusher, will produce a material meeting gradation requirements.

b. Concrete that is free of steel, building materials or other deleterious material; and when processed through a primary crusher produces a material meeting gradation requirements.

c. Select crushed material shall meet the wear requirements of ASTM C131 and the soundness requirement of ASTM C88.

(3) Engineer may reject material produced from deteriorated concrete or from non-durable rock such as sandstone, shale, slate, disintegrated granite, or heavily weathered rock. Select crushed material shall meet the following gradation:

SIEVE	PERCENT PASSING (by weight)
5-inch	90 - 100
1 1/2-inch	20 - 50
No. 10	0 - 10

(4) Furnish select crushed material with a minimum of 50 percent, by count, of the number of particles retained on the 1 ½-inch sieve with at least two fractured faces.

(5) The Department will assess select crushed material acceptability based on soundness, wear, and gradation tests on file for the material source or on certified laboratory tests provided by Contractor.

205.3 Construction

(1) Place select crushed material where shown on the Plans or as the Engineer directs. Ensure that there is adequate moisture in the aggregate during placing, shaping, and compacting to prevent segregation and achieve adequate compaction.

(2) Construct and compact select crushed material to the requirements of 152.2. Spread and compact select crushed material in compacted layers of 16-inches or less. The Engineer may allow thicker layers to address soft foundation conditions.

205.4 Measurement

205.4.1 Measurement by Cubic Yard

(1) Select Crush Material shall be measured by the number of cubic yards of select crush material placed, compacted, and accepted in the completed course. The quantity of select crush material shall be measured in final position based upon survey or depth tests taken by the Engineer. On individual depth measurements, thicknesses more than 1/4 inch in excess of that shown on the Plans shall be considered as the specified thickness plus 1/4 inch in computing the yardage for payment. Select crush materials shall not be included other excavation quantities.

205.4.2 Measurement by Ton

(1) When a Pay Item per ton is provided in the Schedule of Prices, measurement for payment for select crush material shall be made by the number of tons of material placed, compacted, and accepted in accordance with this Specification. Truck scale weights as specified in Section 90.1.4 will be used to determine the basis for tonnage.

205.5 Payment

205.5.1 General

(1) The Pay Items for Select Crushed Material, measured as provided, will be paid for at the Contract unit price per ton or cubic yard. The unit price shall be full compensation for excavation, preparation of the bed, including backfilling and disposal of excess material; for furnishing and placing Select Crushed Material, for restoring the site; and for all equipment, tools, labor, and appurtenant items necessary to complete the Work.

(2) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

205.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P205.010	Select Crushed Material	TON
P205.020	Select Crushed Material	Cubic Yard (CY)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C88	Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate
ASTM C131	Resistance to Abrasion of Small Size Coarse Aggregate by use of the Los Angeles Machine

END OF SPECIFICATION P205

Part 4 – Base Course

Specification P207 – Composite Base Course

207.1 Description

207.1.1 General

(1) This Work consists of constructing a Composite Base Course composed of pulverized existing bituminous pavement, mixed with aggregate, and constructed on a subgrade, in accordance with these specifications and in conformance with the dimensions and typical cross sections shown on the Plans.

(2) The aggregate may be existing base course, virgin crushed aggregate base course, or a mixture of existing and virgin crushed aggregate base course.

(3) Fly ash shall be mixed with the composite base course when the Pay Item for Fly Ash for Composite Base Course is included in the Schedule of Prices. If the Plans require fly ash to be added to the composite base course and there is no Pay Item for fly ash; then the addition of fly ash shall be incidental Work and the cost included in the price for Recycled Composite Base Course.

(4) Composite Base Course In-Place requires pulverizing the existing bituminous surface full depth, incorporating a portion of the existing base course (if shown on the Plans), adding virgin crushed aggregate material (if shown on Plans), adding fly ash (if shown on Plans), mixing the materials to provide a consistent homogenous composite material, shaping the mixture to the cross-section shown on the Plans, and compacting the composite material in-place on the remaining course or the subgrade.

(5) Composite Base Course Transported and Placed will be required when existing pavement needs to be removed to facilitate re-grading of the subgrade. This Pay Item requires pulverizing the existing bituminous surface, including the existing base course, to the depth required to produce the specified mix proportions, as shown on the Plans. Additional virgin crushed aggregate and fly ash will be added to the composite material if required on the Plans or Special Provisions. All of the materials shall be mixed to provide a consistent, homogeneous material. This mixture shall be removed and transported to its final location or to a stockpile as determined by Contractor. Stockpile locations shall be within the construction limits as approved by Engineer, or as shown on Plans. If placed in a stockpile, composite base course meeting the requirements of the specification shall be ultimately transported to its final location. Stockpiled material shall meet all of the requirements for product control specified in 207.2.2. Whether placed immediately or stockpiled and transported, the composite material shall be placed, shaped as required on the Plans, and compacted in its final location.

207.1.2 Construction Staking

(1) Contractor shall provide all construction staking in accordance with 50.6, except Engineer will provide staking as described on the Plans or specified in the Special Provisions.

207.2 Materials

207.2.1 Composite Base Course.

(1) Composite Base Course shall consist of materials produced by pulverizing the existing bituminous pavement and mixing with aggregate base. Contractor shall use the aggregate produced by the recycling operation, with the exception that in no case will material that would be retained on a 2-inch sieve be permitted to be used in the aggregate base, and no more than 50% percent of the material can be from the recycled bituminous material. Material retained on a 2-inch sieve shall be removed by Contractor. Composite Base Course, sampled from the control strip required to determine the target density under 207.3.6.1, shall be tested by Contractor, after processing, to determine gradation, density, and moisture requirements for placing and compacting the composite base material. Contractor shall adjust the amount of virgin aggregate to meet gradation requirements. Contractor's operations shall produce a composite material in conformance with Table 207.2.1 Gradation Requirements, unless variations are approved by Engineer.

Table 207.2.1

COMPOSITE BASE COURSE GRADATION REQUIREMENTS

Sieve	Minimum Percentage by weight passing sieves
2 inch	100
No. 4 (4.75 mm)	55
No. 200 (75 µm)	0-15

207.2.2 Product Control

(1) Contractor shall handle all material in such a manner that the following requirements are maintained:

a. Deleterious Substances. Materials for aggregate base shall be kept free from weeds, sticks, grass, roots, subgrade material, and other undesirable foreign matter.

b. Uniformity of Mix. Materials shall be thoroughly mixed by the Contractor in a manner to ensure that the final product has a uniform gradation.

c. Stockpiling. Equipment and methods used for stockpiling aggregates and for removing the aggregates from the stockpiles shall be such that no detrimental degradation or segregation of the aggregate will result, no appreciable amount of foreign material will be incorporated into the aggregate and no intermingling of the stockpiled material will occur.

207.2.3 Virgin Aggregate

(1) Virgin aggregate shall be P208 Crushed Aggregate Base Course, unless alternative requirements for crushed aggregate is indicated on the Plans or Special Provisions, supplied and spread in a manner suitable for mixing to produce Recycled Composite Base Course.

207.2.4 Fly-Ash

(1) Fly-ash shall meet ASTM Specification C-618, section 3.3 when sampled and tested in accordance with Sections 5, 6, and 8, unless otherwise shown on the Plans. Fly ash shall be Class C containing a minimum of 25 percent CaO. The source of the fly ash shall be identified and approved in advance of stabilization operations in order that laboratory tests can be completed.

(2) Fly ash shall be stored and handled in closed weatherproof containers until just prior to distribution. Temporary storage (less than 12 hours) of fly ash in pits may be allowed provided that wetting of the fly ash by rain or ground water is not allowed. Fly ash exposed to moisture prior to mixing with aggregate mixture shall be discarded.

207.2.5 Water

(1) Water used for mixing and curing shall be clean and free of oil, salt, acid, alkali, sugar, vegetable or other substances injurious to the finished product. Water shall be tested in accordance with and shall meet the suggested requirements of AASHTO T26. Water known to be of potable quality may be used without testing.

207.2.6 Quality Control (QC) Sampling and Testing.

(1) Contractor shall take at least two composite base course material samples per day of production in the presence of Engineer to check the gradation. Sampling shall be per ASTM D75. Material shall meet the requirements in 207.2.1. Samples shall be taken from the in-place, un-compacted material at random sampling locations per ASTM D3665.

207.3 Construction Methods

207.3.1 Milling

(1) Milling, if required, is shown on Plans or specified in the Special Provisions.

207.3.2 Control Strip

(1) The first half-day of construction shall be considered the control strip. Contractor shall demonstrate, in the presence of Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not begin until the control strip has been accepted by Engineer. Upon acceptance of the control

strip by Engineer, Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by Contractor are approved in advance by Engineer.

207.3.3 Pulverizing

(1) The existing bituminous pavement will be pulverized to a depth shown on Plans.

(2) Portions of the existing pavement structure located below the depth of the pavement designated on the Plans to be pulverized shall not be disturbed by the pulverizing operation and shall remain in a compacted condition.

207.3.4 Mixing

(1) The pulverized bituminous pavement, existing aggregate base and virgin aggregate shall be uniformly blended with 10 percent fly ash (if required) and water with a pulverizer to the depth shown on the Plans or in the Special Provisions. The target ratio is 40 percent pulverize bituminous and 60 percent aggregate. In no case shall more than 50 percent of the finished product come from the recycled bituminous pavement.

(2) Pulverizing and mixing may be completed in one operation, however, if the composite material is not uniformly mixed, or if it does not meet the gradation requirements, additional passes of the pulverizer shall be required to produce a uniform, homogeneous mixture.

207.3.5 Placing

(1) Existing aggregate base course material not mixed with the composite base shall remain in place on the undisturbed subgrade.

(2) The maximum depth of a compacted layer shall be 12 inches. If the total depth of the compacted material is more than 12 inches, it shall be constructed in two or more layers. In multi-layer construction, the base course shall be placed in approximately equal depth layers. Prior to placing the next layer, the previously constructed layer shall be cleaned of loose and foreign material.

(3) Immediately after pulverizing and mixing or after removal from the stockpile, relay the composite material with a paver, grader, or both a paver and grader.

(4) After placement has been completed, the Contractor shall remove by manual or mechanical methods, any remaining crack-sealing material that occurs within the top 1-inch of the finished grade. The Engineer will verify that all unwanted material has been removed from the composite base course surface and if not satisfactory, the Engineer will mark materials to be removed. If surface has already been graded to its final location and is substantially disturbed, the Engineer may require the Contractor to re-grade this area prior to acceptance. Work to remove crack seal material and regrading shall be incidental to this item.

207.3.6 Compaction

(1) Immediately upon completion of the spreading operations, the recycled composite base course shall be thoroughly compacted. The number, type and weight of rollers shall be sufficient to compact the material to 95 percent of target density as determined for the test section.

(2) The moisture content of the material during compaction shall be within plus or minus two percent of the optimum moisture content.

207.3.6.1 Target Density

(1) Construct a control strip to determine the target density for the re-laid material. The control strip construction and density testing shall occur under the observation of the Engineer. Additional control strips will be required when the nature or the composition of the material changes.

(2) Unless the Engineer approves otherwise, construct control strips for target density determination to a minimum dimension of 300 feet long and 17.5 feet wide.

(3) Completed control strips may remain in-place to be incorporated into the final cross-section.

(4) Construct additional control strips (at a minimum) when the percent of target density on three consecutive density measurements (for samples taken during construction of the base course) are less than 90 percent or exceed 105 percent of the target density and the density measurements are outside the range for the 10 random measurements defining the control strip.

(5) Construct control strips using equipment and methods representative of the operations to be used to replay and compact the Composite Material. Wet the base, as mutually agreed upon by Contractor and Engineer, to obtain and maintain adequate moisture content to ensure proper compaction. Discontinue water placement if the base begins to exhibit signs of saturation or instability.

(6) After compacting the control strip with a minimum of two passes, mark and take density measurements at three random locations, at least 1-½ feet from the edge of the base. Subsequent density measurements will be taken at the same three locations.

(7) After each subsequent pass of compaction equipment over the entirety of the control strip, take density measurements at the three marked locations. Continue compacting and testing until the increase in density measurements is less than 1.0 lb./ft.^{3}, or the density measurements begin to decrease.

(8) Upon completion of control strip compaction, take ten randomly located density measurements within the limits of the control strip, at least 1-½ feet from the edge of the base. The final measurements recorded at the three locations previously marked may be included as three of the ten measurements. Average the ten measurements to obtain the control strip target density and corresponding target moisture.

207.3.6.2 Proof Rolling

(1) Compacted recycled composite base course shall be proof rolled with a Tandem axle Dual Wheel Dump Truck loaded to the legal limit with tires inflated to 80 psi in the presence of the Engineer. Soft areas of subgrade that deflect greater than 0.5 inch or show permanent deformation greater than 0.5 inch shall be removed and reworked.

(2) The purpose of proof rolling the composite base course is to identify weak areas in the composite base course and shall not be a substitute for testing compaction of the composite base course.

207.3.7 Finishing

(1) The surface of the aggregate base course shall be finished by blading or with automated equipment designed for this purpose. If the top layer is 1/2 inch or more below grade, the top layer shall be scarified to a depth of at least three inches, new material added, and the layer blended and re-compacted to bring it to grade. The addition of layers less than three inches shall not be allowed.

207.3.8 Weather Limitations

(1) When weather conditions detrimentally affect the construction process and/or quality of the materials, Contractor shall stop construction. Cement or fly ash shall not be applied when wind conditions affect the distribution of the materials. When the aggregates contain frozen materials or when the underlying course is frozen or wet, the construction shall be stopped. Construction shall not be performed unless the atmospheric temperature is above 35 degrees Fahrenheit and rising or approved by Engineer. When the temperature falls below 35 degrees Fahrenheit, protect all completed areas against detrimental effects of freezing by approved methods. Correct completed areas damaged by freezing, rainfall, or other weather conditions to meet specified requirements.

207.3.9 Maintenance

(1) The asphalt aggregate base course shall be maintained in a satisfactory condition until the work is accepted by Engineer. Equipment used in the construction of an adjoining section may be routed over completed sections of asphalt aggregate base course, provided that no damage results and equipment is routed over the full width of the completed asphalt aggregate base course. Damage to the recycled asphalt aggregate base course shall be repaired by the Contractor at the Contractor's expense.

207.3.10 Surface tolerances

(1) The finished surface shall be tested for smoothness and accuracy of grade. Areas failing smoothness or grade shall be scarified to a depth of at least three inches, reshaped and re-compacted by the Contractor at the Contractor's expense.

207.3.10.1 Smoothness

(1) The finished surface shall not vary more than 3/8-inch when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12-foot straightedge for the full length of each line on a 50-foot grid, and at additional locations designated by Engineer. Contractor shall perform the smoothness testing in the presence of the Engineer. Contractor shall furnish a straightedge, acceptable to Engineer, constructed and certified by a manufacturer for the use intended.

207.3.10.2 Grade

(1) The grade shall be measured on a 50-foot grid and shall be within plus zero and minus 0.5 inches of the specified grade.

207.3.10.3 Engineer Staking

(1) When Engineer has placed survey hubs to grade, smoothness and accuracy shall be tested by Contractor in the presence of Engineer using a string line stretched taut between hubs (transverse and

longitudinal). The distance between hubs shall be determined by Engineer but shall not exceed 50 feet. The vertical distance from string line to finished grade shall not exceed (plus or minus) 3/8 inch at all points.

207.3.11 Acceptance Sampling and Testing for Density

(1) Composite base course shall be accepted for density and thickness on an area basis. One test for density and thickness will be made for each 1200 square yards. Sampling locations will be determined on a random basis in accordance with ASTM D3665.

207.3.11.1 Density

(1) Contractor's laboratory shall perform all density tests in Engineer's presence and provide the test results upon completion to Engineer for acceptance.

(2) Each area will be accepted for density when the field density is at least 95 percent of the maximum density of the composite base course in accordance with ASTM D698. The in-place field density shall be determined in accordance with ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938. If the specified density is not attained, the area represented by the failed test must be reworked and/or recompacted and two additional random tests made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

207.3.11.2 Thickness

(1) The thickness of the base course shall be within plus zero and minus 0.5 inch of the specified thickness as determined by depth tests taken by Contractor in the presence of Engineer for each area. Where the thickness is deficient by more than 1/2-inch, Contractor shall correct such areas at no additional cost by scarifying to a depth of at least 3 inches, adding new material of proper gradation, and recompacted to grade. The Contractor shall replace, at his expense, base material where depth tests have been taken. Additional test holes may be required to identify the limits of deficient areas. Contractor shall replace, at his expense, base material where depth tests have been taken. The average thickness for the project shall not be less than the specified Plan thickness.

(2) When Engineer has placed survey hubs to grade from the bottom and top of the base course, at intervals not exceeding 50 feet longitudinally, and at the centerline and edges of the base course not exceeding 25 feet, in the transverse direction; then additional thickness testing is not necessary, provided the base course has been tested and has met the requirements for smoothness, cross slope, and accuracy. Engineer reserves the right to randomly spot check hub elevations prior to final acceptance of the base course and commencement of paving.

207.4 Measurement

207.4.1 Composite Base Course In-Place

(1) Composite Base Course In-Place constructed to the specified thickness shall be measured by the square yard (SY) based upon the quantity of existing pavement pulverized. This quantity shall not exceed the amount shown on the Plans without approval of Engineer.

207.4.2 Crushed Aggregate Base Course Spread

(1) Crushed Aggregate Base Course Spread shall be measured by the tons of material, incorporated into the Work based on weight tickets from recorded truck scale weights.

207.4.3 Composite Base Course Transported and Placed

(1) Composite Base Course Transported and Placed shall be measured by the cubic yards (cy) of material placed, in accordance with the Plans and Specifications and measured by Engineer.

(2) The quantity of aggregate base course to be paid for shall be the number of cubic yards of base course material placed and accepted in the completed base course. The quantity of base course material, when measured by the cubic yard, shall be measured in final (compacted) position based upon specified Plan thickness.

207.4.4 Fly-Ash for Composite Base

(1) Fly Ash for Composite Base shall be measured by the ton of material incorporated into the Work based on weight tickets.

207.5 Payment

207.5.1 Composite Base Course In-Place

(1) Payment shall be made at the Contract unit price per square yard (SY) for pulverizing the existing bituminous pavement, blending aggregate base course (when shown on Plans), mixing with fly ash

(when shown on Plans), and spreading and compacting the composite material to the compacted thickness as indicated on the drawings. This price includes all of the necessary material handling, spreading, and compacting as well as removal and disposal of excess material. This price shall be full compensation for furnishing all materials, for preparing and placing these materials, for control sections, quality control testing, and reworking, and for all labor, equipment tools and incidentals to complete the item.

207.5.2 Crushed Aggregate Base Course Spread

(1) Payment shall be made at the Contract unit price per ton for Crushed Aggregate Base Course Spread. This price shall be full compensation for furnishing all materials, in accordance with P208 (or alternative material indicated on the Plans or Special Provisions); for preparing and spreading the material in order to be incorporated in the Composite Base Course, and for all labor, equipment, tools, and incidental items necessary to complete the Work.

(2) Base course material, measured by the ton, which contains total moisture in excess of the optimum moisture content, will have the weight of the excess deducted from the measured weight. Determination of the moisture content of the aggregates will be based on percent of the dry weight of the aggregates.

207.5.3 Composite Aggregate Base Course Transported and Placed.

(1) Payment will be made at the Contract unit price per cubic yard (CY) for Composite Base Course Transported and Placed. This price shall be full compensation for all materials and for all pulverizing, mixing, excavation, transporting, placing, shaping, and compaction; for control section, quality control testing, and reworking, and other operations required, and for all labor, equipment, tools, and incidentals necessary to complete the Work.

207.5.4 Fly-Ash for Composite Base

(1) Payment will be made for Fly-Ash for Composite Base at the Contract unit price per ton. This price shall be full compensation for furnishing, transporting, and spreading the material for incorporation into a Composite Base Course, including all labor, equipment, tools, and incidentals necessary to complete the Work.

207.5.5 Pay Items

(1) Payment will be made for measured quantities based on Contract prices for the following Pay Items:

Pay Item	Description	Unit
P207.010	Composite Base Course In-Place	Square yard (SY)
P207.020	Crushed Aggregate Base Course Spread	TON
P207.030	Composite Base Course Transported and Placed	Cubic yard (CY)
P207.040	Fly-Ash for Composite Base	TON

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C29	Unit Weight of Aggregate
ASTM C88	Soundness of Aggregates by Use of Sodium or Magnesium Sulfate
ASTM C117	Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregate by Washing
ASTM C131	Resistance to abrasion of Small Size Coarse Aggregate by Use of Los Angeles Machine
ASTM C136	Sieve or Screen Analysis of Fine and Coarse Aggregate
ASTM C150	Standard Specification for Portland Cement
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

ASTM D75	Sampling Aggregate
ASTM D558	ASTM D558 Standard Test Methods for Moisture-Density (Unit Weight) Relations of Soil-Cement Mixtures
ASTM D698	Moisture Density Relations of Soils and Aggregate using 5.5 lb Rammer and 12 in drop
ASTM D977	Standard Specification for Emulsified Asphalt
ASTM D1556	Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method
ASTM D1557	Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
ASTM D2216	Test Methods for Laboratory Determination of Water (Moisture) Soil and Rock by Mass
ASTM D2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4751	Standard Test Methods for Determining Apparent Opening Size of a Geotextile
ASTM D5821	Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth)

American Association of State Highway and Transportation Officials (AASHTO)

M288	Standard SPECIFICATION for Geosynthetic Specification for Highway Applications

END OF SPECIFICATION P207

Specification P208 - Aggregate Base Course

208.1 Description

(1) This Work shall consist of a base course composed of course aggregate bonded with fine aggregate base. Construct the base course on a prepared subgrade or subbase course in accordance with these Specifications, conforming to the dimensions and typical cross-section shown on the Plans.

208.1.2 Construction Staking

(1) Contractor shall provide all construction staking in accordance with 50.6, except Engineer will provide staking as described on the Plans or specified in the Special Provisions.

208.2 Materials

208.2.1 Aggregate Base

(1) Aggregate base material shall consist of both fine and coarse aggregate. Material shall be clean, sound, durable particles and fragments of stone or gravel, crushed stone, or crushed gravel mixed or blended with sand, screenings, or other similar materials produced from approved sources. Materials shall be handled and stored in accordance with all federal, state, and local requirements. Provide aggregate free from lumps of clay, organic matter, and other deleterious materials or coatings. The method used to produce the crushed aggregate shall result in the fractured particles in the finished product as nearly constant and uniform as practicable. The fine aggregate portion, defined as the portion passing the No. 4 (4.75 mm) sieve produced in crushing operations, shall be incorporated in the base material to the extent permitted by the gradation requirements. Aggregate base material requirements are listed in the following tables.

Table 208.2.1.1

Aggregate Base Material Requirements		
Coarse Aggregate Portion (Retained on the No. 4 (4.75 mm) sieve)		
Material Test	**Requirement**	**Standard**
Resistance to Degradation	Loss: 50% maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate **or** Magnesium Sulfate	Loss after 5 cycles: 12% maximum using Sodium sulfate - or -18% maximum using magnesium sulfate	ASTM C88
Percentage of Fractured Particles	Minimum 60% by weight of particles with at least two fractured faces and 75% with at least one fractured face [1][3]	ASTM D5821
Flat Particles, Elongated Particles, or Flat and Elongated Particles	10% maximum, by weight, of flat, elongated, or flat and elongated particles [2]	ASTM D4791

[1] *The area of each face shall be equal to at least 75 percent of the smallest mid-sectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces.*

[2] *A flat particle is one having a ratio of width to thickness greater than five; an elongated particle is one having a ratio of length to width greater than five.*

[3] *If allowing crushed gravel is specified in the contract documents, increase weight of two fractured faces to 70% and one fractured face to 85%.*

Table 208.2.1.2

Fine Aggregate Portion (Passing the No. 40 (425µm) sieve)		
Liquid limit	Less than or equal to 25	ASTM D4318
Plasticity Index	Not more than five (5)	ASTM D4318

208.2.1.1 Initial Sampling and Testing Requirements for Aggregate Base

(1) Samples shall be taken by the Contractor in the presence of the Engineer. Material tests shall be provided by Contractor and shall demonstrate that the material meets the requirements in 208.2.1. This sampling and testing shall be completed and certified by a Department approved laboratory and shall be the basis for approval of the aggregate base quality requirements. Provide test results to Engineer 14 days prior to beginning construction.

(2) In lieu of testing previously specified, the Engineer may accept certified State of Wisconsin Department of Transportation test results indicating that the aggregate meets specification requirements.

208.2.2 Gradation Requirement

(1) The gradation of the aggregate base material shall meet the requirements of the gradation given in the following table when tested per ASTM C117 and ASTM C136. The gradation shall be well graded from coarse to fine as defined by ASTM D2487 and shall not vary from the lower limit on one sieve to the high limit on an adjacent sieve or vice versa. The fraction of material passing the No. 200 sieve shall not exceed two-thirds the fraction passing the No. 40 sieve. The portion of the filler and binder, including blended material, passing the No. 40 sieve shall have a liquid limit not more than 25 and a plasticity index not more than five when tested per ASTM D4318.

Table 208.2.2.1

Requirements for Gradation of Aggregate Base

Sieve Designation	Percentage by weight passing sieves		
	Gradation No. 1 2" maximum	Gradation No. 2 1-1/2" maximum	Gradation No. 3 1" maximum
2 inch (50 mm)	100	--	--
1-1/2 inch (38 mm)	70-100	100	--
1 inch (25 mm)	55-85	70-100	100
3/4 inch (19 mm)	50-80	55-85	70-100
No. 4 (4.75 mm)	30-60	30-60	35-65
No. 40 (0.45 mm)	10-30	10-30	10-25
No. 200 (0.075 mm)	5-15	5-15	5-15

Table 208.2.2.2

Gradation Control Bands

Sieve Size	Contractor's Final Gradation (based on initial test)	Job Control Grading Band Tolerances for Contractor's Final Gradation Percent
2 inch (50 mm)		0
1-1/2 inch (38 mm)		±5
1 inch (25 mm)		±8
3/4 inch (19 mm)		±8
No. 4 (4.75 mm)		±8
No. 40 (0.45 mm)		±5
No. 200 (0.075 mm)		±3

(2) Contractor's Final Gradation shall be based on the initial tests of the material source and shall be within the range shown on Table 208.2.2.1 for the gradation specified in the Pay Item description included in

the Schedule of Prices. The “Job Control Grading Band Tolerances for Contractor’s Final Gradation” in the table shall be applied to “Contractor’s Final Gradation” to establish a job control grading band. However, the full gradation tolerances from Table 208.2.2.1 still govern even if the range determined from the Contractor’s Final Gradation and the Job Control Grading Band percentages from Table 208.2.2.2 infer a greater range.

208.2.3 Sampling and Testing for Gradation

(1) Contractor shall take one aggregate base samples per lot and shall deliver the sample to Engineer to check that the final in-place gradation conforms to the gradation band determined from Table 208.2.2.2. Sampling shall be in accordance with ASTM D75. The lot will be consistent with the lot size used for density. The samples shall be taken from the in-place, un-compacted material in the presence of the Engineer. Sampling points and intervals will be designated by the Engineer.

(2) If the gradation of the lot sampled is outside of the gradation band determined from Table 208.2.2.2, Engineer will divide the lot into four or more sublots. Contractor shall take samples from each sublot and perform gradation tests from each lot and test the material for gradation. If the sample gradations are outside of the gradation bands determined from Table 208.2.2.2, Contractor shall remove and replace the material within the sublots that contain non-conforming material. Contractor shall continue to re-test and re-place material until the gradations meet the Specifications. Work required to test and replace non-conforming material shall be completed by Contractor at no cost to Owner.

208.2.4 Separation Geotextile

(1) Construct separation geotextile when shown on Plans and specified in the Special Provisions.

208.3 Construction

208.3.1 Control Strip

(1) The first half-day of construction shall be considered the control strip. Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The maximum compacted thickness may be increased to a maximum of 12 inches upon the Contractor’s demonstration that approved equipment and operations will uniformly compact the lift to the specified density. Engineer must witness this demonstration and approve the lift thickness prior to full production.

(2) Control strips that do not meet specification requirements shall be reworked, re-compacted or removed and replaced at the Contractor’s expense. Full operations shall not continue until the control strip has been accepted by the Engineer. Upon acceptance of the control strip by the Engineer, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the Engineer.

208.3.2 Preparing Underlying Subgrade or Subbase

(1) The underlying subgrade or subbase shall be checked and accepted by the Engineer before base course placing and spreading operations begin. Re-proof rolling of the subgrade or proof rolling of the subbase in accordance with P152, at the Contractor’s expense, may be required by the Engineer if the Contractor fails to ensure proper drainage or protect the subgrade or subbase. Ruts or soft, yielding areas due to improper drainage conditions, hauling, or other cause, shall be corrected before the base course is placed. To ensure proper drainage, the spreading of the base shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope.

208.3.3 Production

(1) The aggregate shall be uniformly blended and, when at a satisfactory moisture content per 208.3.5, the approved material may be transported directly to be placed.

208.3.4 Placement

(1) Aggregate shall be placed and spread on the prepared underlying layer by spreader boxes or other devices as approved by Engineer, to a uniform thickness and width. The equipment shall have positive thickness controls to minimize the need for additional manipulation of the material. Dumping from vehicles that require re-handling shall not be permitted. Hauling over the uncompacted base course shall not be permitted.

(2) Aggregate shall meet gradation and moisture requirements prior to compaction. The base course layer shall be constructed in lifts as established in the control strip, but not less than four inches nor more than 12 inches of compacted thickness.

(3) When more than one lift is required to establish the layer thickness shown on the Plans, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests

verify that compaction requirements have been met. Contractor shall rework, re-compact and retest material placed, which does not meet the specifications, at the Contractor's expense.

208.3.5 Compaction

208.3.5.1 General

(1) Immediately upon completion of the spreading operations, compact each layer of the base course, as specified, with approved compaction equipment. The number, type, and weight of rollers shall be sufficient to compact the material to the required density within the same day that the aggregate is placed on the subgrade.

(2) The field density of each compacted lift of material shall be at least 100% of the maximum density of laboratory specimens prepared from samples of the base material delivered to the jobsite. The laboratory specimens shall be compacted and tested in accordance with ASTM D698 for areas designated for aircraft with gross weights of less than 60,000 pounds, and ASTM D1557 for areas designated for aircraft with gross weights of 60,000 pounds or greater. Refer to 208.5.1 to determine the applicable ASTM standard for the work under this project. The in-place field density shall be determined in accordance with ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The moisture content of the material during placing operations shall be within plus or minus two percentage points of the optimum moisture content as determined by ASTM D6938. All testing shall be done the Engineer. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

208.3.5.2 Proofrolling

(1) The purpose of proof rolling the base is to identify any weak or inadequate stabilization areas in the base and not for compaction of the base. Proof rolling of the base course is required upon completion of placement and density testing. Proof rolling shall be conducted not more than 14 days prior to paving operations, or as approved by the Engineer. If more than 14 days has passed since initial proof rolling, the Engineer will require the contractor to re-proof roll the material within the required 14 days of commencement of paving. The base area must be proof rolled with a Tandem Axle Dual Wheel Dump Truck loaded to the legal limit (or other device as approved by the Engineer) with tires properly inflated in the presence of the Engineer. Apply a minimum of two coverages, or as specified by the Engineer, under pavement areas. A coverage is defined as the application of one tire print over the designated area. The Engineer will determine the acceptability of the stability of the base material. No paving will be allowed without the approval of the Engineer. Unacceptable deflection or other stability concerns that do not meet the acceptance of the Engineer shall be removed and replaced with suitable material or reworked to conform to the moisture content and compaction requirements in accordance with these specifications. If the Engineer believes the deflection may be due to saturated subgrade conditions due to heavy rains or flooding, paving operations shall be delayed until an acceptable proof rolling test is achieved. Any rework or removal and replacement of unacceptable areas is incidental to this item. If the subgrade is found not to be saturated, the Contractor will be paid the measured removal quantity for Common Excavation at the bid price and for replacement of base courses material at the bid price.

208.3.6 Weather limitations

(1) Material shall not be placed unless the ambient air temperature is at least 40°F and rising. Work on base course shall not be conducted when the subgrade or subbase is wet or frozen or the base material contains frozen material.

208.3.7 Maintenance

(1) The base course shall be maintained in a condition that will meet all specification requirements. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, prior to placemen additional material, the Contractor shall verify that materials still meet all specification requirements. Equipment may be routed over completed sections base course, provided that no damage result is routed over the full width of completed base course. Damage resulting to base course from routing equipment over the base course shall be repaired by Contractor at Contractor's expense.

208.3.8 Surface Tolerances

(1) After the course has been compacted, the surface shall be tested for smoothness and accuracy of grade and crown. Portions lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least three inches, reshaped and recompacted to grade, and tested for density until the required smoothness and accuracy are obtained and approved by the Engineer. Deviations in surface tolerances shall be corrected by the Contractor at the Contractor's expense. The smoothness and accuracy requirements specified here apply only to the top layer when base course is constructed in more than one layer.

208.3.8.1 Smoothness

(1) The finished surface shall not vary more than 0.03 feet when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline or reference line. The straightedge shall be moved continuously forward at half the length of the 12-foot straightedge for the full length of each line on a 50-foot grid, and at additional locations designated by Engineer. Contractor shall perform the smoothness testing in the presence of Engineer. Contractor shall furnish a straightedge, acceptable to Engineer, constructed and certified by a manufacturer for the use intended.

208.3.8.2 Grade

(1) The elevation of the base course surface shall be measured at uniform intervals, determined by Engineer, representing no more than 300 square yards and shall be within plus or minus 0.02 feet of the specified Plan elevation.

208.3.8.3 Engineer Staking

(1) When Engineer has placed survey hubs to grade, accuracy shall be tested by Contractor in the presence of Engineer using a string-line stretched taut between hubs (transverse and longitudinal). The distance between hubs shall be determined by Engineer but shall not exceed 50 feet. The vertical distance from string-line to finished grade shall not exceed plus zero or minus 0.03 feet at all points.

208.3.9 Acceptance Sampling and Testing for Density

(1) Aggregate base course shall be accepted for density on a lot basis. A lot will consist of a target size of 1200 square yards. The Engineer may reasonably adjust the lot size to best fit the size and scope of the project. No lot size shall exceed 1500 square yards. Engineer shall determine lot size (based on the previously stated criteria) and location of lots, and shall perform all density tests for acceptance. When more than one layer is required, separate lots shall be tested for each layer.

(2) Each lot shall contain two randomly selected test locations and the average of the two tests shall be used for density determination. Sampling locations will be determined by the Engineer on a random basis per ASTM D3665.

(3) Each lot shall be accepted for density when the field density is at least 100 percent of the maximum density of laboratory specimens compacted and tested per ASTM D698 for areas designated for aircraft with gross weight of less than 60,000 pounds, and ASTM D1557 for areas designated for aircraft with gross weights of 60,000 pounds or greater. Refer to 208.5.1 to determine the applicable ASTM standard for the Work under this project. The in-place field density shall be determined per ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938. If the specified density is not attained, the entire lot shall be reworked and recompacted and two additional random tests made. This procedure shall be followed until the specified density is reached. Rework and recompaction shall be completed at no additional cost to the Owner.

208.3.10 Thickness Control

(1) The thickness of the base course shall be within plus zero and minus 1/2 inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of the Engineer. Tests shall be taken at intervals representing no more than 300 square yards per test. Where the thickness is deficient by more than 1/2 inch, the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least three inches, adding new material of proper gradation, and the material shall be blended and re-compacted to grade. The Contractor shall replace, at his expense, base material where depth tests have been taken. The average thickness for the project shall not be less than the specified Plan thickness.

(2) When Engineer has placed survey hubs to grade for the bottom and top of the base course, at intervals not exceeding 50 feet longitudinally, and at the centerline and edges of the base course (not exceeding 25 feet), in the transverse direction; then additional thickness testing is not necessary, provided the base course has been tested and has met the requirement for smoothness and grade. Engineer reserves the right to randomly spot check elevations prior to final acceptance of the base course and commencement of paving.

208.4 Measurement

208.4.1 General

(1) The quantity of aggregate base course to be paid for will be the number of cubic yards or tons of base course material placed and accepted in the completed base course. The quantity of base course material, when measured by the cubic yard, will be measured in final (compacted) position based upon

determination of depth in accordance with 208.3.10. On individual depth measurements, thickness more than ½ inch in excess of that shown on the Plans will be considered as specified thickness.

(2) The quantity of base course, when measured by the ton, will be determined from recorded truck scale weights. Base course material, measure by the ton, which contains total moisture in excess of the optimum moisture content, will have the weight of the excess water deducted from the measured weight. Determination of the moisture content of the aggregates will be determined by Department based on percent of the dry weight of the aggregates.

208.5 Payment

208.5.1 General

(1) Payment will be made the Contract unit price per cubic yard or ton for aggregate base course. This price will be full compensation for furnishing all materials and for all operations, hauling, placing or these materials, compacting, and reworking and re-compacting if necessary, and for all labor, equipment, tools, testing, and incidentals to complete the Work.

(2) Should excavation below subgrade (EBS) be required in an area of completed and accepted base course construction, restoration of the base course to the Plan grade and cross-section in the area of EBS will be paid for at a unit price determined by multiplying the Contract unit price of the base course by three, unless the total quantity for the project exceeds 50 tons (25 cubic yards when the Pay Item is based on cubic yards), either party to the Contract may request revisions to the unit price. The revisions to the unit price shall be negotiated on the basis of the actual cost of the restoration, plus a negotiated allowance for profit and applicable overhead, and added to the Contract by Change Order. EBS required due to failure on the part of the Contractor to provide maintenance under 208.3.7 shall not be considered for payment under this provision.

(3) Pay Items with the designation B60K in the description are to be compacted as specified in 208.3.5 for aircraft with gross weights of less than 60,000 pounds. Pay Items with the designation A60K in the description are to be compacted as specified in 208.3.5 for aircraft with gross weights of 60,000 pounds or greater.

208.5.2 Pay Items

(1) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P208.010	Aggregate Base Course B60K Gradation No. 1	Cubic Yard (CY)
P208.012	Aggregate Base Course A60K Gradation No. 1	Cubic Yard (CY)
P208.020	Aggregate Base Course B60K Gradation No. 1	TON
P208.022	Aggregate Base Course A60K Gradation No. 1	TON
P208.030	Aggregate Base Course B60K Gradation No. 2	Cubic Yard (CY)
P208.032	Aggregate Base Course A60K Gradation No. 2	Cubic Yard (CY)
P208.040	Aggregate Base Course B60K Gradation No. 2	TON
P208.042	Aggregate Base Course A60K Gradation No. 2	TON
P208.050	Aggregate Base Course B60K Gradation No. 3	Cubic Yard (CY)
P208.052	Aggregate Base Course A60K Gradation No. 3	Cubic Yard (CY)
P208.060	Aggregate Base Course B60K Gradation No. 3	TON
P208.062	Aggregate Base Course A60K Gradation No. 3	TON

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C29	Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2700 kN-m/m^3))
ASTM D2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4643	Standard Test Method for Determination of Water Content of Soil and Rock by Microwave Oven Heating
ASTM D4751	Standard Test Methods for Determining Apparent Opening Size of a Geotextile
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D5821	Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D7928	Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis

American Association of State Highway and Transportation Officials (AASHTO)

M288	Standard Specification for Geosynthetic Specification for Highway Applications

END OF SPECIFICATION P208

Specification P209 - Crushed Aggregate Base Course

209.1 Description

(1) This Work consists of a base course composed of crushed aggregate base constructed on a prepared course in accordance with these specifications and in conformity to the dimensions and typical cross-sections shown on the Plans.

209.1.2 Construction Staking

(1) Contractor shall provide all construction staking in accordance with 50.6, except Engineer will provide staking as described on the Plans or specified in the Special Provisions.

209.2 Materials

209.2.1 Crushed Aggregate Base

(1) Crushed aggregate shall consist of clean, sound, durable particles of crushed stone and shall be free from coatings of clay, silt, organic material, clay lumps or balls, or other deleterious materials or coatings. The method used to produce the crushed material shall result in the fractured particles in the finished product as consistent and uniform as practicable. Fine aggregate portion, defined as the portion passing the No. 4 (4.75 mm) sieve shall consist of fines from the coarse aggregate crushing operation. The fine aggregate shall be produced by crushing stone that meets the coarse aggregate requirements for wear and soundness. Aggregate base material requirements are listed in the following table.

Table 209.2.1.1

Crushed Aggregate Base Material Requirements		
Coarse Aggregate Portion (Retained on the No. 4 (4.75 mm) sieve)		
Material Test	**Requirement**	**Standard**
Resistance to Degradation	Loss: 45% maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate **or** Magnesium Sulfate	Loss after 5 cycles: 12% maximum using Sodium sulfate - or -18% maximum using magnesium sulfate	ASTM C88
Percentage of Fractured Particles	Minimum 98% by weight of particles with at least two fractured faces and 98% with at least one fractured face *[1][3]*	ASTM D5821
Flat Particles, Elongated Particles, or Flat and Elongated Particles	10% maximum, by weight, of flat, elongated, or flat and elongated particles *[2]*	ASTM D4791

[1] The area of each face shall be equal to at least 75 percent of the smallest mid-sectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces.

[2] A flat particle is one having a ratio of width to thickness greater than five; an elongated particle is one having a ratio of length to width greater than five.

[3] If allowing crushed gravel is specified in the contract documents, reduce weight of two fractured faces to 95%.

Table 209.2.1.2

Fine Aggregate Portion (Passing the No. 40 (425µm) sieve)		
Liquid limit	Less than or equal to 25	ASTM D4318
Plasticity Index	Not more than five (5)	ASTM D4318

209.2.2.1 Initial Sampling and Testing Requirements for Aggregate Base

(1) Samples shall be taken by the Contractor in the presence of the Engineer. Material tests shall be provided by Contractor and shall demonstrate that the materials meet the requirements in 209.2.1 and 209.2.2. This sampling and testing shall be completed and certified by Department approved laboratory

and shall be the basis for approval of the aggregate base quality requirements. Provide test results to Engineer 14 days prior to beginning construction.

(2) In lieu of testing previously specified, the Engineer may accept certified State of Wisconsin Department of Transportation test results indicating that the aggregate meets specification requirements.

209.2.2 Gradation Requirements

(1) The gradation of the aggregate base material shall meet the requirements of the gradation given in the following table when tested per ASTM C117 and ASTM C136. The gradation shall be well graded from coarse to fine as defined by ASTM D2487 and shall not vary from the lower limit on one sieve to the high limit on an adjacent sieve or vice versa. The fraction of material passing the No. 200 (0.075 mm) sieve shall not exceed two-thirds the fraction passing the No. 40 (0.45 mm) sieve.

Table 209.2.2

Requirements for Gradation of Aggregate Base

Sieve Size	Design Range Percentage by Weight Passing	Contractor's Final Gradation	Job Control Grading Band Tolerances for Contractor's Final Gradation (Percent)
2 inch (50 mm)	100		0
1-1/2 inch (38 mm)	95-100		±5
1 inch (25 mm)	70-95		±8
3/4 inch (19 mm)	55-85		±8
No. 4 (4.75 mm)	30-60		±8
No. 40 (0.45 mm)	10-30		±5
No. 200 (0.075 mm)	0-10		±3

(2) Contractor's Final Gradation shall be based on the initial tests of the material source and shall be within the range shown on Table 209.2.2. The "Job Control Grading Band Tolerances for Contractor's Final Gradation" in the table shall be applied to "Contractor's Final Gradation" to establish a job control grading band. However, the full design range gradation tolerances from Table 209.2.2 still govern even if the range determined from the Contractor's Final Gradation and the Job Control Grading Band percentages from Table 209.2.2 infer a greater range.

209.2.3 Sampling and Testing For Gradation

(1) Contractor shall take two aggregate base samples per lot and shall deliver the samples to Engineer to check that the final in-place gradation conforms to the gradation band determined from Table 209.2.2. Sampling shall be in accordance with ASTM D75. The lot will be consistent with the lot size used for density. The samples shall be taken from the in-place, un-compacted material in the presence of the Engineer. Sampling points and intervals will be designated by the Engineer.

(2) If the gradation of the lot sampled is outside of the gradation band determined form Table 209.2.2, Engineer will divide the lot into four or more sublots. Contractor shall take samples from each sublot and perform gradation tests from each sublot and test the material for gradation. If the sample gradations are outside of the gradation bands determined from Table 209.2.2, Contractor shall remove and replace the material within the sublots that contain non-conforming material. Contractor shall continue to re-test and re-place material until the gradations meet the Specifications. Work required to test and replace non-conforming material shall be completed by Contractor at no cost to Owner.

209.2.4 Separation Geotextile

(1) Construct separation geotextile when shown on Plans and specified in the Special Provisions.

209.3 Construction Methods

209.3.1 Control Strip

(1) The first half-day of construction shall be considered the control strip. Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The maximum compacted thickness may be increased to a maximum of 12 inches upon the Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the specified density. Engineer must witness this demonstration and approve the lift thickness prior to full production.

(2) Control strips that do not meet specification requirements shall be reworked, re-compacted or removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the Engineer. Upon acceptance of the control strip by the Engineer, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the Engineer.

209.3.2 Preparing Underlying Subgrade and/or Subbase

(1) The underlying subgrade or subbase shall be checked and accepted by the Engineer before base course placing and spreading operations begin. Re-proof rolling of the subgrade or proof rolling of the subbase in accordance with P152, at the Contractor's expense, may be required by the Engineer if the Contractor fails to ensure proper drainage or protect the subgrade or subbase. Ruts or soft, yielding areas due to improper drainage conditions, hauling, or other causes, shall be corrected before the base course is placed. To ensure proper drainage, the spreading of the base shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope.

209.3.3 Production

(1) The aggregate shall be uniformly blended and, when at a satisfactory moisture content per paragraph 209.3.5, the approved material may be transported directly to the placement.

209.3.4 Placement

(1) Aggregate shall be placed and spread on the prepared underlying layer by spreader boxes or other devices as approved by Engineer, to a uniform thickness and width. The equipment shall have positive thickness controls to minimize the need for additional manipulation of the material. Dumping from vehicles that require re-handling shall not be permitted. Hauling over the uncompacted base course shall not be permitted.

(2) Aggregate shall meet gradation and moisture requirements prior to compaction. The base course shall be constructed in lifts as established in the control strip, but not less than four inches nor more than 12 inches of compacted thickness.

(3) When more than one lift is required to establish the layer thickness shown on the plans, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. Contractor shall rework, re-compact and retest any material placed which does not meet the specifications at the Contractor's expense.

209.3.5 Compaction

209.3.5.1 General

(1) Immediately after completion of the spreading operations, compact each layer of the base course, as specified, with approved compaction equipment. The number, type, and weight of rollers shall be sufficient to compact the material to the required density within the same day that the aggregate is placed on the subgrade

(2) Field density of each compacted lift of material shall be at least 100% of the maximum density of laboratory specimens prepared from samples of the base material delivered to the jobsite. The laboratory specimens shall be compacted and tested in accordance with ASTM D698 for areas designated for aircraft with gross weights of 60,000 pounds or less, and ASTM D1557 for areas designated to serve aircraft with gross weights greater than 60,000 pound. The in-place field density shall be determined in accordance with ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The moisture content of the material during placing operations shall be within plus or minus two percentage points of the optimum moisture content as determined by ASTM D6938. Maximum density refers to maximum

dry density at optimum moisture content unless otherwise specified. All testing shall be done by the Engineer.

209.3.5.2 Proof Rolling

(1) The purpose of proof rolling the base is to identify any weak or inadequate stabilization areas in the base and not for compaction of the base. Proof rolling of the base course is required upon completion of placement and density testing. Proof rolling shall be conducted not more than 14 days prior to paving operations, or as approved by the Engineer. If more than 14 days has passed since initial proof rolling, the Engineer will require the contractor to re-proof roll the material within the required 14 days of commencement of paving. The base area must be proof rolled with a Tandem Axle Dual Wheel Dump Truck loaded to the legal limit (or other device as approved by the Engineer) with tires properly inflated in the presence of the Engineer. Apply a minimum of two coverages, or as specified by the Engineer, under pavement areas. A coverage is defined as the application of one tire print over the designated area. The Engineer will determine the acceptability of the stability of the base material. No paving will be allowed without the approval of the Engineer. Unacceptable deflection or other stability concerns that do not meet the acceptance of the Engineer shall be removed and replaced with suitable material or reworked to conform to the moisture content and compaction requirements in accordance with these specifications. If the Engineer believes the deflection may be due to saturated subgrade conditions due to heavy rains or flooding, paving operations shall be delayed until an acceptable proof rolling test is achieved. Any rework or removal and replacement of unacceptable areas is incidental to this item. If the subgrade is found not to be saturated, the Contractor will be paid the measured removal quantity for Common Excavation at the bid price and for replacement of base courses material at the bid price.

209.3.6 Weather Limitations

(1) Material shall not be placed unless the ambient air temperature is at least 40 degrees Fahrenheit and rising. Work on base course shall not be conducted when the subgrade or subbase is wet or frozen or the base material contains frozen material.

209.3.7 Maintenance

(1) The base course shall be maintained in a condition that will meet all specification requirements. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, prior to placement of additional material, the Contractor shall verify that materials still meet all specification requirements. Equipment may be routed over completed sections of base course, provided that no damage results and the equipment is routed over the full width of the completed base course. Damage resulting to the base course from routing equipment over the base course shall be repaired by the Contractor at the Contractor's expense.

209.3.8 Surface Tolerances

(1) After the course has been compacted, the surface shall be tested for smoothness and accuracy of grade and crown. Areas lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least three inches, reshaped and re-compacted to grade, and tested for density until the required smoothness and accuracy are obtained and approved by the Engineer. Deviations in surface tolerances shall be corrected by the Contractor at the Contractor's expense. The smoothness and accuracy requirements specified here apply only to the top layer when base course is constructed in more than one layer.

209.3.8.1 Smoothness

(1) The finished surface shall not vary more than 3/8 inch when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously at half the length of the 12-foot straightedge for the full length of each line on a 50-foot grid, and at additional locations designated by Engineer. Contractor shall perform the smoothness testing in the presence of Engineer. Contractor shall furnish a straightedge, acceptable to Engineer, constructed and certified by a manufacturer for the use intended.

209.3.8.2 Grade

(1) The elevation of the base course surface shall be measured at uniform intervals, determined by Engineer, representing no more than 300 square yards and shall be within plus or minus 0.02 feet of the specified Plan elevation.

209.3.8.3 Engineer Staking

(1) When Engineer has placed survey hubs to grade, smoothness and accuracy shall be tested by Contractor in the presence of Engineer using a string-line stretched taut between hubs (transverse and longitudinal). The distance between hubs shall be determined by Engineer but shall not exceed 50 feet.

The vertical distance from string-line to finished grade shall not exceed plus zero or minus 0.03 feet at all points.

209.3.9 Acceptance Sampling and Testing for Density

(1) Crushed aggregate base course shall be accepted for density and thickness on an area basis. Two tests shall be made for density and thickness for each 1200 square yards. Sampling locations will be determined on a random basis per ASTM D3665

(2) The Engineer shall perform all density tests.

(3) Each lot will be accepted for density when the field density is at least 100 percent of the maximum density of laboratory specimens compacted and tested per ASTM D698 for areas designated for aircraft gross weights of less than 60,000 pounds, and ASTM D1557 for areas designated for aircraft with gross weights of 60,000 pounds or greater. Refer to 209.5.1 to determine the applicable ASTM standard for the Work under this project. The in-place field density shall be determined per ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938. If the specified density is not attained, the entire lot shall be re-worked and re-compacted and two additional random tests made at the Contractor's expense. This procedure shall be followed until the specified density is reached. Rework and recompaction shall be completed at no additional cost to the Owner.

209.3.10 Thickness control

(1) The thickness of the base course shall be within plus zero and minus 1/2 inch of the specified thickness. The thickness will be measured at points surveyed by Engineer at regular intervals determined by Engineer. Where the thickness is deficient by more than 1/2 inch, the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least three inches, adding new material of proper gradation, and the material shall be blended and re-compacted to grade. Additional measurements may be required to identify the limits of deficient areas. Contractor shall replace, at his expense, base material where depth tests have been taken. The average thickness for the project shall not be less than the specified Plan thickness.

(2) When Engineer has placed survey hubs to grade at the bottom and top of the base course, at intervals not exceeding 50 feet longitudinally, and at the centerline and edges of the base course (not exceeding 25 feet) in the transverse direction, the base course will be acceptable, provided the base course has been tested and has met the requirements for smoothness and accuracy. Engineer reserves the right to randomly spot check hub elevations prior to final acceptance of the base course and commencement of paving.

209.4 Measurement
209.4.1 General

(1) The quantity of aggregate base course to be paid for will be the number of cubic yards or tons of base course material placed and accepted in the completed base course. The quantity of base course material, when measured by the cubic yard, will be measured in final (compacted) position based upon determination of depth in accordance with 208.3.10. On individual depth measurements, thickness more than ½ inch in excess of that shown on the Plans will be considered as specified thickness.

(2) Base course measure by the ton will be determined from recorded truck scale weights. Base course material, measure by the ton, which contains total moisture in excess of the optimum moisture content, will have the weight of the excess water deducted from the measured weight. Determination of the moisture content of the aggregates will be based on percent of the dry weight of the aggregates.

209.5 Payment
209.5.1 Payment

(1) Payment shall be made at the contract unit price per ton or cubic yard for crushed aggregate base course. This price shall be full compensation for furnishing all materials, for preparing and placing these materials, for reworking and re-compacting if necessary, and for all labor, equipment tools, and incidentals necessary to complete the Work.

(2) Base course material, measured by the ton, which contains total moisture in excess of the optimum moisture content, will have the weight of the excess deducted from the measured weight. A representative sample of the wet material will be taken by the Engineer and lab tested to determine actual moisture content.

(3) Should excavation below subgrade (EBS) be required in an area of completed base course construction, restoration of the base course to the plan grade and cross-section in the area of EBS will be paid for at a unit price determined by multiplying the Contract unit price of the base course by three, unless the

total quantity of base course to be replaced exceeds 50 tons (25 cubic yards when the Pay Item is based on cubic yards). When the total quantity for base course restoration exceeds 50 tons (25 cubic yards when the Pay Item is based on cubic yards), either party to the Contract may request revision to the unit price. The revision to the unit price shall be negotiated on the basis of the actual cost of the restoration, plus a negotiated allowance for profit and applicable overhead, and added to the Contract by Change Order. EBS required due to failure on the part of the Contractor to provide maintenance under 208.3.7 shall not be considered for payment under this provision.

(4) Pay Items with the designation B60K in the description are to be compacted as specified in 209.3.5 for aircraft with gross weights of less than 60,000 pounds. Pay Items with the designation A60K in the description are to be compacted as specified in 209.3.5 for aircraft with gross weights of 60,000 pounds or greater.

209.5.2 Pay Items

(1) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

(2) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P209.010	Crushed Aggregate Base Course B60K	TON
P209.012	Crushed Aggregate Base Course A60K	TON
P209.020	Crushed Aggregate Base Course B60K	Cubic Yard (CY)
P209.022	Crushed Aggregate Base Course A60K	Cubic Yard (CY)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C29	Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2700 kN-m/m^3))
ASTM D2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate

ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4643	Standard Test Method for Determination of Water Content of Soil and Rock by Microwave Oven Heating
ASTM D4718	Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles
ASTM D4751	Standard Test Methods for Determining Apparent Opening Size of a Geotextile
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D5821	Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D7928	Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis

American Association of State Highway and Transportation Officials (AASHTO)

M288	Standard Specification for Geosynthetic Specification for Highway Applications

END OF SPECIFICATION P209

Specification P219 - Recycled Concrete Aggregate Base Course

219.1 Description

219.1.1 General

(1) This Work consists of a base course composed of recycled concrete aggregate, crushed to meet a particular gradation, constructed on a prepared course in accordance these specifications and in conformity to the dimensions and typical cross-sections shown on the Plans.

219.1.2 Construction Staking

(1) Contractor shall provide all construction staking in accordance with 50.6, except Engineer will provide staking as described on the Plans or specified in the Special Provisions.

219.2 Materials

219.2.1 Aggregate

(1) Recycled concrete aggregate shall consist of Portland cement concrete (PCC) or other concrete containing pozzolanic binder material. The recycled concrete material shall be free of reinforcing steel and expansion material. Asphalt concrete overlays and full slab asphalt panels shall be removed from the PCC surface prior to pavement removal and crushing.

(2) Recycled concrete aggregate shall consist of at least 90 percent, by weight, Portland cement concrete; virgin aggregates may be added to meet the 90% minimum concrete requirement. The remaining 10 percent may consist of the following materials:

Table 219.2.1a

Deleterious Materials

Material	Quantity
Wood	0.1% maximum
Brick, mica, schist, or other friable materials	4% maximum
Asphalt concrete	10% maximum
Total	**10% maximum**

Table 219.2.1a

Recycled Concrete Aggregate Base Material Requirements

Material Test	Requirement	Standard
Coarse Aggregate		
Resistance to Degradation	Loss: 45% maximum	ASTM C131
Flat Particles, Elongated Particles, or Flat and Elongated Particles[1]	10% maximum, by weight, for fraction retained on the ½ inch (12.5mm) sieve and 10% maximum, by weight, for the fraction passing the 1/2-inch (12.5 mm) sieve	ASTM D4791
Clay lumps and friable particles	Less than or equal to 3 percent	ASTM C142
Fine Aggregate Portion		
Liquid limit	Less than or equal to 25	ASTM D4318
Plasticity Index	Not more than four (4)	ASTM D4318

[1] *A flat particle is one having a ratio of width to thickness greater than five; an elongated particle is one having a ratio of length to width greater than five.*

(3) The fine aggregate shall be produced by crushing stone, gravel, slag, or recycled concrete that meet the requirements for wear and soundness specified for coarse aggregate. Fine aggregate may be added to produce the correct gradation.

(4) Each source of recycled concrete aggregate shall meet the above requirements.

(5) Recycled concrete aggregate shape depends on the characteristics of the recycled concrete, plant type, and plant operation speed. This may require a number of trial batches before crushed recycled concrete aggregate meeting the shape and gradation requirements can be produced.

219.2.2 Gradation Requirements

(1) The gradation (job mix) of the final mixture shall fall within the design range indicated in the following table, when tested per ASTM C117 and ASTM C136. The final gradation shall be continuously graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on an adjacent sieve or vice versa.

Table 219.2.3

Requirements for Gradation of Recycled Concrete Aggregate Base

Sieve Size	Percentage by Weight Passing Sieves	Contractor's Final Gradation	Job Mix Tolerances Percent
2 inch (50 mm)	100		--
1-1/2 inch (37.5 mm)	95 - 100		±5
1 inch (25.0 mm)	70 - 95		±8
3/4 inch (19.0 mm)	55 - 85		±8
No. 4 (4.75 mm)	30 - 60		±8
No. 30 (600 µm)	12 - 30		±5
No. 200 (75 µm)	0 - 10		±3

(2) The job mix tolerances in the table shall be applied to the contractor's final gradation to establish a job control gradation band. The full tolerance still will apply if application of the tolerances results in a job control gradation band outside the design range.

219.2.3 Sampling and Testing

219.2.3.1 Aggregate Base Materials

(1) The Contractor shall take samples of the aggregate base in accordance with ASTM D75 to verify initial aggregate base requirements and gradation. Material shall meet the requirements in 219.2.1 and 219.2.2. This sampling and testing will be the basis for approval of the aggregate base quality requirements. Sampling points shall be determined by Engineer. Contactor shall perform required tests and provide written results to Engineer.

219.2.3.2 Gradation Requirements During Construction

(1) Contractor shall take at least two aggregate base samples per day in the presence of Engineer to check the final gradation. Sampling shall be per ASTM D75. Material shall meet the requirements in 219.2.2. The lot will be consistent with the lot size used for density. The samples shall be taken from the in-place, un-compacted material at sampling points and intervals designated by Engineer. Contractor shall perform testing and provide written results to Engineer.

219.2.4 Separation Geotextile

(1) Construct separation geotextile when shown on Plans and specified in the Special Provisions.

219.3 Construction

219.3.1 Control Strip

(1) The first half-day of construction shall be considered the control strip. Contractor shall demonstrate, in the presence of Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The maximum compacted thickness may be increased to a maximum of 12 inches upon the Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the specified density. Engineer must witness this demonstration and approve the lift thickness prior to full production.

(2) Control strips that do not meet specification requirements shall be reworked, re-compacted or removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by Engineer. Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved by Engineer.

219.3.2 Preparing Underlying Course

(1) The underlying course shall be checked by Engineer before placing and spreading operations are started. Ruts or soft yielding places caused by improper drainage conditions, hauling, or other causes shall be corrected at the Contractor's expense before the base course is placed there. Material shall not be placed on frozen material.

(2) To protect the existing layers and to ensure proper drainage, the spreading of the recycled concrete aggregate base course shall begin along the centerline of the pavement on a crowned section or on the greatest contour elevation of a pavement with a variable uniform cross slope.

219.3.3 Placement

(1) The aggregate shall be placed and spread on the prepared underlying layer by spreader boxes or other devices as approved by Engineer, to a uniform thickness and width. The equipment shall have positive thickness controls to minimize the need for additional manipulation of the material. Dumping from vehicles that require re-handling shall not be permitted. Hauling over the uncompacted base course shall not be permitted.

(2) The aggregate shall meet gradation and moisture requirements prior to compaction. The subbase course shall be constructed in lifts as established in the control strip, but not less than four inches nor more than 12 inches of compacted thickness.

(3) When more than one lift is required to establish the layer thickness shown on the plans, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. Contractor shall rework, re-compact and retest material placed which does not meet the specifications.

219.3.4 Compaction

(1) Immediately upon completion of the spreading operations, compact each layer of the base course, as specified, with approved compaction equipment. The number, type, and weight of rollers shall be sufficient to compact the material to the required density within the same day that the aggregate is placed on the subgrade.

(2) The field density of each compacted lift of material shall be at least 100 percent of the maximum density of laboratory specimens prepared from samples of the subbase material delivered to the jobsite. The laboratory specimens shall be compacted and tested in accordance with ASTM D1557. The moisture content of the material during placing operations shall be within plus or minus two percentage points of the optimum moisture content as determined by ASTM D1557. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

(3) Contractor shall perform sampling and testing, and deliver written results to Engineer.

219.3.5 Weather limitations.

(1) Material shall not be placed unless the ambient air temperature is at least 40 degrees Fahrenheit and rising. Work on base course shall not be conducted when the subgrade or subbase is wet or frozen or the base material contains frozen material.

219.3.6 Maintenance.

(1) The base course shall be maintained in a condition that will meet all specification requirements. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, prior to placement of additional material, the Contractor shall verify that materials still meet all specification requirements. Equipment may be routed over completed sections of base course, provided that no damage results and the equipment is routed over the full width of the completed base course. Damage resulting to the base course from routing equipment over the base course shall be repaired by the Contractor at their expense.

219.3.7 Surface Tolerances

(1) After the course has been compacted, the surface shall be tested for smoothness and accuracy of grade and crown. Areas lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least three inches, reshaped and recompacted to grade, and tested for density until the required smoothness and accuracy are obtained and approved by the RPR. Deviations in surface tolerances shall be corrected by the Contractor at the Contractor's expense. The smoothness

and accuracy requirements specified here apply only to the top layer when base course is constructed in more than one layer.

219.3.7.1 Smoothness

(1) The finished surface shall not vary more than 3/8 inch when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously at half the length of the 12-foot straightedge for the full length of each line on a 50-foot grid, and at additional locations designated by Engineer. Contractor shall perform the smoothness testing. Contractor shall furnish a straightedge, acceptable to Engineer, constructed and certified by a manufacturer for the use intended.

219.3.7.2 Grade

(1) The grade and crown shall be measured on a 50-foot grid and shall be within plus zero and minus 0.02 feet of the specified grade.

219.3.7.3 Engineer Staking

(1) When Engineer has placed survey hubs to grade, smoothness and accuracy shall be tested by Contractor in the presence of Engineer using a string-line stretched taut between hubs (transverse and longitudinal). The distance between hubs shall be determined by Engineer but shall not exceed 50 feet. The vertical distance from string-line to finished grade shall not exceed plus zero and minus 3/8 inch at all points.

219.3.8 Acceptance Sampling and Testing for Density.

(1) Recycled Concrete Aggregate base course shall be accepted for density and thickness on an area basis. Two tests shall be made for density and thickness for each 1200 square yards. Sampling locations will be determined on a random basis per ASTM D3665

219.3.8.1 Density

(1) The Contractor's laboratory shall perform all density tests in Engineer's presence and provide the test results upon completion to Engineer for acceptance.

(2) Each area shall be accepted for density when the field density is at least 100 percent of the maximum density of laboratory specimens compacted and tested per ASTM D1557. The in-place field density shall be determined in accordance with ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938. If the specified density is not attained, the area represented by the failed test must be reworked and/or recompacted and two additional random tests made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

219.3.8.2 Thickness

(1) Depth tests shall be made by test holes at least three inches in diameter that extend through the base. The thickness of the base course shall be within plus zero and minus 1/2 inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of Engineer for each area. Where the thickness is deficient by more than 1/2-inch, the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least three inches, adding new material of proper gradation, and the material shall be blended and recompacted to grade. Contractor shall replace, at his expense, base material where depth tests have been taken.

(2) When Engineer has placed survey hubs to grade at the bottom and top of the base course, at intervals not exceeding 50 feet longitudinally, and at the centerline and edges of the base course (not exceeding 25 feet) in the transverse direction, the base course will be acceptable, provided the base course has been tested and has met the requirements for smoothness and accuracy. Engineer reserves the right to randomly spot check hub elevations prior to final acceptance of the base course and commencement of paving.

219.5 Measurement

219.5.1 General

(1) The quantity of Recycled Concrete Aggregate Base course (thickness) will be determined by measurement of the number of square yards of material actually constructed and accepted as complying with the Plans and Specifications.

219.6 Payment

219.6.1 General

(1) Payment shall be made at the contract unit price per square yard for Recycled Concrete Aggregate Base course (thickness). This price shall be full compensation for furnishing all materials, for preparing and placing these materials, and for all labor, equipment, tools, testing, and incidentals necessary to complete the Work.

(2) Payment will be made for measured quantities based upon Contract prices for the following Pay Items:

Pay Item	Description	Unit
P219.010 to P219.019	Recycled Concrete Aggregate Base Course (thickness)	Square Yard (SY)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C29	Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Standard Test Method for Materials Finer than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregate
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2700 kN-m/m^3))
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

END OF SPECIFICATION P219

Part 5 – Stabilized Base Course

Specification P304 - Cement-Treated Aggregate Base Course (CTB)

304.1 Description

304.1.1 General

(1) This Work shall consist of a cement-treated base (CTB) course composed of mineral aggregate and cement, uniformly blended and mixed with water. The mixed material shall be spread and shaped with a mechanical spreader, and compacted with rollers in accordance with these specifications and in conformance to the lines, grades, dimensions, and cross-sections shown on the Plans.

304.1.2 Construction Staking

(1) Contractor shall provide all construction staking in accordance with 50.6, except Engineer will provide staking as described on the Plans or specified in the Special Provisions.

304.2 Materials

304.2.1 Aggregate

(1) Aggregate shall be select granular materials, comprised of crushed or uncrushed gravel and/or stone, or recycled Portland cement concrete (PCC). The material shall be free of roots, sod, and weeds. The crushed or uncrushed aggregate shall consist of hard, durable particles meeting the requirements in the following table

Table 304.2.1

Cement Treated Aggregate Base Material Requirements

Material Test	Requirement	Standard
Coarse Aggregate Portion (retained on the No. 4 (4.75 mm) sieve)		
Resistance to Degradation	Loss: 40% maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88
Flat Particles, Elongated Particles, or Flat and Elongated Particles[1]	10% maximum, by weight, for fraction retained on the ½ inch (12.5mm) sieve and 10% maximum, by weight, for the fraction passing the 1/2-inch (12.5 mm) sieve	ASTM D4791
Clay lumps and friable particles	Less than or equal to 3 percent	ASTM C142
Fine Aggregate Portion (Passing the No. 40 (425µm) sieve)		
Liquid limit	Less than or equal to 25	ASTM D4318
Plasticity Index	Not more than 6	ASTM D4318

[1] *A flat particle is one having a ratio of width to thickness greater than five; an elongated particle is one having a ratio of length to width greater than five.*

304.2.2 Gradation Requirements

(1) Aggregate shall conform to the gradation(s) shown in the table below per ASTM C136, Table 304.2.1. A dense, well-graded aggregate blend that meets the requirements of Table 304.2.1 shall be selected by the Contractor and used in the final mix design. The final aggregate blend shall be well graded from coarse to fine within the limits designated in the table and shall not vary from the low limit on one sieve to the high limit on adjacent sieves, or vice versa.

Table 304.2.2

Aggregate Gradation for CTB Material

Sieve Size	Design Range Percentage by Weight Passing	Contractor's Final Gradation	Job Control Grading Band Tolerances for Contractor's Final Gradation2 Percent
2 inch (50 mm)	100		±0
1 inch (25.0 mm)	90-100		±5
No. 4 (4.75 mm)	45-95		±8
No. 10 (2.00 mm)	37-80		±8
No. 40 (425 μm)	15-50		±5
No. 200 (75 μm)	0–15		±3

(2) For Contractor quality control, sample the aggregate stockpile in accordance with ASTM D75 and perform gradation tests in accordance with ASTM C136 a minimum of once per week during production of CTB.

304.2.3 Sampling and testing

(1) Aggregate base materials. Contractor shall take samples of the aggregate base stockpile in accordance with ASTM D75 to verify initial aggregate base requirements and gradation. Material shall meet the requirements in 304.2.1 and 304.2.2. This sampling and testing will be the basis for approval of the aggregate base quality requirements.

304.2.4 Cement

(1) Cement shall conform to the requirements of ASTM C150 Type I or Type II, or ASTM C595 Type IP, unless a particular requirement for cement is indicated on the Plans or in the Special Provisions.

304.2.5 Cementitious Additives

(1) Pozzolanic and slag cement may be added to the CTB mix. If used, each material must meet the following requirements:

a. **Pozzolan:** Pozzolanic materials must meet the requirements of ASTM C618, Class F, or N with the exception of loss of ignition, where the maximum shall be less than 6 percent.

b. **Slag Cement (ground granulated blast furnace (GGBF) slag):** Slag shall conform to ASTM C989, Grade 80, 100, or 120.

304.2.6 Water

(1) Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with ASTM C1602 prior to use.

304.2.7 Curing Materials

(1) For curing CTB placed under PCC pavement, use white-pigmented, liquid membrane-forming compound conforming to ASTM C309, Type 2, Class A or Class B (wax-based).

(2) For curing CTB placed under HMA pavement, use emulsified asphalt conforming to ASTM D977, RS-1 or SS-1, applied at 75°to 130° Fahrenheit, or ASTM D2397, CRS-1, applied at 75°to 130° Fahrenheit.

304.2.8 Bond Breaker

(1) Liquid membrane forming compound shall be in accordance with paragraph 304.2.7 (and is the preferred method) or a non-woven fabric can be installed and shall meet the requirements of AASHTO M 288 Class I fabric with elongation not less than 50% at the specified strengths, and a minimum weight of 14.5 oz/sy. A certificate of compliance (COC) shall be provided by the fabric manufacturer that the material may be used as a bond breaker.

304.2.9 Sand Blotter

(1) Sand shall be applied, when required, to prevent tracking of the emulsion curing materials. The sand material shall be clean, dry, and non-plastic.

304.3 Composition

304.3.1 General

(1) The CTB material shall be composed of a mixture of aggregate, cementitious material, and water. Fly ash or slag cement may be used as a partial replacement for Portland cement.

304.3.2 Mix Design

(1) The mix design shall use a cement content that, when tested in the laboratory per ASTM D1633, produces a seven-day compressive strength between 400 pounds per square inch minimum and 800 pounds per square inch maximum. The 28-day compressive strength shall not exceed 1000 pounds per square inch, higher strengths may cause shrinkage and reflective cracking and should be avoided.

(2) Wet-dry and freeze-thaw tests shall be performed in accordance with AASHTO T135 and American Association of State Highway and Transportation Officials (AASHTO) T136 respectively. The weight loss for each type of test shall not exceed 14 percent after 12 cycles.

(3) The mix design shall include a complete list of materials, including type, brand, source, and amount of cement, fine aggregate, coarse aggregate, water, and cementitious additives.

(4) Should a change be made in aggregate sources or type of cement, or if cementitious additives are added or deleted from the mix, production of the CTB mix shall be stopped and a new mix design shall be submitted.

304.3.3 Submittals

(1) At least 30 calendar days prior to the placement of the CTB, the Contractor shall submit certified test reports to the Engineer for those materials proposed for use during construction, as well as the mix design information for the CTB material. Tests older than six months shall not be used, unless approved in writing by Engineer. The certification shall show the ASTM or AASHTO specifications or tests for the material, the name of the company performing the tests, the date of the tests, the test results, and a statement that the material did or did not comply with the applicable specifications. The submittal package shall include the following:

   a. Source(s) of materials, including aggregate, cement, cementitious additives, curing, and bond-breaking materials.
   b. Physical properties of the aggregates, cement, cementitious additives, curing, and bond-breaking materials.
   c. Mix design:
      i. Mix identification number
      ii. Aggregate gradation
      iii. Cement content
      iv. Water content
      v. Cementitious materials content
   d. Laboratory test results:
      i. Compaction and strength results
      ii. Laboratory compaction characteristics (maximum dry density and optimum moisture content)
      iii. Compressive strength at seven days
      iv. Wet-dry and/or freeze-thaw weight loss, if applicable

(2) No CTB material shall be placed until the submittal is accepted in writing by the Engineer.

(3) During production, the Contractor shall submit batch tickets for each delivered load.

304.4 Equipment

304.4.1 General

304.4.2 Mixing

(1) The mixer shall be a batch or continuous-flow type stationary mixer that produces a well-blended, uniform mixture of aggregate, cement, water, and pozzolan. The mixer shall be equipped with calibrated metering and feeding devices that introduce the aggregate, cement, water, and cementitious additives (if used) into the mixer in the specified quantities. If necessary, a screening device shall be used to remove oversized material greater than two inches from the raw aggregate feed prior to mixing.

(2) The Engineer shall have free access to the plant at all times for inspection of the plant's equipment and operation and for sampling the CTB mixture and its components.

304.4.3 Hauling

(1) The mixed CTB material shall be transported from the plant to the job site in trucks or other hauling equipment having beds that are smooth, clean, and tight. Truck bed covers shall be provided and used to protect the CTB from rain. CTB material that becomes wet during transport shall be evaluated by Engineer and may be rejected.

304.4.4 Placing

(1) CTB material shall be placed using a mechanical spreader or a machine capable of receiving, spreading, and shaping the mixture without segregation into a uniform layer or lift. The equipment shall be equipped with a strike-off plate capable of being adjusted to the specified layer thickness. It shall also be equipped with two end gates or cut off plates, so that the CTB may be spread in widths varying up to lane width.

304.4.5 Compaction

(1) The number, type, and weight of rollers and/or compactors shall be sufficient to compact the mixture to the required density.

304.5 Construction

304.5.1 Control Strip

(1) Construct a control strip for projects with more than 2,000 square yards. The first half-day of construction shall be considered the control strip. Contractor shall demonstrate, in the presence of Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. Control strips that do not meet specification requirements shall be removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by Engineer. Upon acceptance of the control strip by Engineer, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by Engineer.

304.5.2 Weather limitations.

(1) CTB shall not be placed on frozen surfaces or when weather conditions will detrimentally affect quality of the finished course. Apply cement when the ambient temperature is a minimum of 40 degrees Fahrenheit and rising and aggregate are not frozen or contain frost. If ambient temperature falls below 40 degrees Fahrenheit, protect completed CTB areas against freezing.

(2) Contractor should stop operations prior to and during rain allowing time to cover and protect any freshly placed material. Areas damaged by rain shall be replaced at the Contractor's expense.

304.5.3 Maintenance

(1) Completed portions of the cement-stabilized area may be opened to local traffic provided the curing process is not impaired and to other traffic after the curing period has elapsed, provided that the cement-stabilized course has hardened sufficiently to prevent surface marring or distortion by equipment or traffic. Protect finished portions of cement stabilized base from traffic of equipment used in constructing adjoining sections in a manner to prevent marring or damaging completed work. CTB shall be protected from freezing until covered.

304.5.4 Preparation of Underlying Course

(1) The underlying course shall be checked by Engineer before placing and spreading operations are started. Prior to placing the material, the final grade should be firm, moist and free of frost. Use of chemicals to eliminate frost will not be permitted. The underlying course shall be wetted in advance of placing the CTB layer.

304.5.5 Grade Control

(1) Grade control between the edges of the CTB shall be accomplished at intervals of 50 feet on the longitudinal grade and at 25 feet on the transverse grade.

304.5.6 Placing

(1) CTB mixture shall be deposited on the moistened subgrade or subbase and spread into a uniform layer of specified width and thickness that, when compacted and trimmed, conforms to the required line, grade, and cross-section. When the surface layer is asphalt, longitudinal joints shall be located so there is a 2 foot minimum offset from planned joints in an overlying layer. When surface layer is PCC, there shall be no longitudinal offset. Placement of the material shall begin along the centerline of the pavement on a crowned section or on the highest elevation contour of a pavement with variable cross slope.

(2) Contractor shall install the CTB layer in single compacted layer no greater than 6 inches thick, unless otherwise shown on the Plans or specified in the Special Provisions.

304.5.7 Compaction

(1) All compaction operations shall be completed within two hours from the start of mixing. The field density of the compacted mixture shall be at least 98 percent of the maximum density in accordance with 304.6.1.1. At the start of compaction, the moisture content shall be within plus or minus two percentage points of the specified optimum moisture. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

304.5.8 Finishing

(1) After compaction, shape the surface of the CTB layer to the specified lines, grades, and cross-section. During the finishing process, the surface shall be kept moist by means of fog-type sprayers. Compaction and finishing shall produce a smooth, dense surface, free of ruts, cracks, ridges, and loose material.

304.5.9 Construction Limitations

(1) All placement, compaction, and finishing operations shall be completed within two hours from the start of mixing. Material not completed within the 2-hour time limit shall be removed and replaced at the Contractor's expense.

(2) At the end of each day's construction and/or when operations are interrupted for more than 30 minutes, a straight transverse construction joint shall be formed by a header or by cutting back into the compacted material to form a true vertical face.

(3) Completed portions may be opened to light traffic, if approved by Engineer, and provided the curing is not impaired.

304.5.10 Curing

(1) The compacted and finished CTB shall be cured with the approved curing agents as soon as possible, but in no case later than two hours after completion of the finishing operations. Curing material(s) shall meet the requirements in 304.2.7. The layer shall be kept moist using a moisture-retaining cover or a light application of water until the curing material is applied.

(2) When asphalt emulsion is used as the curing agent, the entire surface of the CTB layer shall be uniformly sprayed with the emulsion at a rate of between 0.15 and 0.30 gallons per square yard; the exact temperature and rate of application being that required to achieve complete and uniform coverage without runoff. Apply sand to treated surfaces requiring protection from traffic.

(3) When a liquid membrane-forming curing compound is specified as the curing agent, the surface of the CTB layer shall be uniformly sprayed with the curing compound at the rate of one gallon to not more than 100 square feet to obtain a uniform cover over the surface. The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. The curing compound shall be thoroughly and uniformly mixed with the pigment in the storage tank. During application, the compound shall be stirred continuously by mechanical means. Hand spraying of odd widths or shapes and CTB surfaces exposed by the removal of forms is permitted.

(4) The curing seal shall be maintained and protected until the pavement is placed. If the surface of the finished CTB and/or the curing seal becomes damaged, additional curing material shall be applied at the time it is damaged or when the damage is first observed.

304.5.11 Surface tolerance.

(1) Contractor shall perform smoothness and grade checks in the presence of Engineer. Areas not meeting smoothness and grade shall be corrected by the Contractor at the Contractor's expense.

304.5.11.1 Smoothness

(1) The finished surface shall not vary more than plus or minus 3/8-inch when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline, and. moved continuously forward at half the length of the 12-foot straightedge for the full length of each line on a 50-foot grid.

304.5.11.2 Grade

(1) The grade shall be measured on a 50-foot grid and shall be within plus or minus 0.05 feet of the specified grade.

304.5.12 Bond-Breaker

(1) When the CTB is to be placed directly beneath PCC, the entire surface of the CTB shall be coated with a de-bonding compound applied in a quantity sufficient to prevent bonding of the PCC pavement to the base course. Contractor shall be responsible for selecting the de-bonding compound and determining the necessary application rate. The de-bonding compound shall be approved by the Engineer prior to being incorporated into the work. As an alternate, a non-woven fabric can be placed and shall meet the requirements of AASHTO M 288 Class I fabric with elongation not less than 50% at the specified

strengths, and a minimum weight of 14.5 oz/sy. A certificate of compliance (COC) shall be provided by the fabric manufacturer that the material may be used as a bond breaker.

304.6 Material Acceptance

304.6.1 Acceptance Sampling and Testing

(1) Cement Treated Aggregate base course shall be accepted for density and thickness on an area basis. Two tests shall be made for density and thickness for each 1200 square yards, but not less than four tests per day of production. Sampling locations will be determined on a random basis per ASTM D3665.

304.6.1.1 Density Testing

(1) CTB samples representing the material placed shall be taken to establish density and moisture requirements in accordance with ASTM D558. Additional CTB samples will be taken daily to verify density and moisture requirements. The Contractor's laboratory shall perform all density tests in Engineer's presence and provide the test results upon completion to Engineer for acceptance.

(2) Each area shall be accepted for density when the field density is at least 98 percent of the maximum density of laboratory specimens. The in-place field density shall be determined in accordance with ASTM D6938, Procedure A, direct transmission method. The in-place moisture content shall be determined in accordance with ASTM D2216. Perform in-place density test immediately after completion of compaction to determine degree of compaction. If the material fails to meet the density requirements, compaction shall continue or the material shall be removed and replaced at the Contractor's expense. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

304.6.1.2 Thickness

(1) Thickness shall be determined by measuring the depth of core holes in the CTB at random locations, per ASTM D3665. The resulting core holes shall be filled by the Contractor with CTB or non-shrink grout.

(2) If specified on the Plans or in the Special Provisions, the thickness of the CTB shall be determined by survey on a 25-foot by 25-foot survey grid. When specified, Engineer will provide survey and determine grid dimensions.

(3) When the thickness measurement is deficient by more than 1/2 inch, the area represented by the tests shall be removed and replaced at the Contractor's expense.

304.7 Measurement

304.7.1 Cement-Treated Base Course

(1) The quantity of Cement-Treated Base Course will be determined by measurement of the number of square yards (SY) of CTB actually constructed and accepted by the Engineer as complying with the Plans and Specifications.

304.8 Payment

304.8.1 Cement-Treated Base Course

(1) Payment shall be made at the contract unit price (as adjusted per 304.6) per square yard, for the thickness specified, for cement-treated base course. This price shall be full compensation for furnishing all materials, including cement; for all preparation, manipulation, placing, and curing of these materials; and for all labor, equipment, testing, tools, and incidentals necessary to complete the item.

(2) Each lot of CTB material will be accepted for density at the full contract price adjusted in accordance with 304.6.1.1; and thickness in accordance with 304.6.1.2.

(3) Payment will be made for measured quantities based upon Contract prices for the following Pay Items:

Pay Item	Description	Unit
P304.010 to P304.019	Cement-Treated Base Course (thickness)	Square Yard (SY)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C88 Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

ASTM C150	Standard Specification for Portland Cement
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregate
ASTM C174	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D558	Standard Test Methods for Moisture-Density (Unit Weight) Relations of Soil-Cement Mixtures
ASTM D559	Standard Test Methods for Wetting and Drying Compacted Soil-Cement Mixtures
ASTM D560	Standard Test Methods for Freezing and Thawing Compacted Soil-Cement Mixtures
ASTM D977	Standard Specification for Emulsified Asphalt
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1633	Standard Test Methods for Compressive Strength of Molded Soil-Cement Cylinders
ASTM D2397	Standard Specification for Cationic Emulsified Asphalt
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D3666	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

END OF SPECIFICATION P304

Specification P306 - Lean Concrete Base Course

306.1 Description

306.1.1 General

(1) This Work shall consist of a lean concrete subbase that is composed of aggregate and cement uniformly blended together and mixed with water. The mixture may also include approved cementitious additives, in the form of fly ash or slag, and chemical admixtures. The mixed material shall be spread, shaped, and consolidated using concrete paving equipment in accordance with these specifications and in conformity to the lines, grades, dimensions, and typical cross-sections shown on the Plans.

306.1.2 Construction Staking

(1) Contractor shall provide all construction staking in accordance with 50.6, except Engineer will provide staking as described on the Plans or specified in the Special Provisions.

306.2 Materials

306.2.1 Aggregate

(1) The coarse aggregate fraction shall be crushed stone, crushed or uncrushed gravel, crushed and adequately seasoned, air-cooled, iron blast furnace slag, crushed recycled concrete, or a combination of the materials listed. The fine aggregate fraction may be part of the natural aggregate blend as obtained from the borrow source or it may be natural sand that is added at the time of mixing. Aggregate shall meet the gradation and material requirements in the following tables.

Table 306.2.1a

Aggregate Material Requirements

Material Test	Requirement	Standard
Coarse Aggregate Portion (retained on the No. 4 (4.75 mm) sieve)		
Resistance to Degradation	Loss: 40% maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88
Flat Particles, Elongated Particles, or Flat and Elongated Particles[1]	10% maximum, by weight, for fraction retained on the ½ inch (12.5mm) sieve and 10% maximum, by weight, for the fraction passing the 1/2-inch (12.5 mm) sieve	ASTM D4791
Clay lumps and friable particles	Less than or equal to 3 percent	ASTM C142
Fine Aggregate Portion (passing the No. 40 (425µm) sieve)		
Clay lumps and friable particles	Less than or equal to 3 percent	ASTM C142
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88

[1] *A flat particle is one having a ratio of width to thickness greater than five; an elongated particle is one having a ratio of length to width greater than five.*

Table 306.2.1b

Aggregate Gradation for Lean Concrete

Sieve Size (square openings)	Percentage by Weight Passing Sieves	
	Gradation A	Gradation B
1-1/2 inch (37.5 mm)	100	--
1 inch (25.0 mm)	70 - 95	100
3/4 inch (19.0 mm)	55 - 85	70 - 100
No. 4 (4.75 mm)	30 - 60	35 - 65
No. 40 (425 µm)	10 - 30	15 - 30
No. 200 (75 µm)	0 - 15	0 - 15

306.2.2 Sampling and Testing

(1) Aggregate base materials. Contractor shall take samples and provide test results for the aggregate base stockpile in accordance with ASTM D75 to verify initial aggregate base requirements and gradation. Material shall meet the requirements in 306.2.1 and 306.2.2. This sampling and testing will be the basis for approval of the aggregate base quality requirements. Provide written results to Engineer two weeks prior to construction.

306.2.3 Cement

(1) Cement shall conform to the requirements of ASTM C150, Type I or Type II; or ASTM C595, Type IP; unless other requirements are specified on the Plans or Special Provisions.

306.2.4 Cementitious Additives

(1) Pozzolanic and slag cement may be added to the lean concrete mix. If used, each material must meet the following requirements:

a. Pozzolan. Pozzolanic materials must meet the requirements of ASTM C618, Class F, or N with the exception of loss of ignition, where the maximum shall be less than six percent. The supplementary optional physical requirements of Table 3 contained in ASTM C618 shall apply.

b. Slag cement (ground granulated blast furnace (GGBF) slag). Slag shall conform to ASTM C989, Grade 100 or 120.

306.2.5 Chemical Admixtures

(1) The Contractor shall submit certificates indicating that the material to be furnished meets all the requirements listed below. In addition, the Engineer may require the Contractor to submit complete test data showing that the material to be furnished meets all the requirements of the cited specification.

a. Air-entraining admixtures**:** Air-entraining admixtures shall meet the requirements of ASTM C260.

b. Water-reducing admixtures: Water-reducing, set-controlling admixtures shall meet the requirements of ASTM C494, Type A, D, E, F, or G. Water-reducing admixtures shall be added at the mixer separately from air-entraining admixtures in accordance with the manufacturer's printed instructions. The air entrainment agent and the water-reducing admixture shall be compatible.

c. Retarding admixtures**:** Retarding admixtures shall meet the requirements of ASTM C494, Type B or D.

d. Accelerating admixtures: Accelerating admixtures shall meet the requirements of ASTM C494, Type C.

306.2.6 Water

(1) Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with ASTM C1602 prior to use.

306.2.7 Curing Materials

(1) For curing lean concrete, use white-pigmented, liquid membrane-forming compound conforming to ASTM C309, Type 2, Class B, or clear or translucent Type 1-D, Class B with white fugitive dye.

306.2.8 Bond Breaker

(1) When asphalt pavement will be placed directly above lean concrete base, bond breaker will not be required.

(2) When PCC pavement will be placed directly above lean concrete base, construct bond breaker between the layers. Utilize liquid membrane unless an alternative is required. See 306.5.14.

a. Choke stone shall be an ASTM C33 Number 89 stone.

b. Fabric shall meet the requirements of AASHTO M 288 Class I non-woven fabric with elongation less than 50% at the specified strengths, and a minimum weight of 14.5 oz/yd. A certificate of compliance (COC) shall be provided by the fabric manufacturer that the material may be used as a bond breaker.

c. Liquid membrane forming compound shall be in accordance with paragraph 306-2.7.

306.3 Mixture Composition

306.3.1 Mix Design

(1) The lean concrete mix design shall be based on trial batch results conducted in the laboratory. The lean concrete shall be designed to meet the criteria in this section.

306.3.1.1 Compressive strength

(1) Compressive strength shall not be less than 500 pounds per square inch nor greater than 800 pounds per square inch at seven days. Compressive strengths shall be taken as the average of two compressive strength test results. All compressive strength specimens shall be prepared and tested in accordance with ASTM C192 and ASTM C39, respectively.

306.3.1.2 Air content

(1) The percentage of air entrainment shall be six percent, plus or minus one-half percent. Air content shall be determined by testing in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag and other highly porous coarse aggregate.

(2) If there is a change in aggregate sources, type of cement used, or pozzolanic materials, a new mix design must be submitted

306.3.2 Submittals

(1) At least 30 days prior to the placement of the lean concrete, Contractor shall submit certified test reports to the Engineer for those materials proposed for use during construction, as well as the mix design information for the lean concrete material. The certification shall identify the specifications and test standard, the name of the testing laboratory, the date of the tests, and a statement that the materials comply with the applicable specifications. Tests older than six (6) months shall not be used. The submittal package shall include the following:

a. Sources of materials, including aggregate, cement, admixtures, and curing and bond breaking materials.

b. Physical properties of the aggregates, cement, admixtures, curing and bond breaking materials.

c. Mix design:

d. Mix identification number

e. Weight of saturated surface-dry aggregates (fine and coarse)

f. Combined aggregate gradation

g. Cement factor

h. Water content

i. Water-cementitious material ratio (by weight)

j. Volume of admixtures and yield for one cubic yard (cubic meter) of lean concrete

k. Laboratory test results:

l. Slump

m. Unit weight

n. Air content

o. Compressive strength at 3, 7, and 28 days (average values)

p. Wet-dry and/or Freeze-thaw weight loss (May be waived by Engineer)

(2) Where applicable, the Contractor shall submit a jointing plan for transverse joints in the lean concrete layer for approval by the RPR.

(3) During production, the Contractor shall submit batch tickets for each delivered load.

306.4 Equipment

306.4.1 General

(1) All equipment necessary to mix, transport, place, compact, and finish the lean concrete material shall be furnished by the Contractor and is subject to inspection and approval by the Engineer. Contractor shall provide certification that all equipment conforms to the requirements of ASTM C94.

306.4.2 Placing and Finishing

306.4.2.1 Forms

(1) Straight side forms shall be made of steel and shall be furnished in sections not less than ten feet in length. Forms shall have a depth equal to the pavement thickness at the edge. Flexible or curved forms of proper radius shall be used for curves of 100 feet radius or less. Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms with battered top surfaces and bent, twisted or broken forms shall not be used. Built-up forms shall not be used, except as approved by the Engineer.

(2) The forms shall contain provisions for locking the ends of abutting sections together tightly for secure setting. Wood forms may be used under special conditions, when accepted by the Engineer.

306.4.3 Concrete pavers

(1) A fixed form or slip-form concrete paver may be used to place lean concrete. The paver shall be fully energized, self-propelled and capable of spreading, consolidating, and finishing the lean concrete material, true to grade, tolerances, and cross-sections. The paver shall be of sufficient weight and power to construct the maximum specified concrete paving lane width, at adequate forward speed, without transverse, longitudinal or vertical instability or without displacement. Slip-form pavers shall be equipped with electronic or hydraulic horizontal and vertical control devises. Bridge deck pavers are approved as paver-finishing machines for lean concrete, provided they are capable of handling the amount of lean concrete required for the full-lane width specified, and capable of spreading, consolidating, and finishing the lean concrete material, true to grade, tolerances, and cross-sections.

306.4.4 Vibrators

(1) For fixed-form construction, vibrators may be either the surface pan type or internal type with either immersed tube or multiple spuds for the full width of the slab. They may be attached to the spreader, the finishing machine, or mounted on a separate carriage. They shall not come in contact with the subgrade or forms.

(2) For slip-form construction, the paver shall be accomplished by internal vibrators for the full width and depth of the pavement being placed. The number, spacing, frequency, and eccentric weights of vibrators shall be provided to achieve acceptable consolidation without segregation and finishing quality. Internal vibrators may be supplemented by vibrating screeds operating on the surface of the lean concrete. Vibrators and screeds shall automatically stop operation when forward motion ceases. An override switch shall be provided.

(3) Hand held vibrators may be used in irregular areas.

306.4.5 Joint Saws

(1) The Contractor shall provide a sufficient number of saws with adequate power to cut contraction or construction joints to the required dimensions as shown on the plans. The Contractor shall provide at least one standby saw in good working order.

306.5 Construction

306.5.1 Control Strip

(1) The first half-day of construction shall be considered the control strip. Contractor shall demonstrate, in the presence of Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. Control strips that do not meet specification requirements shall be removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by Engineer. Upon acceptance of the control strip by Engineer, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by Engineer.

306.5.2 Weather Limitations

(1) Contractor shall follow the recommended practices in American Concrete Institute (ACI) 306R, Guide to Cold Weather Concreting. The temperature of the mixed lean concrete shall not be less than 50 degrees Fahrenheit at the time of placement. The lean concrete shall not be placed when the ambient temperature is below 40 degrees Fahrenheit or when conditions indicate that the temperature may fall below 35 degrees Fahrenheit within 24 hours. The lean concrete shall not be placed on frozen underlying courses.

(2) Contractor shall follow the recommended practices in ACI 305R, Guide to Hot Weather Concreting. The lean concrete temperature from initial mixing through final cure shall not exceed 90 degrees Fahrenheit.

When the maximum daily air temperature exceeds 85 degrees Fahrenheit, the forms and/or the underlying material shall be sprinkled with water before placing the lean concrete.

(3) Contractor should stop operations prior to and during rain allowing time to cover and protect any plastic lean concrete. Areas damaged by rain shall be refinished or replaced at the Contractor's expense.

306.5.3 Maintenance

(1) Contractor shall protect the lean concrete from environmental or mechanical damage. Traffic shall not be allowed on the pavement until test specimens made per ASTM C31 have attained a compressive strength of 500 psi when tested per ASTM C39. The Contractor shall maintain continuity of the applied curing method for the entire curing period.

306.5.4 Form setting

(1) Form sections shall be tightly locked and shall be free from play or movement in any direction. The forms shall not deviate from true line by more than 1/4 inch at any joint. The top face of the form shall not vary from a true plane more than 1/8 inch in 10 feet, and the upstanding leg shall not vary more than 1/4 inch. Forms shall be cleaned and oiled prior to the placing of lean concrete.

306.5.5 Preparation of underlying course.

(1) The underlying course shall be checked and accepted by Engineer before placing operations begin. Prior to placing the material, the final grade should be firm, moist and free of frost. Use of chemicals to eliminate frost will not be permitted. The underlying course shall be wetted in advance of placing the lean concrete base course.

306.5.6 Grade control

(1) Grade control shall be as necessary to construct the layer to the profile and cross-sections as shown on the plans.

306.5.7 Mixing

(1) The batch plant site, layout, equipment, and provisions for transporting material shall assure a continuous supply of material to the work. Stockpiles shall be constructed in a manner that prevents segregation and intermixing of deleterious materials.

(2) All lean concrete shall be mixed and delivered to the site per the requirements of ASTM C94. The mixing time should be adequate to produce lean concrete that is uniform in appearance, with all ingredients evenly distributed. Mixing time shall be measured from the time all materials are emptied into the drum (provided all the water is added before one-fourth the preset mixing time has elapsed) and continues until the time the discharge chute is opened to deliver the lean concrete.

(3) If mixing in a batch plant, the mixing time shall not be less than 50 or greater than 90 seconds. If mixing in a truck mixer, the mixing time shall not be less than 70 or more than 125 truck-drum revolutions at a mixing speed of not less than six or more than 18 truck-drum revolutions per minute.

(4) The elapsed time from the addition of cementitious material to the mix until the lean concrete is deposited in place at the work site shall not exceed 45 minutes when the concrete is hauled in non-agitating trucks, or 90 minutes when it is hauled in truck mixers or truck agitators.

(5) Re-tempering lean concrete will not be permitted, except when delivered in truck mixers. With truck mixers, additional water may be added to the batch materials if the addition of water is added within 45 minutes after the initial mixing operations and the water/cement ratio specified in the mix design is not exceeded.

306.5.8 Placing

(1) The lean concrete material shall be placed continuously at a uniform rate on the underlying course minimizing segregation and handling of the mix. Rakes shall not be allowed for spreading the lean concrete.

306.5.9 Finishing

(1) Shape the finished surface of the lean concrete base layer to the specified lines, grades, and cross-section. Hand finishing will not be permitted except in areas where the mechanical finisher cannot operate.

(2) When a PCC surface will be constructed above the lean concrete layer, the surface of the lean concrete shall not be textured. When an asphalt surface will be constructed above the lean concrete layer, the surface of the lean concrete shall have a coarse texture.

306.5.10 Construction limitations

(1) All placement and finishing operations shall be completed within two hours from the start of mixing. Material not completed within the 2-hour time limit shall be removed and replaced at the Contractor's expense.

(2) At the end of each day's construction and/or when operations are interrupted for more than 30 minutes, a straight transverse construction joint shall be formed by a header or by cutting back into the compacted material to form a true vertical face.

(3) Completed portions may be opened to light traffic when it has achieved its 7-day strength and the curing is not damaged.

306.5.11 Joints

(1) Locate all longitudinal and transverse construction joints as shown on the plans. Longitudinal joints shall be within six inches of planned joints in the overlaying concrete pavement and transverse joints shall be within three inches the planned joints of the overlying concrete surface. Joints shall be sawn as soon as the base can support the saws without damage to the lean concrete base. Joints shall be constructed by sawing the hardened lean concrete to a depth of at least one-third the thickness of the lean concrete base, or 1/5th the depth of the lean concrete base when constructed using early entry saws.

306.5.12 Curing

(1) Immediately after the finishing operations are complete and within two hours of placement of the lean concrete, the entire surface and edges of the newly placed lean concrete shall be sprayed uniformly with white pigmented, liquid membrane forming curing compound: conforming to ASTM C309, Type 2, Class B; or clear or translucent Type 1-D, Class B with white fugitive dye in accordance with 306.2.7. The layer should be kept moist using a moisture-retaining cover or a light application of water until the curing material is applied. The curing compound shall not be applied during rainfall.

(2) The curing material shall be applied at a maximum coverage of 200 square feet per gallon using pressurized mechanical sprayers. The spraying equipment shall be a fully atomizing type equipped with a tank agitator. At the time of use, the curing compound in the tank shall be thoroughly and uniformly mixed with the pigment. During application, the curing compound shall be continuously stirred by mechanical means. Edges of the lean concrete layer shall be sprayed with curing compound immediately following placement with slip-form pavers or when side-forms are removed. Hand spraying of odd widths or shapes and lean concrete surfaces exposed by the removal of forms is permitted.

(3) The lean concrete temperature during curing shall be in accordance with 306.5.2.

(4) If the curing material becomes damaged from any cause, including sawing operations, within the required 7-day curing period or until the overlying course is constructed, the Contractor shall immediately repair the damaged areas by application of additional curing compound or other means approved by Engineer.

306.5.13 Surface tolerance

(1) Contractor shall perform smoothness and grade checks daily. Areas not meeting smoothness and grade shall be corrected by the Contractor at the Contractor's expense. Contractor shall provide smoothness and grade data to Engineer on a daily basis.

306.5.13.1 Smoothness

(1) The finished surface shall not vary more than ±3/8-inch when tested with a 12-footstraightedge applied parallel with and at right angles to the centerline, and. moved continuously forward at half the length of the 12-foot straightedge for the full length of each line on a 50-foot grid. Contractor shall correct any high spots more than 3/8 inch in 12-foot with a grinding machine or remove and replace the material at the Contractor's expense. Areas that have been ground shall have curing compound reapplied.

306.5.13.2 Grade

(1) The grade shall be measured on a 50-foot grid and shall be within plus or minus 0.05 feet of the specified grade. When the surface is more than 1/2 inch above the grade shown in the plans, the surface shall be corrected at the Contractor's expense to an elevation that falls within a tolerance of 1/4 inch.

306.5.14 Bond-breaker

(1) When asphalt surface is placed directly on lean concrete base, no bond breaker is required. When PCC pavement will be placed directly above the lean concrete base, a bond breaker shall be constructed using liquid membrane forming compound as specified, unless an alternative method is utilizing choke stone or fabric is shown on the Plans or in the Special Provisions.

(2) Choke stone per 306.2.8 shall be placed on the surface of the lean concrete to prevent bonding. The choke stone shall be placed in a layer approximately 1/4-inch thick.

(3) Fabric per 306.2.8 shall be placed on the surface of the lean concrete to prevent bonding. The fabric shall be placed with a minimum one foot of overlap where adjoining sections of fabric come together.

(4) Liquid membrane forming compound per 306.2.8 shall be placed on the surface of the lean concrete to prevent bonding. The liquid membrane forming compound when used as a bond breaker shall be applied at least eight hours and not more than 24 hours before placement of the concrete pavement. The curing material shall be applied at a maximum coverage rate of 200 square feet per gallon using pressurized mechanical sprayers.

306.6 Material Acceptance

306.6.1 Sampling and Testing

(1) Acceptance sampling and testing to determine conformance with the requirements specified in this section will be performed by Engineer for each 1200 square yards. Sampling locations will be determined by Engineer on a random basis per ASTM D3665.

306.6.1.1 Compressive Strength

(1) One sample of freshly delivered lean concrete will be taken for compressive strength for each 1200 square yards in accordance with ASTM C172 and air content tests in accordance with ASTM C231. Two test cylinders will be made and cured from the sample per ASTM C31 and the 7-day compressive strength of each cylinder determined per ASTM C39. The compressive strength will be computed by averaging the two 7-day compressive strengths.

(2) Contractor shall provide for the initial curing of cylinders in accordance with ASTM C31 during the 24 hours after molding.

306.6.1.2 Thickness

(1) Cores shall be drilled by the Contractor at two different sampling locations for thickness determination for each 1200 square yards. Thickness will be determined by measuring the depth of core holes and computed by averaging the thickness determination of the two locations.

(2) Core holes shall be filled by the Contractor with lean concrete base or non-shrink grout.

306.6.2 Acceptance

306.6.2.1 Strength

(1) If the lean concrete fails to meet the minimum compressive strength requirements, the Contractor shall remove and replaced the material at the Contractor's expense.

306.6.2.2 Thickness

(1) If the average thickness is not deficient by more than 1/2 inch from the plan thickness, full payment shall be made. When such measurement is deficient by more than 1/2 inch but less than one inch from the plan thickness, the area represented by the test shall be removed and replaced at the Contractor's expense or shall be permitted to remain in-place at an adjusted payment of 75% of the contract unit price.

306.7 Measurement

306.7.1 General

(1) The quantity of Lean Concrete Base Course will be determined by the number of square yard of lean concrete actually constructed and accepted by the Engineer as complying with the Plans and Specifications.

306.8 Payment

306.8.1 General

(1) The accepted quantities of lean concrete will be paid for at the contract unit price per square yard for lean concrete base. The payment shall be full compensation for furnishing and placing all materials, provided; however, for pavement found deficient in thickness as specified in 306.6.2.2, the reduced unit price shall be paid.

306.8.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	**Description**	**Unit**
P306.010 to P306.019	Lean Concrete Base Course Gradation A (thickness)	Square Yard (SY)
P306.020 to P306.029	Lean Concrete Base Course Gradation B (thickness)	Square Yard (SY)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C150	Standard Specification for Portland Cement
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C174	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
ASTM C192	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C618	Specification for Coal Fly Ash and Raw and Calcined Natural Pozzolans for Use in Concrete
ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1567	Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregates (Accelerated Mortar-Bar Method)
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

ASTM D3665	Standard Practice for Random Sampling of Construction Materials

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T136	Standard Method of Test for Freezing-and-Thawing Tests of Compacted Soil-Cement Mixtures

American Concrete Institute (ACI)

ACI 305R	Guide to Hot Weather Concreting
ACI 306R	Guide to Cold Weather Concreting

END OF SPECIFICATION P306

Part 6 – Flexible Pavement

Specification P401 - Hot Mix Asphalt (HMA) Pavements

401.1 Description

401.1.1 General

(1) This Work shall consist of pavement courses composed of mineral aggregate and asphalt cement binder (asphalt binder) mixed in a central mixing plant and placed on a prepared base or stabilized course in accordance with these specifications and shall conform to the lines, grades, thicknesses, and typical cross-sections shown on the Plans. Each course (layer) shall be constructed to the depth, typical section, and elevation required by the Plans and shall be rolled, finished, and approved before the placement of the next course.

(2) Definitions found in 402.2.1 shall apply to this Specification, in particular the following terms shall have the definitions given.

Base layer An asphaltic concrete course which is placed as a stabilizing layer under either asphalt or concrete pavements. The use of a base layer is typically reserved for pavements serving aircraft >100,000 pounds.

Leveling layer An asphaltic concrete course which is placed to eliminate irregularities in profile or thickness of underlying pavement layers. Leveling layers are generally placed thinner than standard pavement layer thicknesses, and are exempt from QMP testing.

Lower layer Also referred to as the binder course or an asphalt base course, is any asphaltic pavement layer below the upper layer when the pavement structure is complete. A pavement structure may have multiple lower(binder) layers.

Upper layer The top asphaltic pavement layer which is in direct contact with traffic when the pavement structure is complete. A pavement structure has only one upper layer.

401.1.2 Construction Staking

(1) Contractor shall provide all construction staking in accordance with 50.6, except Engineer will provide staking as described on the Plans or specified in the Special Provisions.

401.2 Materials

401.2.1 Aggregate

(1) Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screenings, natural sand and mineral filler, as required. The aggregates should have no known history of detrimental pavement staining due to ferrous sulfides, such as pyrite. The portion retained on the No. 4 sieve is coarse aggregate. The portion passing the No. 4 sieve and retained on the No. 200 sieve is fine aggregate, and the portion passing the No. 200 sieve is mineral filler.

401.2.1.1 Coarse Aggregate

(1) Coarse aggregate shall consist of sound, tough, durable particles, free from films of matter that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances. Coarse aggregate material requirements are specified in the following table.

Table 401.2.1.1

Coarse Aggregate Material Requirements (Portion retained on the No. 4 (4.75 mm) sieve)		
Material Test	**Requirement**	**Standard**
Resistance to Degradation	Loss: 40% maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate **or** Magnesium Sulfate	Loss after 5 cycles: 12% maximum using Sodium sulfate - or - 18% maximum using magnesium sulfate	ASTM C88

Clay lumps and friable particles	1.0% maximum	ASTM C142
Percentage of Fractured Particles	For pavements designed for aircraft gross weights of 60,000 pounds or more: Minimum 75% by weight of particles with at least two fractured faces and 85% with at least one fractured face[1]	ASTM D5821
	For pavements designed for aircraft gross weights less than 60,000 pounds: Minimum 50% by weight of particles with at least two fractured faces and 65% with at least one fractured face[1]	
Flat, Elongated, or Flat and Elongated Particles	10% maximum, by weight, of flat, elongated, or flat and elongated particles at 5:1 [2]	ASTM D4791
Bulk density of slag [3]	Weigh not less than 70 pounds per cubic foot	ASTM C29.

[1] *The area of each face shall be equal to at least 75% of the smallest mid-sectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces.*

[2] *A flat particle is one having a ratio of width to thickness greater than five; an elongated particle is one having a ratio of length to width greater than five.*

[3] *Only required if slag is specified.*

401.2.1.2 Fine Aggregate

(1) Fine aggregate shall consist of clean, sound, tough, durable, angular shaped particles produced by crushing stone or gravel that meets the requirements for wear and soundness specified for coarse aggregate. The aggregate particles shall be free from coatings of clay, silt, or other objectionable matter. Natural (non-manufactured) sand may be used to obtain the gradation of the aggregate blend or to improve the workability of the mix. Fine aggregate material requirements are listed in the following table.

Table 401.2.1.2

Fine Aggregate Material Requirements (Portion retained on the No. 200 (75 µm))		
Liquid limit	25 maximum	ASTM D4318
Plasticity Index	3 maximum	ASTM D4318
Soundness of Aggregates by Use of Sodium Sulfate **or** Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88
Clay lumps and friable particles	1.0% maximum	ASTM C142
Sand equivalent	45 minimum	ASTM D2419
Natural Sand	0% to 15% maximum by weight of total aggregate	ASTM D1073

401.2.1.3 Sampling

(1) ASTM D75 shall be used in sampling coarse and fine aggregate.

401.2.2 Mineral Filler

(1) Mineral filler (baghouse fines) may be added in addition to material naturally present in the aggregate. Mineral filler shall meet the requirements of ASTM D242.

Mineral Filler Requirements

Material Test	Requirement	Standard
Plasticity Index	4 maximum	ASTM D4318

401.2.3 Asphalt Cement Binder

(1) Asphalt cement binder shall be supplied and tested in conformance with the Departments' Combined State Binder Group Method of Acceptance for Asphalt Binders, AASHTO Table M332 at:

https://wisconsindot.gov/Documents/doing-bus/eng-consultants/cnslt-rsrces/tools/qmp/csbg-policy.pdf

(2) A certificate of compliance from the manufacturer shall be included with the mix design submittal.

(3) The supplier's certified test report with test data indicating grade certification for the asphalt binder shall be provided to the Engineer for each load at the time of delivery to the mix plant. A certified test report with test data indicating grade certification for the asphalt binder shall also be provided to the Engineer for modifications of the asphalt binder after delivery to the mix plant and before use in the HMA.

401.2.4 Anti-Stripping Agent

(1) Anti-stripping agent or additive (anti-strip) shall be heat stable and shall not change the asphalt binder grade beyond specifications. Anti-strip shall be an approved material of the Wisconsin Department of Transportation.

401.3 Composition

401.3.1 Composition of Mixture

(1) The HMA mix shall be composed of a mixture of well-graded aggregate, filler and anti-strip agent if required, and asphalt binder. The several aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF).

401.3.2 Job Mix Formula (JMF) Laboratory

(1) The laboratory used to develop the JMF shall possess a current certificate of accreditation, listing D3666 from a national accrediting authority and all test methods required for developing the JMF, and listed on the accrediting authority's website.

(2) A copy of the laboratory's current accreditation and accredited test methods shall be submitted to the Engineer prior to start of construction.

401.3.3 Job Mix Formula (JMF)

(1) No hot-mixed asphalt (HMA) for payment shall be produced until a JMF has been approved in writing by the Engineer. The Engineer's review shall not relieve the Contractor of the responsibility to select and proportion the materials to comply with this section.

(2) When the project requires asphalt mixtures of differing aggregate gradations and/or binders, a separate JMF shall be submitted for each mix. Add anti-stripping agent to meet tensile strength requirements.

(3) The mix-design and JMF shall be prepared by an accredited laboratory that meets the requirements of 401.3.2. The HMA shall be designed using procedures contained in Asphalt Institute MS-2 Mix Design Manual, 7th Edition. Samples shall be prepared at and compacted using the gyratory compactor in accordance with ASTM D6925.

(4) Should a change in sources of materials be made, a new JMF must be submitted to Engineer for review and accepted in writing before the new material is used. After the initial production JMF has been approved by Engineer and a new or modified JMF is required for whatever reason, the subsequent cost of the new or modified JMF, including a new control strip when required by Engineer, will be borne by the Contractor.

(5) The Engineer may request samples for testing at any time, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications

(6) The JMF shall be submitted in writing by the Contractor at least 30 days prior to the start of paving operations. The JMF shall be developed with aggregates currently being produced.

(7) The submitted JMF shall be stamped or sealed by the responsible professional Engineer of the laboratory and shall include the following items as a minimum:

a. Manufacturer's Certificate of Analysis (COA) for the asphalt binder used in the JMF in accordance with 401.2.3. Certificate of asphalt performance grade is with modifier already added, if used and must indicate compliance with ASTM D6373. For plant modified asphalt binder, certified test report indicating grade certification of modified asphalt binder.

b. Manufacturer's Certificate of Analysis (COA) for the anti-stripping agent if used in the JMF in accordance with 401.2.4.

c. Certified material test reports for the course and fine aggregate and mineral filler in accordance with 401.2.1.

d. Percent passing each sieve size for individual gradation of each aggregate cold feed and/or hot bin; percent by weight of each cold feed and/or hot bin used; and the total combined gradation in the JMF.

e. Specific Gravity and absorption of each coarse and fine aggregate.

f. Percent natural sand.

g. Percent fractured faces.

h. Percent by weight of flat particles, elongated particles, and flat and elongated particles (and criteria).

i. Percent of asphalt.

j. Number of gyrations.

k. Laboratory mixing and compaction temperature.

l. Supplier-recommended field mixing and compaction temperatures.

m. Plot of the combined gradation on a 0.45 power gradation curve.

n. Graphical plots of air voids, voids in the mineral aggregate, and unit weight versus asphalt content to achieve minimum VMA during production, the mix design needs to account for material breakdown during production.

o. Tensile Strength Ratio (TSR).

p. Type and amount of a-Anti-strip agent when used.

q. Asphalt Pavement Analyzer (APA) results.

r. Date the JMF was developed. Mix designs that are not dated or which are from a prior construction season shall not be accepted.

s. Percentage and properties (asphalt content, asphalt binder properties, and aggregate properties) of reclaimed asphalt mix pavement (RAP) in accordance with 401.3.4, when RAP is allowed.

(8) When the project requires asphalt mixtures of differing aggregate gradations, a separate JMF and the results of JMF verification testing shall be submitted for each mix.

(9) The JMF for each mixture shall be in effect until a modification is approved in writing by the Engineer. Should a change in sources of materials be made, a new JMF must be submitted and approved by the Engineer in writing before the new material is used. After the initial production JMF has been approved by the Engineer and a new or modified JMF is required for whatever reason, the subsequent cost of the Engineer's approval of the new or modified JMF, including a new control strip when required by the Engineer, will be borne by the Contractor.

Table 401.3.3a Asphalt Design Criteria

Test Property	Value	Test Method
Number of gyrations	75 or 50 [2]	
Air Voids (%)	3.5	ASTM D3203
Percent voids in mineral aggregate (VMA), minimum	See Table 401.3.3b	ASTM D6995
Tensile Strength Ratio (TSR)[1]	not less than 80 at a saturation of 70-80%	ASTM D4867
Hamburg Wheel-Track Test (HWT)	Less than 12.5 mm @ 7,500 passes for S-traffic Less than 12.5 mm @ 10,000 passes for H-traffic Less than 12.5 mm @ 15,000 passes for V-traffic Less than 12.5 mm @ 20,000 passes for E-traffic	AASHTO T324

[1] *Test specimens for TSR shall be compacted at 7 ± 1.0 % air voids. In areas subject to freeze-thaw, use freeze-thaw conditioning in lieu of moisture conditioning per ASTM D4867.*

[2] *75 gyrations for pavement designed for aircraft gross weight of 60,000 pounds or more, or 50 gyrations for pavement designed for aircraft gross weight of less than 60,000 pounds.*

(10) The mineral aggregate shall be of such size that the percentage composition by weight, as determined by laboratory sieves, will conform to the gradation or gradations specified in Table 401.3.3b when tested in accordance with ASTM C136 and ASTM C117.

(11) The gradations in Table 401.3.3b represent the limits that shall determine the suitability of aggregate for use from the sources of supply; be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice versa.

Table 401.3.3b Aggregate - HMA Pavements

Sieve Size	Percentage by Weight Passing Sieves		
	Gradation 1 (1-Inch)	**Gradation 2 (3/4-Inch)**	**Gradation 3 (1/2-Inch)**
1 inch (25.0 mm)	100	--	--
3/4 inch (19.0 mm)	90-100	100	--
1/2 inch (12.5 mm)	66-88	90-100	100
3/8 inch (9.5 mm)	60-82	72-88	90-100
No. 4 (4.75 mm)	45-67	53-73	58-78
No. 8 (2.36 mm)	32-54	38-60	40-60
No. 16 (1.18 mm)	22-44	26-48	28-48
No. 30 (0.600 mm)	15-35	18-38	18-38
No. 50 (0.300 mm)	9-25	11.27	11.27
No. 100 (0.150 mm)	6-18	6-18	3-18
No. 200 (0.075 mm)	3-6	3-6	3-6
Minimum Voids in Mineral Aggregate (VMA) Percent	14	15	16
Asphalt Percent:			
Stone or gravel	4.5-7.0	5.0-7.5	5.5-8.0
Lift Thickness:			
Minimum Construction Lift Thickness (Inches)	2.25 - 3	1.75 - 2	1.5 [1]

[1] Can be used for a leveling layer at reduced thickness.

(12) The aggregate gradations shown are based on aggregates of uniform specific gravity. The percentages passing the various sieves shall be corrected when aggregates of varying specific gravities are used, as indicated in the Asphalt Institute MS-2 Mix Design Manual, 7th Edition.

401.3.4 Reclaimed Asphalt Pavement (RAP)

(1) Reclaimed HMA shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt cement. Recycled asphalt shingles (RAS) are not allowed. The RAP shall be of a consistent gradation and asphalt content and properties. When RAP is fed into the plant, the maximum RAP chunk size shall not exceed one inch.

(2) The reclaimed asphalt pavement mix shall be designed using procedures contained in the Asphalt Institute MS-2 Mix Design Manual, 7th Edition. The percentage of asphalt in the RAP shall be established for the mixture design according to ASTM D2172 using the appropriate dust correction procedure. The JMF shall meet the requirements of 401.3.3. RAP shall only be used for shoulder surface course mixes and for any lower layers. The use of RAP containing Coal Tar shall not be allowed. Coal Tar surface treatments must be removed prior to recycling underlying asphalt material. The amount of RAP shall be limited to 20 percent. In addition to the requirements of 401.3.3, the JMF shall indicate the percent of reclaimed asphalt pavement and the percent and grade of new asphalt binder.

401.3.5 Control Strip

(1) Full production shall not begin until an acceptable control strip has been constructed and accepted in writing by Engineer**.** Contractor shall prepare and place a quantity of asphalt according to the JMF. The

underlying grade or pavement structure upon which the control strip is to be constructed shall be the same as the remainder of the course represented by the control strip. A control strip is not required for project with less than 3000 tons total asphalt pavement.

(2) Contractor will not be allowed to place the control strip until Contractor quality control program (CQCP), showing conformance with the requirements of 401.5, has been accepted, in writing, by Engineer.

(3) The control strip will consist of at least 250 tons or 1/2 sublot, whichever is greater. The control strip shall be placed in two lanes of the same width and depth to be used in production with a longitudinal cold joint. The cold joint must be cut back in accordance with 401.4.14 using the same procedure that will be used during production. The cold joint for the control strip will be an exposed construction joint at least four hours old or when the mat has cooled to less than 160 degrees Fahrenheit. The equipment used in construction of the control strip shall be the same type, configuration and weight to be used on the project.

(4) The control strip will be considered acceptable by Engineer if the gradation, asphalt content, and VMA are within the action limits specified in 401.5.5; and Mat density greater than or equal to 94.5 percent, air voids 3.5 percent plus or minus one percent, and joint density greater than or equal to 92.5 percent.

(5) If the control strip is unacceptable, necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made and another control strip shall be placed. Unacceptable control strips shall be removed at the Contractor's expense.

(6) The control strip will be considered one lot for payment based upon the average of a minimum of three samples (no sublots required for control strip). Payment will only be made for an acceptable control strip in accordance with 401.8.1 using a lot pay factor equal to 100.

401.4 Construction Methods

401.4.1 Weather Limitations.

(1) The HMA shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 401.4.1. The temperature requirements may be waived by the Engineer, if requested; however, all other requirements including compaction shall be met.

Table 401.4.1. Surface Temperature Limitations of Underlying Course

Mat Thickness	Base Temperature (Minimum)	
	Degrees Fahrenheit	Degrees Centigrade
3 inches or greater	40	4
Greater than 2 inches but less than 3 inches	45	7

401.4.2 HMA Plant

(1) Plants used for the preparation of HMA shall conform to the requirements of American Association of State Highway and Transportation Officials (AASHTO) M156 including the following items.

401.4.2.1 Inspection of Plant

(1) The Engineer, or Engineer's authorized representative, shall have access, at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant: verifying weights, proportions, and material properties; and checking the temperatures maintained in the preparation of the mixtures.

401.4.2.2 Storage Bins and Surge Bins

(1) The HMA stored in storage and/or surge bins shall meet the same requirements as HMA loaded directly into trucks. Asphalt mixture shall not be stored in storage and/or surge bins for a period greater than twelve hours. If Engineer determines there is an excessive heat loss, segregation, or oxidation of the asphalt mixture due to temporary storage, temporary storage shall not be allowed.

401.4.3 Aggregate Stockpile Management

(1) Aggregate stockpiles shall be constructed in such a manner that prevents segregation and intermixing of deleterious materials. Aggregates from different sources shall be stockpiled, weighed and batched

separately at the concrete batch plant. Aggregates that have become segregated or mixed with earth or foreign material shall not be used.

(2) A continuous supply of materials shall be provided to the work to ensure continuous placement.

401.4.4 Hauling Equipment

(1) Trucks used for hauling HMA shall have tight, clean, and smooth metal beds. To prevent the HMA from sticking to the truck beds, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other material approved by the Engineer. Petroleum products shall not be used for coating truck beds. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary, to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers shall be securely fastened.

401.4.4.1 Material transfer vehicle (MTV)

(1) Material transfer vehicles used to transfer the material from the hauling equipment to the paver, shall use a self-propelled, material transfer vehicle with a swing conveyor that can deliver material to the paver without making contact with the paver. The MTV shall be able to move back and forth between the hauling equipment and the paver providing material transfer to the paver, while allowing the paver to operate at a constant speed. The Material Transfer Vehicle will have remixing and storage capability to prevent physical and thermal segregation. Material transfer vehicles are only required if specified in the Special Provisions or on the Plans.

401.4.5 HMA Pavers

(1) HMA pavers shall be self-propelled with an activated heated screed, capable of spreading and finishing courses of HMA that will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface. The HMA paver shall be equipped with a control system capable of automatically maintaining the specified screed grade and elevation.

(2) If the spreading and finishing equipment in use leaves tracks or indented areas, or produces other blemishes in the pavement that are not satisfactorily corrected by the scheduled operations, the use of such equipment shall be discontinued.

(3) The paver shall be capable of paving to a minimum width specified in 401.4.12.

401.4.6 Rollers

(1) The number, type, and weight of rollers shall be sufficient to compact the HMA to the required density while it is still in a workable condition without crushing of the aggregate, depressions or other damage to the pavement surface. Rollers shall be in good condition, clean, and capable of operating at slow speeds to avoid displacement of the HMA.

(2) All rollers shall be specifically designed and suitable for compacting HMA concrete and shall be properly used. Rollers that impair the stability of a pavement structure or underlying soils shall not be used. Depressions in pavement surfaces caused by rollers shall be repaired by the Contractor at their own expense.

401.4.7 Density Device

(1) Contractor shall have on site a density gauge during all paving operations in order to assist in the determination of the optimum rolling pattern, type of roller and frequencies, as well as to monitor the effect of the rolling operations during production paving. Contractor shall also supply a qualified technician during all paving operations to calibrate the gauge and obtain accurate density readings for all new HMA. These densities shall be supplied to the Engineer upon request at any time during construction. No separate payment will be made for supplying the density gauge and technician.

401.4.8 Preparation of Asphalt Binder

(1) Asphalt binder shall be heated in a manner that will avoid local overheating and provide a continuous supply of the asphalt binder to the mixer at a uniform temperature. The temperature of unmodified asphalt binder delivered to the mixer shall be sufficient to provide a suitable viscosity for adequate coating of the aggregate particles, but shall not exceed 325°F when added to the aggregate. The temperature of modified asphalt binder shall be no more than 350°F when added to the aggregate.

401.4.9 Preparation of Mineral Aggregate

(1) Aggregate for the HMA shall be heated and dried. The maximum temperature and rate of heating shall be such that no damage occurs to the aggregates. The temperature of the aggregate and mineral filler shall not exceed 350°F when the asphalt binder is added. Particular care shall be taken that aggregates high in calcium or magnesium content are not damaged by overheating. The temperature shall not be

lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

401.4.10 Preparation of HMA

(1) Aggregates and the asphalt binder shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but not less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D2489, for each individual plant and for each type of aggregate used. The wet mixing time will be set to achieve 95 percent of coated particles. For continuous mix plants, the minimum mixing time shall be determined by dividing the weight of its contents at operating level by the weight of the mixture delivered per second by the mixer. The moisture content of all HMA upon discharge shall not exceed 0.5 percent.

401.4.11 Preparation of the Underlying Surface

(1) Immediately before placing the HMA, the underlying course shall be cleaned of all dust and debris. A tack coat shall be applied in accordance with Specification P603, if shown on the Plans.

401.4.12 Laydown Plan, Transporting, Placing, And Finishing

(1) Prior to the placement of the HMA, the Contractor shall prepare a laydown plan with the sequence of paving lanes and width to minimize the number of cold joints; the location of any temporary ramps; laydown temperature; and estimated time of completion for each portion of the work (milling, paving, rolling, cooling, etc.). The laydown plan and any modifications shall be approved by Engineer.

(2) Deliveries shall be scheduled so that placing and compacting of HMA is uniform with minimum stopping and starting of the paver. Hauling over freshly placed material shall not be permitted until the material has been compacted, as specified, and allowed to cool to approximately ambient temperature. Contractor shall be responsible for repair of damage to the pavement caused by Contractors hauling operations.

(3) Contractor shall survey each lift of HMA surface course and certify to Engineer that every lot of each lift meets the grade tolerances of 401.5.3.8 before the next lift can be placed.

(4) Edges of existing HMA pavement abutting the new work shall be saw cut and carefully removed as shown on the drawings and coated with asphalt tack coat before new material is placed against it.

(5) The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. Placement of the asphalt mix shall begin along the centerline of a crowned section or on the high side of areas with a one way slope unless shown otherwise on the laydown plan as accepted by Engineer. The asphalt mix shall be placed in consecutive adjacent lanes having a minimum width of 15 feet (or as shown on the Plan or approved by Engineer), except where edge lanes require less width to complete the area. Additional screed sections attached to widen the paver to meet the minimum lane width requirements must include additional auger sections to move the asphalt mixture uniformly along the screed extension.

(6) The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least one foot; however, the joint in the surface top course shall be at the centerline of crowned pavements. Transverse joints in one course shall be offset by at least 10 feet (3 m) from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset by at least 10 feet. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the HMA may be spread and luted by hand tools.

(7) Areas of segregation in the surface course or unacceptable surface defects, as determined by the Engineer, shall be removed and replaced at the Contractor's expense. The area shall be removed by saw cutting and milling a minimum of the construction lift thickness as specified in Table 401.3.3b for the approved mix design. The area to be removed and replaced shall be a minimum width of the paver and a minimum of 10 feet long.

(8) The Engineer may at any time, reject and require the Contractor to dispose of any batch of HMA which is unacceptable for any reason and rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, or improper mix temperature. If rejected, the Contractor may take a representative sample of the rejected material in the presence of the Engineer, to be tested for conformance in the laboratory. Conformance testing shall be conducted, in the presence of the Engineer. If the material is determined to be in acceptable conformance, the rejected material will be paid at the contract unit price as part of that lot including any pay adjustments.

401.4.13 Compaction of HMA

(1) After placing, the HMA shall be thoroughly and uniformly compacted by self-propelled rollers. The surface shall be compacted as soon as possible when the HMA has attained sufficient stability so that the rolling does not cause undue displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Surface defects and/or displacement occurring as a result of the roller operation, or from other causes, shall be corrected at Contractor's expense.

(2) Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross-section, and the required field density is obtained. To prevent adhesion of the HMA to the roller, the wheels shall be equipped with a scraper and kept properly moistened with water as necessary.

(3) In areas not accessible to the roller, the mixture shall be thoroughly compacted with approved power driven tampers.

(4) HMA that becomes loose and broken, mixed with dirt, contains check-cracking, or has other defectives shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching shall not be allowed.

401.4.14 Joints

(1) The formation of all joints shall be made in such a manner as to ensure a continuous bond between the courses and obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

(2) The roller shall not pass over the unprotected end of the freshly laid HMA except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. In both methods, all contact surfaces shall be coated with an asphalt tack coat before placing fresh HMA against the joint.

(3) Longitudinal joints which have been left exposed for more than four hours, the surface temperature has cooled to less than 175°F or are irregular, damaged, uncompacted or otherwise defective shall be cut back with a cutting wheel or pavement saw a maximum of three inches to six inches to expose a clean, sound, uniform vertical surface for the full depth of the course. All cutback material and laitance produced from cutting joints shall be removed from the project. Asphalt tack coat or other product approved by the Engineer shall be applied to the clean, dry joint, prior to placing any additional fresh HMA against the joint. Laitance produced from cutting joints shall be removed by vacuuming and washing. The cost of this work shall be considered incidental to the cost of the HMA.

401.4.15 Saw-Cut Grooving

(1) If shown on the Plans, saw cut grooves shall be provided as specified in Specification P621.

401.4.16 Diamond Grinding

(1) Diamond grinding shall be completed prior to pavement grooving, if pavement grooving is specified. Diamond grinding, when necessary, shall be accomplished by sawing with saw blades impregnated with industrial diamond abrasive.

(2) Diamond grinding shall be performed with a machine designed specifically for diamond grinding capable of cutting a path at least three feet wide. The saw blades shall be 1/8-inch wide with a sufficient number of blades to create grooves between 0.090 and 0.130 inches wide; and peaks and ridges approximately 1/32 inch higher than the bottom of the grinding cut. The actual number of blades will be determined by the Contractor and depend on the hardness of the aggregate. Equipment or grinding procedures that cause ravels, aggregate fractures, spalls or disturbance to the pavement will not be permitted. Contractor shall demonstrate to Engineer that the grinding equipment will produce satisfactory results prior to making corrections to surfaces. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The slurry resulting from the grinding operation shall be continuously removed and the pavement left in a clean condition. The Contractor shall apply a surface treatment per P603 to all areas that have been subject to grinding.

401.4.17 Nighttime Paving Requirements

(1) The Contractor shall provide adequate lighting during any nighttime construction. A lighting plan must be submitted by the Contractor and approved by the Engineer prior to the start of any nighttime work. All work shall be in accordance with the approved CSPP and lighting plan.

401.5 Contractor Quality Control (CQC)

401.5.1 General

(1) Contractor shall develop a Contractor Quality Control Program (CQCP) in accordance with Section 100 of the General Requirements and Covenants. No partial payment will be made for materials without an approved CQCP.

401.5.2 Contractor Quality Control Facilities

(1) Contractor shall provide or contract for testing facilities in accordance with Section 100. Engineer shall be permitted unrestricted access to inspect the Contractor's QC facilities and witness QC activities. Engineer will advise Contractor in writing of any noted deficiencies concerning the QC facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting the test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

401.5.3 Contractor Quality Control (CQC) Testing

(1) The Contractor shall perform all quality control tests necessary to control the production and construction processes applicable to these Specifications and as set forth in the approved Contractor Quality Control Program. The testing program shall include, but not necessarily be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, field compaction, and surface smoothness. A Quality Control Testing Plan shall be developed as part of the Contractor Quality Control Program.

401.5.3.1 Asphalt Content

(1) A minimum of two tests shall be performed per lot in accordance with ASTM D6307 or ASTM D2172 for determination of asphalt content. When using ASTM D6307, the correction factor shall be determined as part of the first test performed at the beginning of plant production; and as part of every tenth test performed thereafter. The asphalt content for the lot will be determined by averaging the test results.

401.5.3.2 Gradation

(1) Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of extracted aggregate in accordance with ASTM D5444, ASTM C136, and ASTM C117.

401.5.3.3 Moisture Content of Aggregate

(1) The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C566.

401.5.3.4 Moisture Content of HMA

(1) The moisture content shall be determined once per lot in accordance with AASHTO T329 or ASTM D1461.

401.5.3.5 Temperatures

(1) Temperatures shall be checked, at least four times per lot, at necessary locations to determine the temperatures of the dryer, the asphalt binder in the storage tank, the HMA at the plant, and the HMA at the job site.

401.5.3.6 in-Place Density Monitoring

(1) Contractor shall conduct any necessary testing to ensure that the specified density is being achieved. A nuclear gauge may be used to monitor the pavement density in accordance with ASTM D2950.

401.5.3.7 Smoothness for Contractor Quality Control

(1) Contractor shall perform smoothness testing in transverse and longitudinal directions daily to verify that the construction processes are producing pavement with variances less than ¼ inch in 12 feet, identifying areas that may pond water which could lead to hydroplaning of aircraft. If the smoothness criteria is not met, appropriate changes and corrections to the construction process shall be made by the Contractor before construction continues.

(2) The Contractor may use a 12-foot "straightedge, a rolling inclinometer meeting the requirements of ASTM E2133 or rolling external reference device that can simulate a 12-foot straightedge approved by Engineer. Straight-edge testing shall start with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. Testing shall be continuous across all joints. The surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between the two high points. If the

rolling inclinometer or external reference device is used, the data may be evaluated using either the FAA profile program, ProFAA, or FHWA ProVal, using the 12-foot straightedge simulation function.

(3) Smoothness readings shall not be made across grade changes or cross slope transitions. The transition between new and existing pavement shall be evaluated separately for conformance with the plans.

a. Transverse measurements. Transverse measurements shall be taken for each day's production placed. Transverse measurements shall be taken perpendicular to the pavement centerline each 50 feet or more often as determined by the Engineer. The joint between lanes shall be tested separately to facilitate smoothness between lanes.

b. Longitudinal measurements. Longitudinal measurements be taken for each day's production placed. Longitudinal tests shall be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet; and at the third points of paving lanes when widths of paving lanes are 20 feet or greater. When placement abuts previously placed material the first measurement shall start with one half the length of the straight edge on the previously placed material.

(4) Deviations on the final surface course in either the transverse or longitudinal direction that will trap water greater than 1/4 inch shall be corrected with diamond grinding per 401.4.16 or by removing and replacing the surface course to full depth. Grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. Areas in which diamond grinding has been performed shall be subject to the final pavement thickness tolerances specified in 401.6.2.4. Areas that have been ground shall be sealed with a surface treatment in accordance with Item P626. To avoid the surface treatment creating any conflict with runway or taxiway markings, it may be necessary to seal a larger area.

(5) Control charts shall be kept to show area of each day's placement and the percentage of corrective grinding required. Corrections to production and placement shall be initiated when corrective grinding is required. If the Contractor's machines and/or methods produce significant areas that need corrective actions in excess of 10 percent of a day's production, production shall be stopped until corrective measures are implemented by the Contractor.

401.5.3.8 Grade

(1) Grade shall be evaluated daily to allow adjustments to paving operations when grade measurements do not meet specifications. As a minimum, grade shall be evaluated prior to and after the placement of the first lift and after placement of the surface lift.

(2) Measurements will be taken at appropriate gradelines (as a minimum at center and edges of paving lane) and longitudinal spacing as shown on cross-sections and plans. The final surface of the pavement will not vary from the gradeline elevations and cross-sections shown on the plans by more than 1/2 inch vertically and 0.1 feet laterally. The documentation will be provided by the end of the following working day.

(3) Areas with humps or depressions that exceed grade or smoothness criteria and that retain water on the surface must be ground off provided the course thickness after grinding is not more than 1/2 inch less than the thickness specified on the plans. Grinding shall be in accordance with 401.4.16.

(4) The Contractor shall repair low areas or areas that cannot be corrected by grinding by removal of deficient areas to the depth of the final course plus ½ inch and replacing with new material. Skin patching is not allowed.

401.5.3.9 Monitoring

(1) Engineer reserves the right to monitor any or all of the above testing.

401.5.4 Sampling

(1) When directed by the Engineer, the Contractor shall sample and test material that appears inconsistent with similar material being sampled, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

401.5.5 Control Charts

(1) The Contractor shall maintain linear control charts both for individual measurements and range (that is, difference between highest and lowest measurements) for aggregate gradation, asphalt content, and VMA. The VMA for each day will be calculated and monitored by the Quality Control laboratory.

(2) Control charts shall be posted in a location satisfactory to the Engineer and shall be kept current. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the Action and Suspension Limits applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor's projected

data during production indicates a problem and the Contractor is not taking satisfactory corrective action, the Engineer may suspend production or acceptance of the material.

401.5.5.1 Individual Measurements

(1) Control charts for individual measurements shall be established to maintain process control within tolerance for aggregate gradation, asphalt content, and VMA. The control charts shall use the job mix formula target values as indicators of central tendency for the following test parameters with associated Action and Suspension Limits:

Table 401.5.5.1

Control Chart Limits for Individual Measurements

Control Chart Limits For Individual Measurements		
Sieve	**Action Limit**	**Suspension Limit**
3/4 inch (19.0 mm)	±6%	±9%
1/2 inch (12.5 mm)	±6%	±9%
3/8 inch (9.5 mm)	±6%	±9%
No. 4 (4.75 mm)	±6%	±9%
No. 16 (1.18 mm)	±5%	±7.5%
No. 50 (0.30 mm)	±3%	±4.5%
No. 200 (0.075 mm)	±2%	±3%
Asphalt Content	±0.45%	±0.70%
Minimum VMA	-0.5%	-1.0%

401.5.5.2 Range

(1) Control charts for range shall be established to control process variability for the test parameters and Suspension Limits listed below. The range shall be computed for each lot as the difference between the two test results for each control parameter. The Suspension Limits specified below are based on a sample size of n = 2. Should the Contractor elect to perform more than two tests per lot, the Suspension Limits shall be adjusted by multiplying the Suspension Limit by 1.18 for n = 3 and by 1.27 for n = 4.

Table 401.5.5.2

Control Chart Limits Based on Range

Control Chart Limits Based On Range (Based On n = 2)	
Sieve	**Suspension Limit**
1/2 inch (12.5 mm)	11%
3/8 inch (9.5 mm)	11%
No. 4 (4.75 mm)	11%
No. 16 (1.18 mm)	9%
No. 50 (0.30 mm)	6%
No. 200 (0.075 mm)	3.5%
Asphalt Content	0.8%

401.5.5.3 Corrective Action

(1) The Contractor Quality Control Program shall indicate that appropriate action shall be taken when the process is believed to be out of tolerance. The Plan shall contain sets of rules to gauge when a process is out of control and detail what action will be taken to bring the process into control. As a minimum, a process shall be deemed out of control and production stopped and corrective action taken, if:

a. One point falls outside the Suspension Limit line for individual measurements or range; or

b. Two points in a row fall outside the Action Limit line for individual measurements.

401.5.6 Quality Control Reports

(1) Contractor shall maintain records and shall submit reports of quality control activities daily, in accordance with the Contractor Quality Control Program described in General Provisions, Section 100.

401.6 Material Acceptance

401.6.1 Acceptance Sampling and Testing

(1) Unless otherwise specified, all acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the Engineer at no cost to the Contractor except that coring and profilograph smoothness testing as required in this section shall be completed and paid for by the Contractor.

401.6.1.1 Quality Assurance Laboratory

(1) The QA testing laboratory performing these acceptance tests except profilograph will be accredited in accordance with ASTM D3666. The QA laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for acceptance sampling and testing will be listed on the lab accreditation.

401.6.1.2 Lot Size

401.6.1.2.1 Standard lot.

(1) A standard lot will be equal to one day's production. If the day's production exceeds 4000 tons, the lot size will be 1/2 of the day's production. Each lot will be divided into approximately equal sublots of between 400 to 600 tons. When only one or two sublots are produced in a day's production, the sublots will be combined with the production lot from the previous or next day's lot.

(2) Where more than one plant is simultaneously producing HMA for the job, the lot sizes will apply separately for each plant.

401.6.1.3 HMA Air Voids

(1) Plant-produced HMA will be tested for air voids on a sublot basis.

(2) Sampling. Material from each sublot shall be sampled in accordance with ASTM D3665. Samples shall be taken from material deposited into trucks at the plant or from trucks at the job site in accordance with ASTM D979.

(3) The sample of HMA may be put in a covered metal tin and placed in an oven for not less than 30 minutes nor more than 60 minutes to maintain the material at or above the compaction temperature as specified in the JMF.

(4) Testing for Air voids will be determined for each sublot in accordance with ASTM D3203 for a set of three (3) compacted specimens prepared in accordance with ASTM D6925.

401.6.1.4 In-place HMA Mat and Joint Density

(1) Each sublot will be tested for in-place mat and joint density as a percentage of the theoretical maximum density (TMD).

401.6.1.4.1 Sampling

(1) Contractor shall cut minimum five inch diameter samples in accordance with ASTM D5361. The Contractor shall furnish all tools, labor, and materials for cleaning, and filling the cored pavement. Laitance produced by the coring operation shall be removed immediately after coring, and core holes shall be filled within one day after sampling in a manner acceptable to Engineer.

401.6.1.4.2 Bond

(1) Each lift of asphalt shall be bonded to the underlying layer. If cores reveal that the surface is not bonded, additional cores shall be taken as directed by Engineer to determine the extent of unbonded areas. Unbonded areas shall be removed by milling and replaced at no additional cost as directed by Engineer.

401.6.1.4.3 Thickness

(1) Thickness of each lift of surface course will be evaluated by Engineer for compliance to the requirements shown on the plans after any necessary corrections for grade. Measurements of thickness will be made using the cores extracted for each sublot for density measurement. The maximum allowable deficiency at any point will not be more than 1/4 inch less than the thickness indicated for the lift. Average thickness of lift, or combined lifts, will not be less than the indicated thickness. Where the thickness tolerances are not met, the lot or sublot shall be corrected by the Contractor at his expense by removing the deficient area and replacing with new pavement. Contractor, at his expense, may take additional cores as approved by Engineer to circumscribe the deficient area.

401.6.1.4.4 Mat Density

(1) One core shall be taken from each sublot. Core locations will be determined by Engineer in accordance with ASTM D3665. Cores for mat density shall not be taken closer than one foot from a transverse or longitudinal joint. The bulk specific gravity of each cored sample will be determined in accordance with ASTM D2726. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each sublot sample by the TMD for that sublot.

401.6.1.4.5 Joint Density

(1) One core centered over the longitudinal joint shall be taken for each sublot that has a longitudinal joint. Core locations will be determined by Engineer in accordance with ASTM D3665. The bulk specific gravity of each core sample will be determined in accordance with ASTM D2726. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each joint density sample by the average TMD for the lot. The TMD used to determine the joint density at joints formed between lots will be the lower of the average TMD values from the adjacent lots.

401.6.2 Acceptance Criteria

401.6.2.1 General

(1) Acceptance will be based on the implementation of the Contractor Quality Control Program (CQCP) and the following characteristics of the asphalt and completed pavement test results:

a. Air voids
b. Mat density
c. Joint density
d. Grade
e. Profilograph roughness (only required for runway or taxiway pavement projects greater than 500 feet in length)

401.6.2.2 Air Voids and Mat Density

(1) Acceptance of each lot of plant produced material for mat density and air voids will be based on the percentage of material within specification limits (PWL). If the PWL of the lot equals or exceeds 90 percent, the lot will be acceptable. Acceptance and payment will be determined in accordance with 401.8.1.

401.6.2.3 Joint Density

(1) Acceptance of each lot of plant produced HMA for joint density will be based on the PWL. If the PWL of the lot is equal to or exceeds 90 percent, the lot will be considered acceptable. If the PWL is less than 90 percent, the Contractor shall evaluate the reason and act accordingly. If the PWL is less than 80 percent, the Contractor shall cease operations until the reason for poor compaction has been determined. If the PWL is less than 71 percent, the pay factor for the lot used to complete the joint will be reduced by five percentage points. This lot pay factor reduction will be incorporated and evaluated in accordance with 401.8.1.

401.6.2.4 Grade

(1) The final finished surface of the pavement shall be surveyed to verify that the grade elevations and cross-sections shown on the plans do not deviate more than 1/2 inch vertically or 0.1 feet laterally.

(2) Cross-sections of the pavement shall be taken at a minimum 50-foot longitudinal spacing, at all longitudinal grade breaks, and at the start and end of each lane placed. Minimum cross-section grade points shall include grade at centerline, and edge of runway and taxiway pavement.

(3) The survey and documentation shall be stamped and signed by a licensed surveyor. Payment for sublots that do not meet grade for over 25% of the sublot shall not be more than 95%.

401.6.2.5 Profilograph Roughness for QA Acceptance

(1) Profilograph under this section is only required for new or reconstructed runways and taxiways greater than 500 feet in length or as indicated on the Plans or Special Provisions.

(2) The final profilograph shall be the full length of the project to facilitate testing of roughness between lots. Contractor, in the presence of Engineer shall perform a profilograph roughness test on the completed project with a profilograph meeting the requirements of ASTM E1274 or a Class I inertial profiler meeting ASTM E950. Data and results shall be provided within 48 hrs of profilograph roughness tests.

(3) The pavement shall have an average profile index less than 15 inches per mile per 1/10 mile. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must grind" bumps and the Profile Index for the pavement using a 0.2-inch blanking band. The bump template must span one inch with an offset of 0.4 inches. The profilograph must be calibrated prior to use and operated by a factory or State DOT approved, trained operator. Profilograms shall be recorded on a longitudinal scale of one inch equals 25 feet and a vertical scale of one inch equals one inch. Profilograph shall be performed one foot right and left of project centerline and 15 feet right and left of project centerline. Areas that indicate "must grind" shall be corrected with diamond grinding per 401.4.16 or by removing and replacing full depth of surface course. Where corrections are necessary, a second profilograph run shall be performed to verify that the corrections produced an average profile index of 15 inches per mile per 1/10 mile or less.

401.6.3 Percentage of Material within Specification Limits (PWL)

(1) The PWL will be determined in accordance with procedures specified in Section 110 of the General Requirements and Covenants. The specification tolerance limits (L) for lower and (U) for upper are contained in Table 401.6.3.

Table 401.6.3 Gyratory Acceptance Limits for Air Void, Density.

TEST PROPERTY	Pavements Specification Tolerance Limits	
	L	U
Air Voids Total Mix (percent)	2	5
Surface Course Mat Density (percent)	92.8	-
Lower Layer Mat Density (percent)	92.0	-
Joint Density (percent)	90.5	

401.6.3.1 Outliers

(1) All individual tests for mat density and air voids will be checked for outliers (test criterion) in accordance with ASTM E178, at a significance level of 5 percent. Outliers will be discarded, and the PWL will be determined using the remaining test values. The criteria in Table 401.6.3 is based on production processes which have a variability with the following standard deviations: Surface Course Mat Density (percent), 1.30; Base Course Mat Density (percent), 1.55; Joint Density (percent), 1.55.

(2) The Contractor should note that:

a. 90 PWL is achieved when consistently producing a surface course with an average mat density of at least 94.5 percent with 1.30 percent or less variability,

b. 90 PWL is achieved when consistently producing a base course with an average mat density of at least 94.0 percent with 1.55 percent or less variability, and

c. 90 PWL is achieved when consistently producing joints with an average joint density of at least 92.5 percent with 1.55 percent or less variability.

401.6.4 Resampling Pavement for Mat Density

401.6.4.1 General

(1) Resampling of a lot of pavement will only be allowed for mat density, and then, only if the Contractor requests same, in writing, within 48 hours after receiving the written test results from the Engineer. A retest will consist of all the sampling and testing procedures contained in 401.6.1.4 and 401.6.1.2. Only one resampling per lot will be permitted.

a. A redefined PWL will be calculated for the resampled lot. The number of tests used to calculate the redefined PWL will include the initial tests made for that lot plus the retests.

b. The cost for resampling and retesting shall be borne by the Contractor.

401.6.4.2 Payment for resampled Lots

(1) The redefined PWL for a resampled lot shall be used to calculate the payment for that lot in accordance with Table 401.8.1.3.

401.6.4.3 Outliers

(1) Check for outliers in accordance with ASTM E178, at a significance level of five percent.

401.6.5 Leveling Course

(1) The leveling course is the first variable thickness lift placed to correct surface irregularities prior to placement of subsequent courses. The leveling course shall meet the aggregate gradation in Table 401.3.3b, of 401.3.3. The leveling course shall meet the requirements of 401.3.3 and 401.6.2.2 for air voids, but shall not be subject to the density requirements of 401.6.2.2 for mat density and 401.6.2.3 for joint density. The leveling course shall be compacted with the same effort used to achieve density of the test section. The trueing and leveling course shall not exceed the maximum lift thickness associated with each gradation in Table 401.3.3b, of 401.3.3.

401.7 Measurement

401.7.1 Measurement

(1) HMA shall be measured by the number of tons of HMA used in the accepted work. Batch weights or truck scale weights will be used to determine the basis for the tonnage.

401.8 Basis of Payment

401.8.1 Payment

(1) Payment for a lot of HMA meeting all acceptance criteria as specified in 401.6.2 shall be made based on results of tests for mat density, and air voids. Payment for acceptable lots shall be adjusted according to 401.8.1.3 for mat density and air voids; and 401.6.2.3 for joint density, subject to the following requirements.

401.8.1.1 Maximum Payment

(1) The total project payment for plant mix asphalt concrete pavement shall not exceed 103 percent of the product of the Contract unit price and the total number of tons (kg) of HMA used in the accepted work (See Note 1 under Table 401.8.1.3).

401.8.1.2 Payment Basis

(1) Payment shall be made at the Contact unit price per ton for Hot Mix Asphalt (HMA) Pavement Surface, Base, Binder, or Leveling Course of the Class (401.1.1), Gradation (401.3.3(11)), Performance Grade - PG (401.2.3), Binder Designation - BD (401.2.3) contained in the Schedule of Prices in the Bid. The price shall be compensation for furnishing all materials, for all preparation, mixing, and placing of these materials, for Contractor Quality Control, testing and sampling, profilograph testing, and for all labor, equipment, tools, and incidentals and appurtenant items necessary to complete the Work.

401.8.1.3 Basis of Adjusted Payment

(1) The pay factor for each individual lot shall be calculated in accordance with Table 401.8.1.3. A pay factor shall be calculated for both mat density and air voids. The lot pay factor shall be the higher of the two values when calculations for both mat density and air voids are 100 percent or higher. The lot pay factor shall be the product of the two values when only one of the calculations for either mat density or air voids is 100 percent or higher. The lot pay factor shall be the lower of the two values when calculations for both mat density and air voids are less than 100 percent. If PWL for joint density is less than 71 percent then the lot pay factor shall be reduced by five percent but be no higher than 95 percent.

(2) For each lot accepted, the adjusted Contract unit price shall be the product of the lot pay factor for the lot and the Contract unit price. Payment shall be subject to the total project payment limitation specified in 401.8.1. Payment in excess of 100 percent for accepted lots of HMA shall be used to offset payment for accepted lots of asphaltic concrete pavement that achieve a lot pay factor less than 100 percent.

(3) Payment for sublots which do not meet grade in accordance with 401.6.2.4 after correction for over 25 percent of the sublot shall be reduced by 5 percent.

Table 401.8.1.3 Price Adjustment Schedule[1]

Percentage of material within specification limits (PWL)	Lot pay factor (percent of Contract unit price)
96 – 100	106
90 – 95	PWL + 10
75 – 89	0.5 PWL + 55
55 – 74	1.4 PWL – 12
Below 55	Reject [2]

[1] *Although it is theoretically possible to achieve a pay factor of 106 percent for each lot, actual payment above 100 percent shall be subject to the total project payment limitation specified in 401.8.1.*

[2] *The lot shall be removed and replaced. However, the Engineer may decide to allow the rejected lot to remain. In that case, if the Engineer and Contractor agree in writing that the lot shall not be removed, it shall be paid for at 50 percent of the Contract unit price and the total project payment shall be reduced by the amount withheld for the rejected lot.*

401.8.1.4 Profilograph Roughness

(1) The Contractor will receive full payment when the profilograph average profile index is in accordance with 401.6.2.5. When the final average profile index for the entire length of pavement does not exceed 15 inches per mile per 1/10 mile, payment will be made at the Contract unit price for the completed pavement.

401.8.1.6. Payment

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items:

Pay Item	Description	Unit
P401.110 to P401.199	HMA Pavement Surface (designation) (Gradation) (PG) (BD)	TON
P401.200 to P401.299	HMA Pavement Binder (designation) (Gradation) (PG) (BD)	TON
P401.300 to P401.399	HMA Pavement Base (designation) (Gradation) (PG) (BD)	TON
P401.400 to P401.499	HMA Pavement Leveling (designation) (Gradation) (PG) (BD)	TON

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
ASTM International (ASTM)

ASTM C29	Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C127	Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C566	Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying

ASTM D75	Standard Practice for Sampling Aggregates
ASTM D242	Standard Specification for Mineral Filler for Bituminous Paving Mixtures
ASTM D946	Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction ASTM D979 Standard Practice for Sampling Bituminous Paving Mixtures
ASTM D979	Standard Practice for Sampling Asphalt Paving Mixtures
ASTM D1073	Standard Specification for Fine Aggregate for Bituminous Paving Mixtures
ASTM D1188	Standard Test Method for Bulk Specific Gravity and Density of 9394 Compacted Bituminous Mixtures Using Coated Samples
ASTM D2172	Standard Test Method for Quantitative Extraction of Bitumen from Asphalt Paving Mixtures
ASTM D1461	Standard Test Method for Moisture or Volatile Distillates in Asphalt Paving Mixtures
ASTM D2041	Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D2489	Standard Practice for Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D2726	Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D2950	Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
ASTM D3203	Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
ASTM D3381	Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D3666	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4552	Standard Practice for Classifying Hot-Mix Recycling Agents
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D4867	Standard Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D5361	Standard Practice for Sampling Compacted Asphalt Mixtures for Laboratory Testing
ASTM D5444	Standard Test Method for Mechanical Size Analysis of Extracted Aggregate
ASTM D5821	Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate ASTM D6084 Standard Test Method for Elastic Recovery of Bituminous Materials by Ductilometer
ASTM D6307	Standard Test Method for Asphalt Content of Hot Mix Asphalt by Ignition Method
ASTM D6373	Standard Specification for Performance Graded Asphalt Binder
ASTM D6752	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method
ASTM D6925	Standard Test Method for Preparation and Determination of the Relative Density of Hot Mix Asphalt (HMA) Specimens by Means of the SuperPave Gyratory Compactor.

ASTM D6926	Standard Practice for Preparation of Bituminous Specimens Using Marshall Apparatus
ASTM D6927	Standard Test Method for Marshall Stability and Flow of Bituminous Mixtures
ASTM D6995	Standard Test Method for Determining Field VMA based on the Maximum Specific Gravity of the Mix (Gmm)
ASTM E11	Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
ASTM E178	Standard Practice for Dealing with Outlying Observations
ASTM E1274	Standard Test Method for Measuring Pavement Roughness Using a Profilograph
ASTM E950	Standard Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference
ASTM E2133	Standard Test Method for Using a Rolling Inclinometer to Measure Longitudinal and Transverse Profiles of a Traveled Surface

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T030	Standard Method of Test for Mechanical Analysis of Extracted Aggregate
AASHTO T110	Standard Method of Test for Moisture or Volatile Distillates in Hot Mix Asphalt (HMA)
AASHTO T275	Standard Method of Test for Bulk Specific Gravity (Gmb) of Compacted Hot Mix Asphalt (HMA) Using Paraffin-Coated Specimens
AASHTO M156	Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
AASHTO T329	Standard Method of Test for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method
AASHTO T324	Standard Method of Test for Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures
AASHTO T 340	Standard Method of Test for Determining the Rutting Susceptibility of Hot Mix Asphalt (APA) Using the Asphalt Pavement Analyzer (APA)

Asphalt Institute (AI)

Asphalt Institute Handbook MS-26,Asphalt Binder

Asphalt Institute MS-2 Mix Design Manual, 7th Edition

AI State Binder Specification Database

Federal Highway Administration (FHWA)

Long Term Pavement Performance Binder Program

Advisory Circulars (AC)

AC 150/5320-6 Airport Pavement Design and Evaluation

FAA Orders

5300.1 Modifications to Agency Airport Design, Construction, and Equipment Standards

Software

FAARFIELD

END OF SPECIFICATION P401

Specification P402 – WisDOT Hot Mix Asphalt Pavement for Airports

402.1 Description

402.1.1 General

(1) This Specification describes developing an Airport Hot Mix Asphalt (HMA) mixture design, providing and maintaining a quality management program for HMA mixtures, and constructing HMA pavement. Unless specifically indicated otherwise, references within P402 to HMA also apply to Warm Mix Asphalt (WMA).

(2) Airport Hot Mix Asphalt (HMA) Pavement shall be composed of mineral aggregate and asphalt binder mixed in a central mixing plant and placed on a prepared course in accordance with these Specifications, conforming to the lines, grades, thicknesses, and typical cross sections shown on the Plans. Each course must be constructed to the depth, typical section, and elevation required by the Plans; and must be rolled, compacted, finished, and approved before the placement of the next course. The materials, composition, and construction must meet the appropriate requirements of the State of Wisconsin Standard Specification for Highway and Structure Construction, current edition (referred to herein as State Highway Specifications), except as modified herein.

402.1.2 Terminology

(1) Acronyms and Definitions found in this Specification and Section 10 of the General Provisions of this Standard Specification for Airport Construction shall apply to the Contract Documents.

(2) The terms “road” and “roadway” found in the State Highway Specification and referenced in this Specification shall be synonymous with the runways, taxiways, and other airport transportation facilities when use in the context of airport pavement construction.

(3) References to sections, subsections, and paragraphs in the State Highway Specifications are indicated by the corresponding reference number with a double underline, such as 999.9.

(4) References to the sections, subsection and paragraphs of this Specification and the Standard Specification for Airport Construction in Wisconsin shall be indicated by the corresponding reference number with a single underline, such as P999.9.

(5) References to the Wisconsin DOT Construction and Materials Manual shall be indicated by the corresponding reference number with a double underline, such as CMM 9-99.

402.1.3 Construction Staking

(1) Contractor shall provide all construction staking in accordance with 50.6, except Engineer will provide staking as described on the Plans or specified in the Special Provisions.

402.2 Materials

402.2.1 General

(1) Furnish a homogeneous mixture of coarse aggregate, fine aggregate, mineral filler if required, recycled material if used, warm mix asphalt additive or process if used, and asphaltic material. Do not regress air voids.

(2) Interpret materials related acronyms as follows:

FRAP	Fractioned reclaimed asphaltic pavement
HMA	Hot mix asphalt
JMF	Job mix formula
PG	Performance graded
RAP	Reclaimed asphaltic pavement
RAS	Recycled asphalt shingles (not allowed for Airport Pavement)
SMA	Stone matrix asphalt (not used for Airport Pavement)
VMA	Voids in mineral aggregate
WMA	Warm mix asphalt

(3) Interpret materials related definitions as follows:

Additive	A material blended with asphaltic binder or aggregate to enhance the characteristics of the final HMA blend, but that does not alter the binder performance grade.
Asphaltic binder	The predominant asphalt cement in Hot Mix Asphalt mixture.
Filler	Mineral fillers include mineral dust from the crushing and screening of aggregate (including baghouse fines), lime, Portland cement, and fly ash. Used primarily to fill voids between aggregate particles in order to meet gradation requirements.

Fractioned reclaimed asphaltic pavement Reclaimed asphalt pavement processed by screening and separating by maximum and minimum particle size, asphalt content, asphalt performance grade, and aggregate characteristics.

Leveling layer An asphaltic concrete course which is placed to eliminate irregularities in profile or thickness of underlying pavement layers. Leveling layers are generally placed thinner than standard pavement layer thicknesses, and are exempt from QMP testing.

Lower layer Also referred to as the binder course or an asphalt base course, is any asphaltic pavement layer below the upper layer when the pavement structure is complete. A pavement structure may have multiple lower layers.

Modifier A material blended with the asphaltic binder to enhance its characteristics by modifying the performance grade of the binder.

Reclaimed asphaltic pavement (RAP) Material resulting from cold milling or crushing existing asphaltic pavement.

Recycled asphalt shingles Waste material from a shingle manufacturing facility, either new or used material salvaged from residential roofing operations, or any combination of these materials ground to ensure that 100 percent will pass a 1/2 sieve and processed to remove deleterious material. (Not allowed for Airport Pavement)

Upper layer The top asphaltic pavement layer which is in direct contact with traffic when the pavement structure is complete. A pavement structure has only one upper layer.

Warm mix asphalt Asphaltic mixture that contains a warm mix additive, or utilizes a warm mix process, as part of its mixture design that has the ability to reduce the mixing and compaction temperature requirements below the typical temperatures used for that application.

Wedging A tapered layer of asphaltic pavement used to build up an existing surface. Wedging layers may be thicker or thinner than standard pavement layers.

402.2.2 Aggregates

402.2.2.1 General

(1) Provide coarse aggregates from a Department-approved source as specified under 60.3.4.2. Obtain Engineer's approval of the aggregates before producing HMA mixtures.

(2) Furnish an aggregate blend consisting of hard durable particles containing no more than a combined total of one percent, by weight, of lumps of clay, loam, shale, soft particles, organic matter, adherent coatings, and other deleterious material. Ensure that the aggregate blend conforms to the percent fractured faces and flat and elongated requirements of Table 402.2.7. If the aggregate blend contains materials from different deposits or sources, ensure that material from each deposit or source has an LA Wear percent loss meeting the requirements of Table 402.2.7.

402.2.2.2 Freeze-Thaw Soundness

(1) If the aggregate blend contains materials from different deposits or sources, ensure that material from each deposit or source has a freeze-thaw loss percentage meeting the requirements of Table 402.2.7 and 60.3.4.2.2.

402.2.2.3 Aggregate Gradation Master Range

(1) Ensure that the aggregate blend, including recycled material and mineral filler, conforms to the gradation requirements in Table 402.2.2.3. The values listed are design limits; production values may exceed those limits.

TABLE 402.2.2.3 AGGREGATE GRADATION MASTER RANGE AND VMA REQUIREMENTS

SIEVE	PERCENTS PASSING DESIGNATED SIEVES				
	NOMINAL SIZE				
	No. 1 1.5 inch (37.5 mm)	No. 2 1.0 inch (25.0 mm)	No. 3 ¾ inch (19.0 mm)	No. 4 ½ inch (12.5 mm)	No. 5 3/8 inch (9.5 mm)
2.0 in.(50.0-mm)	100				
1.5 in. (37.5-mm)	90 –100	100			
1.0 in. (25.0-mm)	90 max	90 -100	100		
¾ in.(19.0-mm)	----	90 max	90 -100	100	
½ in. (12.5-mm)	----	----	90 max	90 -100	100
3/8 in. (9.5-mm)	----	----	----	90 max	90 -100
No. 4 (4.75-mm)	----	----	----	----	90 max
No. 8 (2.36-mm)	15 – 41	19 - 45	23 - 49	28 - 58	32 - 67
No. 200 (75-µm)	0 – 6.0	1.0 - 7.0	2.0 - 8.0	2.0 - 10.0	2.0 - 10.0
% MINIMUM VMA	11.0	12.0	13.0	14.0[1]	15.0[2]

[1]14.5 for LT and MT mixes

[2]15.5 for LT and MT mixes

402.2.2.4 Aggregate Sampling and Testing

(1) The Department and the Contractor will sample and test according to the following methods, except as revised with the Engineer's approval:

Sampling aggregates ..... AASHTO T2
Material finer than No. 200 sieve ..... AASHTO T11
Sieve analysis of aggregates ..... AASHTO T27
Mechanical analysis of extracted aggregate ..... AASHTO T30
Sieve analysis of mineral filler ..... AASHTO T37
Los Angeles abrasion of coarse aggregate ..... AASHTO T96
Freeze-thaw soundness of coarse aggregate[1] ..... AASHTO T103
Sodium sulfate soundness of aggregates (R-4, 5 cycles) ..... AASHTO T104
Extraction of bitumen ..... AASHTO T164

[1] As modified in CMM 860.2

402.2.3 Asphaltic Binders

(1) Department will designate the grade of asphaltic binder in the HMA Pavement Pay Item. Use the binder grade the Pay Item specifies. Do not change the PG binder grade without Engineer's written approval. The Department will designate the grade of virgin asphaltic binder in the Contract, however, Contractor may use virgin binder, modified binder, a blend of virgin and recovered binder, or a blend of modified and recovered binder. When the percent asphalt binder replaced exceeds the allowable limits in 402.2.5, provide test results from extracted and recovered binder to ensure that the resultant asphaltic binder conforms to the Contract Specifications.

(2) Asphaltic Materials shall be in conformance with the following:

a. Furnish asphaltic material that meets the minimum PG binder grade the Contract specifies. Furnish binder with an “S” designation unless the Contract specifies otherwise. Ensure that the material furnished conforms to the Department’s Combined State Binder Group Method of Acceptance for Asphalt Binders available at:

https://wisconsindot.gov/Documents/doing-bus/eng-consultants/cnslt-rsrces/tools/qmp/csbg-policy.pdf

b. Sample according to the Department’s Combined State Binder Group Method of Acceptance for Asphalt Binders available at:

https://wisconsindot.gov/Documents/doing-bus/eng-consultants/cnslt-rsrces/tools/qmp/csbg-policy.pdf

c. Test according to the Department’s Combined State Binder Group Method of Acceptance for Asphalt. Binders available at:

https://wisconsindot.gov/Documents/doing-bus/eng-consultants/cnslt-rsrces/tools/qmp/csbg-policy.pdf

d. Furnish material conforming to the Department's Combined State Binder Group Method of Acceptance for Asphalt Binders available at:

https://wisconsindot.gov/Documents/doing-bus/eng-consultants/cnslt-rsrces/tools/qmp/csbg-policy.pdf

(3) Provide all other asphaltic materials in accordance with Wisconsin DOT Standard Specification 455.

402.2.4 Additives

402.2.4.1 Hydrated Lime Antistripping Agent

(1) If used in HMA mixtures, furnish hydrated lime conforming to ASTM C977 and containing no more than 8 percent unhydrated oxides. Percent added is by weight of the total dry aggregate.

402.2.4.2 Liquid Antistripping Agent

(1) If used in HMA mixtures, add liquid antistripping agent to the asphaltic binder before introducing the binder into the mixture. Provide documentation indicating that addition of liquid antistripping agent will not alter the characteristics of the original asphaltic binder performance grade (PG).

402.2.4.3 Stone Matrix Asphalt Stabilizer

(1) Stone matrix asphalt is not included in this Specification.

402.2.4.4 Warm Mix Asphalt Additive or Process

(1) Use additives or processes from the Department's approved products list. Follow supplier or manufacturer recommendations for additives and processes when producing WMA mixtures.

402.2.5 Recycled Asphaltic Materials

(1) Contractor may use recycled asphaltic materials from FRAP, and RAP in HMA mixtures, subject to the limits in the following Table 402.2.5. Stockpile recycled materials separately from virgin materials and list each as individual JMF components. RAS shall not be incorporated in Airport HMA.

(2) Control recycled materials used in HMA by evaluating the percent binder replacement, the ratio of recovered binder to the total binder.

Table 402.2.5

MAXIMUM ALLOWABLE PERCENT BINDER REPLACEMENT

Recycled Asphaltic Material RAP and FRAP in any combination	HMA Surface Course Lower Layer Percent	HMA Surface Course Upper Layer Percent
Runway	20	0
Taxiway	20	0
Apron	20	0
All other Areas	20	20

402.2.6 Recovered Asphaltic Binders

(1) Establish the percent of recovered asphaltic binder from FRAP and RAP for the mixture design using automated extraction ASTM D8159 as modified in CMM 836.6.3.1 or according to AASHTO T164 method A or B using the appropriate dust correction procedure. If production test results indicate a change in the percent of recovered asphaltic binder, Contractor or Engineer may request a change in the design recovered asphaltic binder. Provide the department with documentation of at least 2 extraction samples collected and tested within 2 months of the request unless the department approves otherwise. Submit using form “Recycled Asphaltic Binder Change Request” to a department HTCP-certified HMA Technician for production process change review in CMM 836.2. Contact the Bureau of Technical Services for current form. Ensure that those samples were prepared by a WisDOT qualified laboratory.

(2) Contractor may replace virgin binder with recovered binder up to the maximum percentage allowed under 402.2.5 without changing the asphaltic binder grade. If using more than the maximum allowed under 402.2.5, furnish test results indicating that the resultant binder meets the grade the Contract originally specified.

402.2.7 HMA Mixture Design

(1) For each HMA mixture type used under the Contract, develop and submit an asphaltic mixture design according to CMM 866 and conforming to the requirements of Table 402.2.2.3 and Table 402.2.7. The values listed are design limits; production values may exceed those limits. Department will review mixture designs and report the results of that review to the designer according to CMM 866.

TABLE 402.2.7 MIXTURE REQUIREMENTS

Mixture type	LT	MT	HT
ESALs x 10^6 (20 yr design life)	<2.0	2 - <8	>8
LA Wear (AASHTO T96)			
100 revolutions(max % loss)	13	13	13
500 revolutions(max % loss)	50	45	45
Soundness (AASHTO T104) (sodium sulfate, max % loss)	12	12	12
Freeze/Thaw (AASHTO T103 as modified in CMM 860.2) (specified counties, max % loss)	18	18	18
Fractured Faces (ASTM D5821 as modified in CMM 860) (one face/2 face, % by count)	65/ __	75 / 60	98 / 90
Flat & Elongated (ASTM D4791) (max %, by weight)	5 (5:1 ratio)	5 (5:1 ratio)	5 (5:1 ratio)
Fine Aggregate Angularity (AASHTO T304, method A, min)	40	43	45
Sand Equivalency (AASHTO T176, min)	40	40	45
Gyratory Compaction			
Gyrations for N_{ini}	6	7	8
Gyrations for N_{des}	40	75	100
Gyrations for N_{max}	60	115	160
Air Voids, $\%V_a$ ($\%G_{mm}$ N_{des})	4.0 (96.0)	4.0 (96.0)	4.0 (96.0)
% G_{mm} N_{ini}	< = 91.5[1]	< = 89.0[1]	< = 89.0
% G_{mm} N_{max}	< = 98.0	< = 98.0	< = 98.0
Dust to Binder Ratio[2] (% passing 0.075/P_{be})	0.6 - 1.2	0.6 - 1.2	0.6 - 1.2
Voids filled with Binder (VFB or VFA, %)	68 - 80[4] [5]	65 – 75[3] [5]	65 - 75[3] [5]
Tensile Strength Ratio (TSR)[6] [7] (AASHTO T283)			
no antistripping additive	0.75 min.	0.75 min.	0.75 min.
with antistripping additive	0.80 min.	0.80 min.	0.80 min.

[1] *The percent maximum density at initial compaction is only a guideline.*

[2] *For a gradation that passes below the boundaries of the caution zone (ref. AASHTO MP3), the dust to binder ratio limits are 0.6 - 1.6.*

[3] *For No. 5 (9.5mm) and No. 4 (12.5 mm) nominal maximum size mixtures, the specified VFB range is 70 - 76%.*

[4] *For No. 2 (25.0mm) nominal maximum size mixes, the specified VFB lower limit is 67%.*

[5] *For No. 1 (37.5mm) nominal maximum size mixes, the specified VFB lower limit is 67%.*

[6] *WisDOT eliminates freeze-thaw conditioning cycles from the TSR test procedure.*

[7] *Run TSR at asphalt content corresponding to 3.0% air void regressed design using distilled water for testing.*

402.2.8 Quality Management Program

(1) Contractor shall provide and maintain a Contractor Quality Control (CQC) program defined as all activities, including mix design, process control inspection, sampling and testing, and process adjustments related to producing and placing HMA pavement conforming to the Specifications.

(2) The Department will provide product quality verification as follows:

a. By conducting verification testing of independent samples.

b. By periodically observing Contractor sampling and testing.

c. By monitoring required control charts exhibiting test results and control parameters.

d. By Engineer directing the Contractor to take additional samples at any time during production.

(3) Refer to CMM 836 for detailed guidance on sampling, testing, and documentation under the Quality Management Program (QMP).

402.2.8.2 Contractor Quality Control (CQC)

402.2.8.2.1 Required Quality Control Program

402.2.8.2.1.1 Personnel Requirements

(1) Provide HTCP-certified sampling and testing personnel. Provide at least one full-time HMA technician minimally qualified as an HTCP-certified Hot Mix Asphalt, Technician I, Production Tester (HMA-IPT) at each plant site furnishing material to the project. Before mixture production begins, provide an organizational chart in the Contractor's laboratory. Include the names, telephone numbers, and current certifications of all personnel with CQC responsibilities. Keep the chart updated.

(2) Ensure that sampling and testing personnel are minimally qualified as follows: *[1]*

a. HMA technician certified at a level appropriate for sampling and production control testing, Transportation Materials Sampling Technician (TMS).

b. HMA technician certified at a level appropriate for production control testing (HMA-IPT).

c. Assistant Certified Technician (ACT) *[2]*.

[1] After informing the Engineer, a non-certified person under the direct observation of a certified HMA technician may sample for a period not to exceed three calendar days.

[2] An HTCP-certified HMA technician must coordinate and take responsibility for the work an ACT performs. No more than one ACT can work under a single certified technician.

(3) Have an HTCP-certified HMA technician ensure that all sampling and testing is performed correctly, analyze test results, and post resulting data.

(4) Have an HTCP-certified Hot Mix Asphalt, Trouble Shooting, Process Control (HMA-TPC) technician or HTCP-certified Hot Mix Asphalt, Mix Design, Report Submittals (HMA-MD) technician available to make necessary process adjustments.

402.2.8.2.1.2 Laboratory Requirements

(1) Conduct CQC testing in a facility conforming to the Department's laboratory qualification program.

(2) Ensure that all testing equipment conforms to the equipment specifications applicable to the required testing methods.

402.2.8.2.1.3 Required Sampling and Testing

402.2.8.2.1.3.1 Contracts with 5000 Tons of Mixture or Greater

(1) Furnish and maintain a laboratory at the plant site fully equipped for performing Contractor QC testing. Have the laboratory on-site and operational before beginning mixture production.

(2) Obtain random samples and perform tests according to CMM 836. Obtain HMA mixture samples from trucks at the plant. Perform tests the same day taking the sample.

(3) Retain the split portion of the Contractor HMA mixture and blended aggregate samples for 14-calendar days at the laboratory site in a dry, protected area. Engineer may decrease this 14-day retention period. At project completion the Contractor may dispose of remaining samples if Engineer approves.

(4) Use the test methods identified below, or other methods Engineer approves, to perform the following tests at the frequency indicated:

a. Blended aggregate gradations:

i. Drum plants:

1. Field extraction by ignition oven according to AASHTO T308 (CMM 8-36.6.3.6), chemical extraction according to AASHTO T-164 method A or B; or automated extraction according to ASTM D8159 as modified in CMM 836.6.3.1. Gradation of resulting aggregate sample determined according to AASHTO T30.

2. Belt samples, optional for virgin mixtures, obtained from stopped belt or from the belt discharge using an Engineer-approved sampling device and performed according to AASHTO T11 and T27.

ii. Batch plants:

3. Field extraction by ignition oven according to AASHTO T308 (CMM 8-36.6.3.6), chemical extraction according to AASHTO T-164 method A or B; or automated extraction according to ASTM D8159 as modified in CMM 836.6.3.1. Gradation of resulting aggregate sample determined according to AASHTO T30.

b. Asphalt content (AC) in percent: AC by ignition oven according to AASHTO T308 (CMM 836.6.3.6), chemical extraction according to AASHTO T-164 method A or B; or automated extraction according to ASTM D8159 as modified in CMM 836.6.3.1. Gradation of resulting aggregate sample determined according to AASHTO T30.

c. Bulk specific gravity of the compacted mixture according to AASHTO T166 as modified in CMM 836.6.5.

d. Theoretical Maximum specific gravity according to AASHTO T209 as modified in CMM 836.6.6.

e. Air voids (V_a) by calculation according to AASHTO T269.

f. VMA by calculation according to AASHTO R35.

(5) Test each design mixture at a frequency at or above the following:

TOTAL DAILY PLANT PRODUCTION FOR DEPARTMENT CONTRACTS in tons	SAMPLES PER DAY[1]
50 to 600	1
601 to 1500	2
1501 to 2700	3
2701 to 4200	4
greater than 4200	see footnote [2]

[1] Frequencies are for planned production. If production is other than planned, conform to CMM 836.

[2] Add a random sample for each additional 1500 tons or fraction of 1500 tons.

(6) Conduct TSR tests during mixture production according to CMM 836.6.14. Test each full 50,000 ton production increment, or fraction of an increment, after the first 5000 tons of production. Perform required increment testing in the first week of production of that increment. If production TSR values are below the limit specified in CMM 836.6.14, notify the Engineer. The Engineer and Contractor will jointly determine a corrective action.

(7) Conduct smoothness and grade testing in accordance with 402.2.8.2.2.

402.2.8.2.1.3.2 Contracts with Less Than 5000 Tons of Mixture

(1) Conform to 402.2.8.2.1.3.1 modified as follows:

a. Contractor may conduct CQC tests in an off-site laboratory.

b. No field tensile strength ratio testing is required.

(2) Conduct smoothness and grade testing in accordance with 402.2.8.2.2.

402.2.8.2.1.3.3 Contracts with Less Than 500 Tons of Mixture

(1) Department may waive CQC testing on contracts with less than 500 tons of mixture. If testing is waived, acceptance will be by visual inspection unless defined otherwise by Contract Change Order.

(2) If HMA density testing is waived under 402.3.3.3, CQC testing is also waived.

(3) Smoothness and grade testing in accordance with 402.2.8.2.2 is waived.

402.2.8.2.1.3.4 Temporary Pavements

(1) Engineer may waive all testing for temporary pavements, defined for this purpose as pavements that will be placed and removed before Contract completion.

(2) Smoothness and grade testing in accordance with 402.2.8.2.2 is waived.

402.2.8.2.1.4 Documentation

402.2.8.2.1.4.1 Records

(1) Document all observations, inspection records, mixture adjustments, and test results daily. Note observations and inspection records in a permanent field record as they occur. Record all process adjustments and JMF changes. Submit copies of the running average calculation sheets for blended aggregate, mixture properties, and asphalt content along with mixture adjustment records to Engineer

each day. Submit testing records and control charts to Engineer in a neat and orderly manner within 10 days after paving is completed.

(2) Continue charts, records, and testing frequencies, for a mixture produced at one plant site, from contract to contract.

402.2.8.2.1.4.2 Control Charts

(1) Maintain standardized control charts at the laboratory. Record Contractor test results on the charts the same day as testing. Record data on the standardized control charts as follows:

a. Blended aggregate gradation tests in percent passing. Of the following, plot those sieves the design specifications require: 37.5-mm, 25.0-mm, 19.0-mm, 12.5-mm, 9.5-mm, 4.75 –mm, 2.36-mm, & 75-µm.

b. Asphalt material content in percent.

c. Air voids in percent.

d. VMA in percent.

(2) Plot both the individual test point and the running average of the last four data points on each chart. Show CQC data in black with the running average in red. Draw the warning limits with a dashed green line and the JMF limits with a dashed red line. Contractor may use computer generated black-and-white printouts with a legend that clearly identifies the specified color coded components.

402.2.8.2.1.5 Control Limits

(1) Conform to the following control limits for the JMF and warning limits based on a running average of the last four data points:

ITEM	JMF LIMITS	WARNING LIMITS
Percent passing given sieve:		
37.5-mm	+/- 6.0	+/- 4.5
25.0-mm	+/- 6.0	+/- 4.5
19.0-mm	+/- 5.5	+/- 4.0
12.5-mm	+/- 5.5	+/- 4.0
9.5-mm	+/- 5.5	+/- 4.0
4.75-mm	+/- 5.0	+/- 4.0
2.36-mm	+/- 5.0	+/- 4.0
75-µm	+/- 2.0	+/- 1.5
Asphaltic content in percent	- 0.3	- 0.2
Air voids in percent	+1.3/-1.0	+1.0/-0.7
VMA in percent [1]	- 0.5	- 0.2

[1] *VMA limits based on minimum requirement for mix design nominal maximum aggregate size in Table 402.2.2.3.*

(2) Warning bands are defined as the area between the JMF limits and the warning limits.

402.2.8.2.1.6 Job Mix Formula Adjustment

(1) Contractor may request adjustment of the JMF according to CMM 836.6.13.1. Have an HTCP-certified Hot Mix Asphalt, Trouble Shooting, Process Control (HMA-TPC) technician or HTCP-certified Hot Mix Asphalt, Mix Design, Report Submittals (HMA-MD) technician submit a written JMF adjustment request. Ensure that the resulting JMF is within specified master gradation bands. Department will have an HMA-MD technician review the proposed adjustment and, if acceptable, issue a revised JMF.

(2) Department will not allow adjustments that do the following:

a. Exceed specified JMF tolerance limits.

b. Reduce the JMF asphalt content unless the production VMA running average meets or exceeds the minimum VMA design requirement defined in Table 402.2.2.3 for the mixture produced.

(3) Have an HMA-TPC technician make related process adjustments. If mixture redesign is necessary, have an HMA-MD technician submit a new JMF, subject to the same specification requirements as the original JMF.

402.2.8.2.1.7 Corrective Action

(1) When running average values trend toward the warning limits, consider taking corrective action. Document all corrective actions undertaken. Include all test results in the contract files and in running average calculations.

(2) Notify Engineer if running average values exceed the warning limits. If two consecutive running average values exceed the warning limits, stop production and make adjustments. Do not restart production until after notifying Engineer of the adjustments made. Do not calculate a new running average until the fourth test after the required production stop.

(3) If the process adjustment improves the property in question so that the running average after four additional tests is within the warning limits, Contractor may continue production with no reduction in payment.

(4) If the adjustment does not improve the properties and the running average after four additional tests stays inside the warning bands, the mixture is nonconforming and subject to pay adjustment.

(5) If Contractor fails to stop production and make adjustments when required, all mixture produced from the stop point to the point when the running average is back inside the warning limits is nonconforming and subject to pay adjustment.

(6) If the running average values exceed the JMF limits, stop production and make adjustments. Do not restart production until after notifying Engineer of the adjustments made. Continue calculating the running average after the production stop.

(7) If the air voids running average of four exceeds the JMF limits, the material is nonconforming. Remove and replace unacceptable material at no additional expense to the Department. Engineer will determine the quantity of material to replace based on the testing data using the methods in CMM 836 and an inspection of the completed pavement. If the Engineer allows the mixture to remain in place, the Department will pay for the mixture and asphaltic material as specified in 402.5.2.1.

(8) If the running average of four exceeds the JMF limits for other properties, and Engineer allows the mixture to remain in place, the Department will pay for the mixture as specified in 402.5.2.1. Engineer will determine the quantity of material subject to pay reduction based on the testing data and an inspection of the completed pavement.

402.2.8.2.2 Smoothness and Grade for CQC

(1) Contractor shall provide in accordance with 402.2.8.2.1.

402.2.8.2.2.1 Smoothness

(1) The Contractor shall perform smoothness testing on each sublot to verify that the construction processes are producing pavement that meets the following guidelines. If the smoothness criteria is not met, appropriate changes and corrections to the construction process shall be made by the Contractor before construction continues.

(2) Smoothness shall be tested in both the transverse and longitudinal direction of each lot to identify areas that may be prone to ponding of water which could lead to hydroplaning of aircraft. The final surface shall be free from roller marks. After the final rolling, but not later than 24 hours after placement, the surface of each lot shall be tested in both longitudinal and transverse directions for smoothness. The Contractor has the option of using either a 12-foot straightedge or a rolling inclinometer meeting the requirements of ASTM E2133. Testing shall be continuous across all joints. Straight-edge testing shall start with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points. The Contractor may choose to evaluate daily lot compliance with the 1/4-inch straightedge requirement using a rolling inclinometer (i.e., SurPRO). If the rolling inclinometer is used, the acquired data can be read into the FAA profile program, ProFAA, using the straightedge simulation function to assess the compliance with 1/4-inch variance with a 12-foot straightedge. If the Contractor opts to use a rolling inclinometer, the device shall be operated in accordance with ASTM E2133.

(3) The final finished surface course of the pavement shall not vary more than 1/4 inch transversely. Smoothness readings will not be made across grade changes or cross slope transitions. Deviations on final surface course in either the transverse or longitudinal direction that will trap water, greater than 1/4 inch will be corrected with diamond grinding per paragraph 402.3.5.1.3 or by removing and replacing the surface course to full depth. Grinding will be tapered in all directions to provide smooth transitions

to areas not requiring grinding. All areas in which diamond grinding has been performed will be subject to the final pavement thickness tolerances specified. Areas that have been ground will be sealed with a surface treatment in accordance with Item P626. To avoid the surface treatment creating conflicts with runway or taxiway markings, it may be necessary to seal a larger area.

a. Transverse measurements. Transverse measurements will be taken for each lot placed. Transverse measurements will be taken perpendicular to the pavement centerline each 50 feet or more often as determined by the Engineer. The joint between lots shall be tested separately to facilitate smoothness between lots.

b. Longitudinal measurements. Longitudinal measurements will be taken for each lot placed. Longitudinal tests will be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet; and at the third points of paving lanes when widths of paving lanes are 20 feet or greater.

(4) If the Contractor's machines and/or methods produce significant areas that need corrective actions, production must be stopped until corrective measures can be implemented.

402.2.8.2.2.2 Grade

(1) Grade will be evaluated prior to the first day of placement and then as a minimum, prior to placement of the surface lift and after the placement of the surface lift to allow adjustments to paving operations if measurements do not meet specification requirements.

(2) The Contractor shall submit the survey data to the Engineer by the following day after measurements have been taken with measurements taken at appropriate gradelines (as a minimum at center and edges of paving lane) and 50-foot longitudinal spacing on cross-sections verifying that project is in conformance with project plans and cross-sections.

(3) The final finished surface of the pavement of the completed project shall not vary from the gradeline elevations and cross-sections shown on the Plans by more than 1/2 inch vertically. The documentation, stamped and signed by a licensed surveyor, shall be provided by the Contractor to the Engineer. The Contractor shall pay the cost of the surveying and level runs.

(4) Grinding shall be in accordance with 402.3.5.1.3. High points may be ground off provided the course thickness after grinding is not more than 1/2 inch less than the thickness specified on the Plans.

402.2.8.3 Department Testing

402.2.8.3.1 Quality Verification (QV) Program

402.2.8.3.1.1 General

(1) Engineer will conduct QV tests to determine the quality of the final product and measure characteristics that predict relative performance.

402.2.8.3.1.2 Personnel Requirements

(1) The Department will provide at least one HTCP-certified Transportation Materials Sampling Technician (TMS) technician, to observe QV sampling of project mixtures.

(2) An HTCP-certified Hot Mix Asphalt, Technician I, Production Tester (HMA-IPT) or an HMA Assistant Certified Technician (ACT) working under the HTCP-certified technician, will split samples and do the testing. An HMA-IPT HTCP-certified Hot Mix Asphalt, Technician I, Production Tester (HMA-IPT) will coordinate and take responsibility for the work an ACT performs. No more than one ACT can work under a single certified technician.

(3) An HMA-IPT technician certified at a level appropriate for sampling and mixture production control testing will determine that all sampling and testing is performed correctly, analyze test results, and post resulting data.

(4) Department will make an organizational chart available at the testing laboratory and to Contractor before mixture production begins. The Department's chart will include names, telephone numbers, and current certifications of all QV testing personnel. The Department will update the chart with appropriate changes, as they become effective.

402.2.8.3.1.3 Laboratory Requirements

(1) Department will furnish and maintain a facility for QV testing conforming to the Department's laboratory qualification program requirements and fully equipped to perform QV testing. In all cases, the Department will conduct testing in a separate laboratory from Contractor's laboratory.

402.2.8.3.1.4 Department Verification Testing Requirements

(1) HTCP-certified Department personnel will obtain random samples by directly supervising HTCP-certified Contractor personnel sampling from trucks at the plant. The Department will sample according to

CMM 836. Sample size must be adequate to run the appropriate required tests in addition to one set of duplicate tests that may be required for dispute resolution. Engineer will split the sample for testing and retain the remaining portion for additional testing if needed.

(2) Department will verify product quality using the test methods listed in 402.2.8.3.1.4(3), other Engineer-approved methods, or other methods the industry and Department HMA technical team recognizes. The Department will identify test methods before construction starts and use only those methods during production of that material unless the Engineer and Contractor mutually agree otherwise.

(3) Department will perform all testing conforming to the following standards:

a. Bulk specific gravity (Gmb) of the compacted mixture according to AASHTO T166.
b. Maximum specific gravity (Gmm) according to AASHTO T209.
c. Air voids (Va) by calculation according to AASHTO T269.
d. VMA by calculation according to AASHTO R35.

(4) Department will randomly test each design mixture at the following minimum frequency:

FOR TONNAGES TOTALING:	
Less than 501 tons	no tests required
From 501 to 5,000 tons	one test
More than 5,000 tons	add one test for each additional 5,000-ton increment

402.2.8.3.1.5 Documentation

(1) Engineer will document all observations during QV sampling, and review CQC mixture adjustments and CQC test results daily. Engineer will note results of observations and inspection records in a permanent field record as they occur.

402.2.8.3.1.6 Acceptable Verification Parameters

(1) Engineer will provide test results to Contractor within two mixture-production days after obtaining the sample. The quality of the product is acceptably verified if it meets the following limits:

a. Va is within a range of 2.0 to 4.3 percent.
b. VMA is within minus 0.5 of the minimum requirement for the mix design nominal maximum aggregate size.

(2) If QV test results are outside the specified limits, Engineer will investigate immediately through dispute resolution procedures. Engineer may stop production while the investigation is in progress if the potential for a pavement failure is present.

(3) If production continues for that mixture design, Engineer will provide additional retained sample testing at the frequency provided for in CMM 836. This supplemental testing will continue until the material meets allowable differences or as Engineer and Contractor mutually agree.

402.2.8.3.1.7 Dispute Resolution

(1) When QV test results do not meet the specified limits, the Department's AASHTO accredited laboratory and certified personnel will referee test the retained portion of the QV sample and the retained portion of the nearest available previous CQC sample.

(2) Department will notify the Contractor of the referee test results within 3 business days after receipt of the samples.

(3) Department will determine mixture conformance and acceptability by analyzing referee test results, reviewing mixture project data, and inspecting the completed pavement all according to CMM 836.

402.2.8.3.1.8 Corrective Action

(1) Remove and replace unacceptable material at no additional expense to Department.

(2) Department will reduce pay for the tonnage of nonconforming mixture, as determined during QV dispute resolution, if Engineer allows that mixture to remain in place. If production of that mixture design continued during the investigation, Department will also adjust pay for that mixture forward to the next conforming QV or CQC point. Department will pay for the affected mixture as specified in 402.5.2.1.

402.2.8.3.2 Independent Assurance Testing

(1) Department will evaluate both Contractor and Department testing personnel and equipment as specified in 60.3.4.3.4.

402.3 Construction

402.3.1 General

(1) Construct HMA pavement of the type the Pay Item indicates, encoded as follows:

Table 402.3.1 Combined Pay Item Encoding

3 LT 58-34 S ⇗ ⇧ ⇧ ⇖ **Gradation Traffic Binder Designation**					
GRADATIONS (NMAS)		TRAFFIC VOLUME		BINDER DESIGNATION LEVEL	
1	37.5 mm	LT	Low	S	Standard
2	25.0 mm	MT	Medium	H	Heavy
3	19.0 mm	HT	High	V	Very Heavy
4	12.5 mm			E	Extremely Heavy
5	9.5 mm				

402.3.2 Thickness

(1) Provide the Plan thickness for lower and upper layers limited as follows:

Nominal Size	**Minimum Layer Thickness**	**Maximum Lower Layer Thickness**	**Maximum Upper Layer Thickness**	**Maximum Single Layer Thickness[1]**
	In inches	In inches	In inches	In inches
No. 1 (37.5mm)	4.5	6	4.5	6
No. 2 (25.0 mm)	3.0	5	4	6
No. 3 (19.0 mm)	2.25	4	3	5
No. 4 (12.5 mm)	1.75	3	2.5	4
No. 5 (9.5 mm)	1.25	3	2	3

[1] For use on shoulders and temporary pavements.

(2) Place leveling layers using No. 4 (12.5 mm) or No. 5 (9.5 mm) mixtures. Leveling layers may be thinner than the minimum lower layer thickness for the mixture used.

(3) Place wedging layers as the contract specifies or engineer directs. Wedging layers have no specified minimum or maximum thickness.

402.3.3 HMA Pavement Density Maximum Density Method

402.3.3.1 Minimum Required Density

(1) Compact all layers of HMA mixture to the density shown in Table 402.3.3.1 for the applicable mixture, location, and layer.

TABLE 402.3.3.1 MINIMUM REQUIRED DENSITY

Location	Layer	Percent Of Target Maximum Density	
		Mixture Type	
		LT and MT	HT
Airport Pavement *[1]*	Lower	93.5	93.5
	Upper	94.0	94.0
Airport Pavement Joints *[2]*		Layer mat density minus 1.5%	Layer mat density minus 1.5%

[1] The table values are for average lot density. If any individual density test result falls more than 3.0 percent below the minimum required target maximum density, Engineer may investigate the acceptability of that material.

[2] The table values are for average lot density. Individual test results more than 2 percent below and more than 5 percent above layer mat density may result in an investigation of acceptability of that material.

402.3.3.2 Pavement Density Determination

(1) Engineer will determine the target maximum density using Department procedures described in CMM 815. Engineer will determine density as soon as practicable after compaction and before placement of subsequent layers or before opening to traffic.

(2) Do not re-roll compacted mixtures with deficient density test results. Do not operate continuously below the specified minimum density. Stop production, identify the source of the problem, and make corrections to produce work meeting the specification requirements.

(3) Lots are defined in CMM 815 and placed within a single layer for each location and target maximum density category indicated in Table 402.3.3.1. The lot density is the average of all samples taken for that lot. The Department determines the number of tests per lot according to CMM 815.

(4) A HTCP-certified Nuclear Density Technician I (NUCDENSITYTEC-I) or a nuclear density ACT working under a NUCDENSITYTEC-I technician, will locate samples and perform the testing. A NUCDENSITYTEC-I technician will coordinate and take responsibility for the work an ACT performs. No more than one ACT can work under a single NUCDENSITYTEC-I technician. The responsible NUCDENSITYTEC-I technician will ensure that sample location and testing is performed correctly, analyze test results, and provide density results to Contractor weekly.

402.3.3.3 Waiving Density Testing

(1) Department may waive density testing for one or more of the following reasons:

a. It is impracticable to determine density by the lot system.

b. Contract contains less than 750 tons of a given mixture type placed within the same layer and target maximum density category.

(2) If the Department waives density testing they will notify Contractor before paving.

(3) If HMA CQC testing is waived under 402.2.8.2.1.3.3, density testing is also waived.

402.3.3.4 Joint Density Testing

(1) Engineer shall determine joint density using equipment and procedures specified in 402.3.3.2. Evaluation for acceptance of each lot of field placed material for joint density will be based on the average in-place joint density expressed as a percentage of the average theoretical maximum density (TMD) for the lot. The TMD for each lot will be determined as the average TMD of the sublots. The average in-place joint density for a lot must be in accordance with Table 402.3.3.1.

(2) The lot size will be the total length of longitudinal joints constructed for the lot determined for the corresponding plant produced material, and will be divided into four equal sublots. For each sublot, the same number of joint density readings will be taken, as required for the mat.

402.3.4 Equipment

402.3.4.1 Batch Plants

402.3.4.1.1 Plant Scales

(1) Provide beam, springless, dial, or digital scales on weigh boxes and silos. Use scales of a standard make and design accurate to within 0.5 percent of the maximum required load. For each plant, provide at least ten standard 50 pound weights accurate to within 0.1 percent. For each scale, provide a suitable cradle or platform for applying test loads.

(2) If using beam scales for aggregate, provide a separate beam for each size of aggregate. Also provide a device that warns when the applied load is within 200 pounds of the required load.

(3) If using beam scales for asphaltic materials, provide a tare beam and a full capacity beam with a minimum graduation no greater than two pounds. Also provide a device that warns when the applied load is within 20 pounds of the required load.

(4) If using dial scales, provide a standard make springless scale designed, constructed, and installed to be vibration free. Ensure that all dials are plainly visible to the operator at all times. Equip with adjustable pointers for marking the weight of each material batched.

(5) If using digital scales, conform to National Bureau of Standards Handbook 44.

402.3.4.1.2 Automatic Batching

(1) On contracts with 10,000 tons or more, provide automated batch plants. Ensure that the plants' control system can coordinate mixture proportioning, timing, and discharge by the operation of a single control. Also provide an automatic batch weighing, cycling, and monitoring system.

(2) On contracts with less than 10,000 tons, if Contractor elects to use batch plant automatic systems, conform to the requirements here under 402.3.4.1.2. Contractor need not use automatic recordation. If Contractor elects to use automatic recordation, conform to 402.3.4.1.4 for truck loads, or 402.3.4.1.3 for batch weights.

(3) Ensure that the system accurately proportions mixture components by weight or volume in the proper order and controls the mixing cycle sequence and timing. Provide interlocks that ensure that the scale is at zero before a batch can start and that the batch is mixed completely before discharge. Do not start subsequent batches before completely discharging the previous batch. Also provide interlocks that ensure that all batch materials are in the mixer before the batch can discharge. Ensure that unauthorized personnel cannot alter mix designs and that equipment emits an audible signal if discharging a batch with out-of-tolerance component weights. Ensure that this signal is loud enough to hear throughout the plant area under normal operating conditions.

(4) Provide adjustable timing devices to control individual component batching and mixing operations. Provide auxiliary interlock cutoff circuits necessary to stop automatic cycling whenever a weighing error exceeding a specified tolerance occurs or when another part of the control system malfunctions.

(5) Ensure that the batching system automatic control can stop the cycle in the underweight check position and the overweight check position for each material to check tolerance limits.

(6) Ensure that the scale system is equipped with a device that applies pressure to a scale lever to simulate batching operations for tolerance checks.

(7) Consistently deliver materials within the full range of batch sizes within the following tolerances:

MATERIAL	PERCENT OF TOTAL MATERIAL BATCH WEIGHT
Coarse aggregate	+ 1.0
Fine aggregate	+ 1.0
Aggregate for use with salvaged or reclaimed pavement materials	+ 1.5
Mineral filler	+ 0.5
Salvaged or reclaimed asphaltic pavement material	+ 1.5
Asphaltic material	+ 0.1
Zero return for aggregate	+ 0.5
Zero return for salvaged or reclaimed material	+ 0.5
Zero return for asphaltic material	+ 0.1

(8) Unless providing separate tolerance controls for batching mineral filler, reduce aggregate tolerances to plus or minus 0.5 percent for aggregates delivered before the filler.

(9) Ensure that the total weight of the batch does not vary by more than plus or minus 2.0 percent of the designated batch weight.

(10) Ensure that the electrical circuits for the above delivery tolerances of each cutoff interlock are capable of providing the total span for the full allowable tolerance for maximum batch size. Provide tolerance controls automatically or manually adjustable to provide spans suitable for less than full-size batches. Ensure that the automatic controls and interlock cutoff circuits are consistently coordinated with the batching scale or meter within an accuracy of 0.2 percent of the scale or meter nominal capacity[1] throughout the full range of the batch sizes.

[1] *Nominal capacity of a scale is defined as the maximum quantity which the scale or meter can measure.*

(11) If the automatic control or monitoring systems break down, the Contractor may operate the plant manually for up to 2 working days.

402.3.4.1.3 Recording Batch Weights

(1) On contracts involving 10,000 tons or more of asphaltic mixtures, unless Contractor elects to record truck loads as provided in 402.3.4.1.4, produce an automatic digital record for each batch indicating the proportions of each aggregate component, mineral filler, and asphaltic material.

(2) Provide a digital recorder that can print multiple copies of mixture reports that give the total weight of asphaltic mixture and asphaltic material both per load and per batch. Include weights of the individual aggregates and fillers. Reports need not provide tare weight and may use accumulative weights. Ensure that reported weights are accurate within plus or minus one kg/500 kg. Allow sufficient time for the scale to come to rest before printing each weight.

(3) Contractor may use mixture storage silos with digital recorder equipped batch plants if the Department determines the storage silo output is coordinated with the recorded batch weights.

(4) If the recording system breaks down, Contractor may operate the plant without automatic recording for up to 2 working days.

402.3.4.1.4 Recording Truck Loads

(1) If not using automatic batch recording, install a digital recorder as part of the platform truck or storage silo scales. Ensure that the recorder can produce a printed digital record of at least the gross or net weights of delivery trucks. Provide gross, tare, and net weights. load count, and the cumulative tonnage; the date, time, ticket number, project ID, and mix 250 number; and the mix type including the traffic, binder, and mix designation codes specified in 402.3.1 Ensure that scales cannot be manually manipulated during the printing process. Provide an interlock to prevent printing until the scales come to rest. Size the scales and recorder to accurately weigh the heaviest loaded trucks or tractor-trailers hauling asphaltic mixture. Ensure that recorded weights are accurate to within 0.1 percent of the nominal capacity of the scale.

(2) Ensure that tickets identify additives not included in the mix design submittal or cold weather paving plan. Indicate on the ticket if the mixture is placed under a cold weather paving plan.

402.3.4.2 Asphaltic Mixture Hauling Vehicles

(1) Provide trucks for hauling asphaltic mixtures with tight, clean, and smooth boxes. Contractor may thinly coat boxes with a release agent chosen from the Department's approved products list. Drain excess release agent after coating. Equip each box with a cover big enough to protect the mixture. Do not use trucks that show oil leaks of any magnitude.

402.3.4.3 Transfer Devices

(1) Ensure that transfer devices have surge bin capacity adequate to pave continuously at a uniform speed. If maintaining uniform and continuous paving, the Engineer may allow the Contractor to omit the surge bin. Do not use devices that cause vibrations or other motion that adversely affect the finished ride.

402.3.4.4 Pavers

(1) Ensure that the screed or strike-off assembly produces a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture. Use a screed adjustable for the required crown and cross section of the finished pavement.

(2) Ensure that pavers are equipped with an activated screed or strike-off assembly and use activation at all times during paving unless the Engineer allows otherwise. Do not extend the screed with one or more static extensions totaling more than 12 inches at either screed end, except at the shoulder end for paving shoulders.

(3) Provide pavers with Department-approved automatics that control the elevation and slope of the screed. The Department will not require automatic controls when paving entrances, approaches, side road connections, small irregular areas, or if Engineer determines using automatic controls is impracticable. Use both grade and slope controls whenever automatics are required, except the Engineer may waive the longitudinal or grade control requirement for the final surface. Ensure that the operator can adjust or vary the slope throughout super elevated curves and transitions. Also ensure that the system allows the sensor to operate on either side of the paver.

(4) If automatics break down, Contractor may pave under manual control only until the end of that working day.

402.3.4.5 Compaction Equipment

(1) Ensure all rollers are in good mechanical condition, capable of operating both forwards and backwards, and the operating mechanism allows for starting, stopping, or reversing direction in a smooth manner, without loosening or distorting the surface being rolled.

(2) Equip all rollers with a drum or tire lubricator. Do not lubricate with petroleum or tar products.

402.3.4.6 Smoothness Equipment

(1) Profilograph shall meet ASTM E1274

(2) Rolling Inclinometer shall meet ASTM E2133

(3) Inertial Profiler shall meet ASTM E950

402.3.5 Constructing Asphaltic Mixtures

402.3.5.1 General

402.3.5.1.1 Preparation and Paving Operations

(1) Do not place asphaltic mixture when the air temperature approximately three feet above grade, in shade, and away from artificial heat sources is less than 36 degrees Fahrenheit for upper layers or 32 degrees

Fahrenheit for lower layers unless Engineer allows in writing. Contractor should place HMA pavement for projects in the northern asphalt zone between May 1 and October 15, inclusive; and for projects in the southern asphalt zone between April 15 and November 1, inclusive. CMM 458 figure 2 defines asphalt zones. Notify the Engineer at least one business day before paving.

(2) Unless the Contract specifies otherwise, conform to the following:

a. Keep the open to all traffic during construction when specified.

b. Prepare the existing foundation for treatment as required in these Specifications.

c. Incorporate loose aggregate as a part of preparing the foundation, in shoulder construction, or dispose of as Engineer approves.

(3) Place asphaltic mixture only on a prepared, firm, and compacted base, foundation layer, or existing pavement substantially surface-dry and free of loose and foreign material. Do not place over frozen subgrade or base, or where the roadbed is unstable.

402.3.5.1.2 Cold Weather Paving

402.3.5.1.2.1 General

(1) HMA shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 402.3.2.1.2. The temperature requirements may be waived by the Engineer, as described in the following paragraph; however, all other requirements including compaction shall be met.

Table 402.3.2.1.2 Surface Temperature Limitations of Underlying Course

Mat Thickness	Base Temperature (Minimum)	
	(F	(C
3 inches or greater	40	4
Greater than 2 inches but less than 3 inches	45	7

(2) If allowed by Engineer or included in the Contract conform cold weather paving provisions for work performed as described in the Contract Documents.

402.3.5.1.2.2 Cold Weather Paving Plan

(1) Submit a written cold weather paving plan to Engineer at the preconstruction meeting. In that plan outline material, operational, and equipment changes for paving when the air temperature approximately three feet above grade, in shade, and away from artificial heat sources is less than 40 degrees Fahrenheit. Include the following:

a. Use a Department-accepted HMA mix design that incorporates a warm mix additive from the Department's approved products list. Do not use a foaming process that introduces water into the mix.

b. Identify the warm mix additive and dosage rate.

c. Identify modifications to the compaction process and when to use them.

(2) Engineer written acceptance is required for the cold weather paving plan. Engineer acceptance of the plan does not relieve the Contractor of responsibility for the quality of HMA pavement placed in cold weather.

402.3.5.1.2.3 Cold Weather Paving Operations

(1) Do not place asphaltic mixture when the air temperature approximately three feet above grade, in shade, and away from artificial heat sources is less than 40 degrees Fahrenheit unless a valid Engineer-accepted cold weather paving plan is in effect.

(2) If the national weather service forecast for the construction area predicts ambient air temperature less than 40 degrees Fahrenheit at the projected time of paving within the next 24 hours, confirm or submit revisions to the cold weather paving plan for Engineer review. Update the plan as required to accommodate the conditions anticipated for the next day's operations. Upon review of the plan, Engineer will allow paving to proceed the next day. Once in effect, pave conforming to the engineer-accepted cold weather paving plan for the balance of that work day or shift regardless of the temperature at the time of paving.

402.3.5.1.3 Diamond Grinding

(1) When required, diamond grinding shall be accomplished by sawing with saw blades impregnated with industrial diamond abrasive. The saw blades shall be assembled in a cutting head mounted on a

machine designed specifically for diamond grinding that will produce the required texture and smoothness level without damage to the pavement. The saw blades shall be 1/8-inch wide and there shall be a sufficient number of blades to produce the required surface texture; the actual number of blades will be determined by the Contractor and depend on the hardness of the aggregate. Each machine shall be capable of cutting a path at least 3 feet wide. Equipment that causes ravels, aggregate fractures, spalls or disturbance to the pavement will not be permitted. The surface of the ground pavement shall have a texture consisting of grooves between 0.090 and 0.130 inches wide. The peaks and ridges shall be approximately 1/32 inch higher than the bottom of the grooves. Contractor shall demonstrate to the Engineer that the grinding equipment will produce satisfactory results prior to making corrections to surfaces. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The pavement shall be left in a clean condition. The removal of all of the slurry resulting from the grinding operation shall be continuous. Control the grinding operation so the residue from the operation does not flow across other lanes of pavement.

402.3.5.2 Preparing and Storing Mixtures

(1) Heat and combine aggregate and asphaltic material to produce a mixture within the temperature range the mixture design specifies when discharged from the mixer. Mix until achieving a homogeneous mixture with uniformly coated aggregate. The Contractor may store the mixture in silos.

402.3.5.3 Transporting and Delivering Mixtures

(1) Deliver the mixture to the paver receiving hopper at a temperature within 20 degrees Fahrenheit of the temperature the asphaltic material supplier recommends. Cover all loads during inclement weather or when the ambient air temperature falls below 65 degrees Fahrenheit.

(2) If depositing asphaltic mixture on the roadway, provide equipment to pick up substantially all of the asphaltic mixture from the roadway and load it directly into the paver receiving hopper. Use either a device integral to the paver or intermediate transfer equipment.

402.3.5.4 Correcting Base

(1) Before placing asphaltic base or surface courses, correct the existing pavement by filling potholes, sags, and depressions; altering the existing crown; or other corrections shown on the Plans. Place asphaltic lower layer mixtures where required. Contractor may hand place or use blade graders or mechanical spreaders to place mixture used for wedging, leveling layers, or filling holes. Feather the mixture out to become co-planar with adjoining areas and compact uniformly as specified.

402.3.5.5 Spreading and Finishing Mixture

(1) Place asphaltic mixtures in layers to the typical sections the plans show with self-propelled pavers. Pave at a constant speed, appropriate for the paver and mixture to ensure uniform spreading and strike-off with a smooth, dense texture and no tearing or segregation. Do not pave faster than the average delivery rate of asphaltic mixture to ensure, as nearly as possible, continuous paving.

(2) If placing the initial lane of a given layer, sense off a tight string line, a mobile string line, or a traveling straightedge whichever Engineer approves for the specific field conditions. On subsequent lanes of the layer, Contractor may sense off the adjacent lane surface.

(3) Avoid raking over machine spread and finished material on surface courses to the extent possible to prevent segregation.

(4) Contractor may spread material by hand in areas not accessible to pavers. Dump material outside the placement area, spread into place with shovels, and shape to the required grade and contour with rakes and lutes. Do not rake material from a pile of dumped material.

(5) Do not haul over any portion of a placed layer until after the final rolling is complete on that portion.

402.3.5.6 Compaction

(1) When specified in 402.3.3.1, compact asphaltic mixture using the roller pattern established during construction of a control strip. Use 2 or more rollers per paver if placing more than 165 tons per hour.

(2) On the first day of production, construct a control strip under the direct observation of department personnel. After compacting the control strip with a minimum of 3 passes, mark the gauge outline and take a one-minute wet density measurement using a nuclear density gauge in back scatter mode at a single location. Take a density measurement at the same location after each subsequent pass. Continue compacting and testing until the increase in density is less than 1 pcf for 3 consecutive passes. Submit the final roller pattern to the engineer in writing. Once the roller pattern is established do not change the pattern or decrease the number, type, or weight of rollers without the engineer's written approval.

(3) After establishing the roller pattern, and under the direct observation of the engineer, cut at least one 4-inch diameter or larger core from the control strip density gauge outline. Prepare cores and determine density according to AASHTO T166. Dry cores after testing. Fill core holes and obtain engineer approval before opening to traffic. The department will maintain custody of cores throughout the entire sampling and testing process. The department will label cores, transport cores to testing facilities, witness testing, store dried cores, and provide subsequent verification testing.

(4) After placing, the HMA shall be thoroughly and uniformly compacted by power rollers. The surface shall be compacted as soon as possible when the HMA has attained sufficient stability so that the rolling does not cause undue displacement, cracking or shoving. Sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Displacement occurring as a result of reversing the direction of the roller, or from other causes, shall be corrected at once.

(5) Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross-section, and the required field density is obtained. To prevent adhesion of the HMA to the roller, the wheels shall be equipped with a scraper and kept properly moistened but excessive water will not be permitted.

(6) In areas not accessible to the roller, the mixture shall be thoroughly compacted with approved power driven tampers. Tampers shall weigh not less than 275 pounds, have a tamping plate width not less than 15 inches, be rated at not less than 4,200 vibrations per minute, and be suitably equipped with a standard tamping plate wetting device.

(7) HMA that becomes loose and broken, mixed with dirt, contains check-cracking, or in any way defective shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching shall not be allowed.

402.3.5.7 Applying Tack Coat

(1) Apply tack coat as specified in P603 to each layer of a plant-mixed asphaltic base or pavement that will be overlaid with asphaltic mixture under the same contract.

402.3.5.8 Jointing

(1) The formation of all joints shall be made to ensure a continuous bond between the courses and obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade. Place all layers as continuously as possible without joints.

(2) If an asphaltic mat adjoins an older high-type asphaltic mat, cut back the old mat on a straight line to form a butt joint over full depth of the new mat.

(3) The roller shall not pass over the unprotected end of the freshly laid asphalt except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. In both methods, all contact surfaces shall be coated with an asphalt tack coat before placing any fresh asphalt against the joint.

(4) Longitudinal joints which have been left exposed for more than four (4) hours; the surface temperature has cooled to less than 175°F (80°C); or are irregular, damaged, uncompacted or otherwise defective shall be cut back with a cutting wheel or pavement saw a maximum of 3 inches (75 mm) to expose a clean, sound, uniform vertical surface for the full depth of the course. All cutback material and any laitance produced from cutting joints shall be removed from the project. Asphalt tack coat in accordance with P603 shall be applied to the clean, dry joint prior to placing any additional fresh asphalt against the joint, including the vertical face of the joint. The cost of this work shall be considered incidental to the cost of the asphalt.

402.4 Measurement

(1) Department will measure asphaltic mixtures by the ton of mixed aggregate and asphaltic material incorporated in the work unless the measurement subsection for a particular application specifies otherwise. Provide Engineer with weigh tickets showing the net weight of each load of material delivered. Department or Department-authorized testing firms or agencies will test the Contractor's truck, storage silo, or plant scales.

(2) For minor quantities of mixtures and if Engineer approves, Contractor may report batch weights from plant scales as described in 402.3.4.1.1, instead of truck or storage silo scale weights.

(3) The Department will measure HMA Cold Weather Paving by the ton of HMA mixture placed conforming to an Engineer-accepted cold weather paving plan.

402.5 Payment

402.5.1 General

(1) HMA Pavement Shall be specified by a type designation. The type is defined by the following characteristics:

a. Gradation (N_{mas} Size) per Table 402.2.2.3.
b. Traffic level per Table 402.2.7.
c. Asphaltic Binder Grade
d. Binder Designation

(2) An example of a type designation would be “4 MT 58-28 S.”

402.5.2 HMA Pavement

402.5.2.1 General

(1) Department will pay for the HMA Pavement Pay Items at the Contract unit price subject to one or more of the following adjustments:

a. Disincentive for density of HMA pavement as specified in 402.5.2.2.
b. Incentive for density of HMA pavement as specified in 402.5.2.3.
c. Reduced payment for nonconforming smoothness as specified in 402.2.8.2.2.1. If smoothness criteria cannot be met or contractor and BOA agree to leave pavement in place, an appropriate deduction shall be provided for the non-conforming work, as determined by the BOA.
d. Reduced payment for nonconforming QMP HMA mixtures as specified in 402.2.8.2.1.7.

(2) Payment for the HMA Pavement bid items is full compensation for providing HMA pavement including binder; for mixture design; for preparing the foundation; and for QMP and aggregate source testing.

(3) If provided for in the plan quantities, the Department will pay for a leveling layer, placed to correct irregularities in an existing paved surface before overlaying, under the pertinent paving Pay Item. Absent a plan quantity, the Department will pay for a leveling layer as extra work.

(4) The Department will administer pay reduction for nonconforming QMP mixture under the Nonconforming QMP HMA Mixture administrative item. The Department will reduce pay based on the Contract unit price for the HMA Pavement Pay Item.

(5) The Department will reduce pay for nonconforming QMP HMA mixtures as specified in 402.2.8.2.1.7, starting from the stop point to the point when the running average of four is back inside the warning limits. Engineer will determine the quantity of material subject to pay reduction based on the testing data and an inspection of the completed pavement. The Department will reduce pay as follows:

PAYMENT FOR MIXTURE[1] [2]

ITEM	PRODUCED WITHIN WARNING BANDS	PRODUCED OUTSIDE JMF LIMITS
Gradation	90%	75%
Asphalt Content	85%	75%
Air Voids	70%	50%
VMA	90%	75%

[1] For projects or plants where the total production of each mixture design requires less than four tests refer to CMM 836.

[2] Payment is in percent of the Contract unit price for the HMA Pavement Pay Item. The Department will reduce pay based on the nonconforming property with lowest percent pay.

[3] In addition to any pay adjustment listed in the previous table, Department will adjust pay for nonconforming binder under the Nonconforming QMP Asphaltic Material administrative item. Department will deduct 25 percent of the Contract unit price of the HMA Pavement bid item per ton of pavement placed with nonconforming PG binder the Engineer allows to remain in place.

(6) If during a QV dispute resolution investigation, the Department discovers mixture with 1.5 > Va > 5.0 or VMA more than 1.0 below the minimum or above the maximum allowed in Table 402.2.2.3, and the Engineer allows that mixture to remain in place, the Department will pay for the quantity of affected material at 50 percent of the Contract price.

(7) If the Department waives density testing under 402.3.3.3, the Department will not adjust pay under either 402.5.2.2 or 402.5.2.3.

(8) Restore the surface after cutting density samples as specified in 402.3.3.2(1) at no additional cost to the Department.

402.5.2.2 Disincentive for HMA Pavement Density

(1) Department will administer density disincentives under the Disincentive Density HMA Pavement administrative item. If the lot density is less than the specified minimum in Table 402.3.3.1, the Department will reduce pay based on the Contract unit price for the HMA Pavement Pay Item for that lot as follows:

DISINCENTIVE PAY REDUCTION FOR HMA PAVEMENT DENSITY

PERCENT LOT DENSITY BELOW SPECIFIED MINIMUM	PAYMENT FACTOR (percent of Contract price)
From 0.5 to 1.0 inclusive	98
From 1.1 to 1.5 inclusive	95
From 1.6 to 2.0 inclusive	91
From 2.1 to 2.5 inclusive	85
From 2.6 to 3.0 inclusive	70
More than 3.0 [1]	____

[1] *Remove and replace the lot with a mixture at the specified density. When acceptably replaced, the Department will pay for the replaced work at the Contract unit price. Alternatively, Engineer may allow the nonconforming material to remain in place with a 50 percent payment factor.*

(2) Department will not assess density disincentives for pavement placed in cold weather due to a Department-caused delay as specified in 402.5.2.4(2).

402.5.2.3 Incentive for HMA Pavement Density

(1) If the lot density is greater than the minimum specified in Table 402.3.3.1 and all individual air voids test results for that mixture placed during the same day are within 2.5-4.0 percent, Department will adjust pay for that lot as follows:

INCENTIVE PAY ADJUSTMENT FOR HMA PAVEMENT DENSITY

PERCENT LOT DENSITY ABOVE SPECIFIED MINIMUM	PAY ADJUSTMENT PER TON [1]
From -0.4 to 1.0 inclusive	$0
From 1.1 to 1.8 inclusive	$0.40
More than 1.8	$0.80

[1] *The Department will prorate the pay adjustment for a partial lot.*

(2) Department will adjust pay under the Incentive Density HMA Pavement Pay Item. Adjustment under this item is not limited, either up or down, to the bid amount the schedule of items shows.

402.5.2.4 Total Project Payment

(1) The total project payment for HMA pavement will not exceed 103 percent of the product of the Contract unit price and the total number of tons of HMA mixture used in the accepted work. Payment in excess of 103 percent for individual accepted lots of HMA pavement will be used to offset payment for accepted lots of HMA pavement that achieve a lot pay factor less than 103 percent. The calculation of excess and offset will be applied as equivalent amounts. In the event a lot is identified for removal and replacement in accordance with criteria defined in the specifications, Engineer may decide to allow the rejected lot to remain. In that case, if the Engineer and Contractor agree in writing that the lot will not be removed, it will be paid for at 50 percent of the Contract unit price and the total project payment limitation will be reduced by the amount withheld for the rejected lot.

402.5.2.5 Cold Weather Paving

(1) Payment for HMA Cold Weather Paving is full compensation for additional materials and equipment specified for cold weather paving under 402.3.5.1.2 including costs for preparing, administering, and following Contractor's cold weather paving plan. The Department will not pay for HMA Cold Weather Paving for HMA placed on days when the Department is assessing liquidated damages.

a. If the lot density is less than the minimum specified in Table 402.2.7 for mixture placed under P402.

b. On days when the Department is assessing liquidated damages.

(2) If because of an excusable compensable delay under 80.10.2, the Engineer directs Contractor to pave when the temperature is less than 36 degrees Fahrenheit for the upper layer or less than 32 degrees Fahrenheit for lower layers, the Department:

a. Will relieve the Contractor of responsibility for damage and defects the Engineer attributes to cold weather paving.

b. Will not assess disincentives for density or ride.

(3) If HMA pavement is placed under 402.3.5.1.2 and the HMA Cold Weather Paving Pay Item is not in the Contract, the Department will pay for the additional costs specified in 402.5.2.4(1) as extra work. The Department will pay separately for HMA pavement under the appropriate HMA Pavement Pay Items.

402.5.3 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P402.500 through P402.599	HMA Pavement (gradation) LT (binder)(designation)	TON
P402.600 through P402.699	HMA Pavement (gradation) MT (binder)(designation)	TON
P402.700 through P402.799	HMA Pavement (gradation) HT (binder)(designation)	TON
P402.800 through P402.899	HMA Pavement Leveling (gradation) (type) (binder) (designation)	TON
P402.900	Incentive Density HMA Pavement	DOL
P402.910	HMA Cold Weather Paving	TON

END OF SPECIFICATION P402

Part 7 – Rigid Pavement

Specification P501 - Portland Cement Concrete (PCC) Pavement

501.1 Description

501.1.1 General

(1) This work shall consist of pavement composed of Portland cement concrete (PCC), constructed on a prepared underlying surface in accordance with these specifications and shall conforming to the lines, grades, thickness, and typical cross-sections shown on the Plans. Reinforcement is required when shown on the Plans. The terms cement concrete, hydraulic cement concrete, and concrete are interchangeable in this specification.

501.1.2 Construction Staking

(1) Contractor shall provide all construction staking in accordance with 50.6, except Engineer will provide staking as described on the Plans or specified in the Special Provisions.

501.2 Materials

501.2.1 Aggregates

501.2.1.1 Reactivity

(1) Fine and Coarse aggregates to be used in PCC on this project shall be tested and evaluated by the Contractor for alkali-aggregate reactivity in accordance with both ASTM C1260 and ASTM C1567. Tests must be representative of aggregate sources which will be providing material for production. ASTM C1260 and ASTM C1567 tests may be run concurrently. Reactivity testing will not be required for projects with less than 20,000 square yards of paving, unless the source of the aggregate is in Clark, Marathon, Portage, or Wood Counties.

501.2.1.1.1 ASTM C1260

(1) Coarse and fine aggregate shall be tested separately in accordance with ASTM C1260, however, the length of test shall be extended to 28 days (30 days from casting). Tests must have been completed within the last six months of the date of the concrete mix design submittal.

(2) If either of the tests exceed 0.10% it serves as an indication that the ASTM C1567 test may be an issue. ASTM C1260 tests exceeding 0.10 percent do not require mitigation and are not a basis for rejecting the aggregate.

501.2.1.1.2 ASTM C1567

(1) Combined coarse and fine aggregate shall be tested in accordance with ASTM C1567, modified for combined aggregates, using the proposed mixture design proportions of aggregates, cementitious materials, and/or specific reactivity reducing chemicals. If the expansion does not exceed 0.10% at 28 days, the proposed combined materials will be accepted. If the expansion is greater than 0.10% at 28 days, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than 0.10% at 28 days, or new aggregates shall be evaluated and tested.

(2) Fly Ash added to the mix design as a routine practice not intended specifically as an ASR mitigative effort, does not need to meet the Calcium Oxide (CaO) and total alkali limit of 501.2.3.1

501.2.1.1.3 Acceptance or Adjustments

(1) If lithium nitrate is proposed for use with or without supplementary cementitious materials, the aggregates shall be tested in accordance with Corps of Engineers (COE) Concrete Research Division (CRD) C662 in lieu of ASTM C1567. If lithium nitrate admixture is used, it shall be nominal 30% ±0.5% weight lithium nitrate in water. If the expansion does not exceed 0.10% at 28 days, the proposed combined materials will be accepted. If the expansion is greater than 0.10% at 28 days, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than 0.10% at 28 days, or new aggregates shall be evaluated and tested.

501.2.1.2 Fine Aggregate

(1) Grading of the fine aggregate, as delivered to the mixer, shall conform to the requirements of ASTM C33 and the parameters identified in the fine aggregate material requirements below. Fine aggregate material requirements and deleterious limits are shown in the following table.

Table 501.2.1.2

Fine Aggregate Material Requirements (Portion Passing the 3/8-inch (9.5 mm) sieve and retained on the No. 200 (75 µm))		
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88
Sand Equivalent	45 minimum	ASTM D2419
Fineness Modulus (FM)	2.50 ≤ FM ≤ 3.40	ASTM C136
Limits for Deleterious Substances in Fine Aggregate for Concrete		
Clay lumps and friable particles	1.0% maximum	ASTM C142
Coal and lignite	0.5% using a medium with a density of Sp. Gr. of 2.0	ASTM C123
Total Deleterious Material	1.0% maximum	

501.2.1.3 Coarse Aggregate

(1) The maximum size coarse aggregate shall be 1-1/2 inch.

(2) Aggregates delivered to the mixer shall be clean, hard, uncoated aggregates consisting of crushed stone, crushed or uncrushed gravel, air-cooled iron blast furnace slag, crushed recycled concrete pavement, or a combination. To the best of the aggregate producer's knowledge, the aggregates shall have no known history of detrimental pavement staining. Steel blast furnace slag shall not be permitted. The aggregate shall be composed of clean, hard, uncoated particles. Coarse aggregate material requirements and deleterious limits are shown in the following table; washing may be required to meet aggregate requirements.

(3) Crushed granite, calcite cemented sandstone, quartzite, basalt, diabase, rhyolite, or trap rick are considered to meet the D-cracking test requirement, but must meet all other quality tests specified.

Table 501.2.1.3

Coarse Aggregate Material Requirements (Portion retained on the No. 4 (4.75 mm) sieve)		
Material Test	**Requirement**	**Standard**
Resistance to Degradation	Loss: 40% maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 12% maximum using Sodium sulfate - or - 18% maximum using magnesium sulfate	ASTM C88
Flat, Elongated, or Flat and Elongated Particles[1]	8% maximum, by weight, of flat, elongated, or flat and elongated particles at 5:1 for any size group coarser than 3/8 sieve[1]	ASTM D4791
Bulk density of slag [2]	Weigh not less than 70 pounds per cubic foot	ASTM C29
D-cracking (Freeze-Thaw)[3]	Durability factor ≥ 95	ASTM C666

[1] *A flat particle is one having a ratio of width to thickness greater than five; an elongated particle is one having a ratio of length to width greater than five.*

[2] *Only required if slag is specified.*

[3] *Coarse aggregate may only be accepted from sources that have a 20-year service history for the same gradation to be supplied with no history of D-Cracking. Aggregates that do not have a 20-year record of service free from major repairs (less than 5% of slabs replaced) in similar conditions without D-cracking shall not be used unless the material currently being produced has a durability factor greater than or equal to 95 per ASTM C666. The Contractor shall submit a current certification and test results to verify the aggregate acceptability. Test results will only be accepted from a State Department of Transportation (DOT) materials laboratory or an accredited laboratory. Certification and test results which are not dated or which are over one (1) year old or which are for different gradations will not be accepted.*

(3) The amount of deleterious material in the coarse aggregate shall not exceed the following limits:

Table 501.2.1.3(3)

Limits for Deleterious Substances in Coarse Aggregate for Concrete

Deleterious material	ASTM	Percentage by Mass
Clay Lumps and friable particles	ASTM C142	1.0
Material finer than No. 200 sieve (0.075mm)	ASTM C117	1.0[1]
Lightweight particles	ASTM C123 using a medium with a density of Sp. Gr. of 2.0	0.5
Chert[2] (less than 2.40 Sp. Gr.)	ASTM C123 using a medium with a density of Sp. Gr. of 2.40)	1.0

[1] *The limit for material finer than 75-µm is allowed to be increased to 1.5% for crushed aggregates consisting of dust of fracture that is essentially free from clay or shale test results supporting acceptance of increasing limit to 1.5% with statement indicating material is dust of fracture must be submitted with Concrete Mix Design. Acceptable techniques to characterizing these fines include methylene blue adsorption or X-ray diffraction analysis.*

[2] *Chert and aggregates with less than 2.4 specific gravity.*

501.2.1.4 Combined Aggregate Gradation

(1) This specification is targeted for a combined aggregate gradation developed following the guidance presented in United States Air Force Engineering Technical Letter (ETL) 97-5: Proportioning Concrete Mixtures with Graded Aggregates for Rigid Airfield Pavements. Base the aggregate grading upon a combination of all the aggregates (coarse and fine) to be used for the mixture proportioning. Three aggregate sizes may be required to achieve an optimized combined gradation that will produce a workable concrete mixture for its intended use. Use aggregate gradations that produce concrete mixtures with well-graded or optimized aggregate combinations. The Contractor shall submit complete mixture information necessary to calculate the volumetric components of the mixture. The combined aggregate grading shall meet the following requirements:

a. The materials selected and the proportions used shall be such that when the Coarseness Factor (CF) and the Workability Factor (WF) are plotted on a diagram as described in the following paragraph (501.2.1.4 d), the point thus determined shall fall within the parallelogram described therein.

b. The CF shall be determined from the following equation:

CF = (cumulative percent retained on the 3/8 in. sieve)(100) divided by (cumulative percent retained on the No. 8 sieve)

c. The Workability Factor (WF) is defined as the percent passing the No. 8 sieve based on the combined gradation. However, WF shall be adjusted, upwards only, by 2.5 percentage points for each 94 pounds of cementitious material per cubic meter yard greater than 564 pounds per cubic yard.

d. A diagram shall be plotted using a rectangular scale with WF on the Y-axis with units from 20 (bottom) to 45 (top), and with CF on the X-axis with units from 80 (left side) to 30 (right side). On this diagram a parallelogram shall be plotted with corners at the following coordinates (CF-75, WF-28), (CF-75, WF-40), (CF-45, WF-32.5), and (CF-45, WF-44.5). If the point determined by the intersection of the computed CF and WF does not fall within the above parallelogram, the grading of each size of aggregate used and the proportions selected shall be changed as necessary. The point determined by the plotting of the CF and WF may be adjusted during production ±3 WF and ±5 CF. Adjustments to gradation may not take the point outside of the parallelogram.

501.2.1.5 Contractor's Combined Aggregate Gradation

(1) Contractor shall submit their combined aggregate gradation in accordance with the following table.

Table 501.2.1.5

Contractor's PCC Combined Aggregate Gradation

Sieve Size	**Contractor's Mix Design Gradation (Percent passing by weight)**
2 inch (50 mm)	*
1-1/2 inch (37.5 mm)	*
1 inch (25.0 mm)	*
¾ inch (19.0 mm)	*
½ inch (12.5 mm)	*
3/8 inch (9.5 mm)	*
No. 4 (4.75 mm)	*
No. 8 (2.36 mm)	*
No. 16 (1.18 mm)	*
No. 30 (0.600 mm)	*
No. 50 (0.300 mm)	*
No. 100 (0.150 mm)	*

* Insert based on 501.2.1.4

501.2.2 Cement

(1) Cement shall conform to the requirements of ASTM C150, Type I, II, or V; or ASTM C595, Type IP, IS, or IL.

501.2.3 Cementitious Materials

501.2.3.1 Fly Ash

(1) Fly ash shall meet the requirements of ASTM C618, with the exception of loss of ignition, where the maximum shall be less than six percent. Fly ash for use in mitigating alkali-silica reactivity shall have a Calcium Oxide (CaO) content of less than 15 percent and a total available alkali content less than three percent per ASTM C311. Fly ash produced in furnace operations using liming materials or soda ash (sodium carbonate) as an additive shall not be acceptable. The Contractor shall furnish the previous three most recent, consecutive ASTM C618 reports for each source of fly ash proposed in the mix design, and shall furnish each additional report as they become available during the project. The reports can be used for acceptance or the material may be tested independently by the Engineer.

(2) Fly ash meeting ASTM C618 Type C is acceptable in mix provided the proposed mix has acceptably met ASTM C1567 maximum expansion limits as specified in 501.2.1.1.2.

501.2.3.2 Slag Cement (Ground Granulated Blast Furnace (GGBF))

(1) Slag cement shall conform to ASTM C989, Grade 100 or Grade 120. Slag cement shall be used only at a rate between 25 percent and 55 percent of the total cementitious material by mass.

501.2.3.3 Raw or Calcined Natural Pozzolan

(1) Natural pozzolan shall be raw or calcined and conform to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and shall have a loss on ignition not exceeding 6 percent. Class N pozzolan for use in mitigating Alkali-Silica Reactivity shall have a total available alkali content less than three percent.

501.2.4 Joint Seal

(1) The joint seal for the joints in the concrete pavement shall meet the requirements of Item P605 and shall be of the type specified in the Plans.

501.2.5 Isolation Joint Filler

(1) Pre-molded joint filler for isolation joints shall conform to the requirements of ASTM D1751 or ASTM D1752 and shall be where shown on the Plans. The filler for each joint shall be furnished in a single

piece for the full depth and width required for the joint, unless otherwise specified by the Engineer. When the use of more than one piece is required for a joint, the abutting ends shall be fastened securely and held accurately to shape by stapling or other positive fastening means satisfactory to the Engineer.

501.2.6 Steel Reinforcement

(1) Reinforcing shall consist of grade 60 conforming to the requirements of ASTM A615.

501.2.7 Dowel and Tie Bars

(1) Dowel bars shall be plain steel bars conforming to ASTM A615 and shall be free from burring or other deformation restricting slippage in the concrete.

a. Dowel bars. Before delivery to the construction site each dowel bar shall be epoxy coated per ASTM A1078, Type 1, with a coating thickness after curing greater than ten mils. Patched ends are not required for Type 1 coated dowels. The dowels shall be coated with a bond-breaker recommended by the manufacturer. Dowel sleeves or inserts are not permitted. Grout retention rings shall be fully circular metal or plastic devices capable of supporting the dowel until the grout hardens.

b. Tie bars. Tie bars shall be deformed steel bars conforming to the requirements of ASTM A615. Tie bars designated as Grade 60 in ASTM A615 or ASTM A706 shall be used for construction requiring bent bars.

c. Contractor may be allowed to substitute a dowel or tie bar with equal or more corrosion resistance with prior approval from the Engineer and at no additional cost to the project.

501.2.8 Water

(1) Water used in mixing or curing shall be potable. If water is taken from other sources considered non-potable it shall meet the requirements of ASTM C1602.

501.2.9 Material for Curing Concrete

(1) Curing materials shall conform to one of the following specifications:

a. Liquid membrane-forming compounds for curing concrete shall conform to the requirements of ASTM C309, Type 2, Class A, or Class B.

b. White polyethylene film for curing concrete shall conform to the requirements of ASTM C171.

c. White burlap-polyethylene sheeting for curing concrete shall conform to the requirements of ASTM C171.

d. Waterproof paper for curing concrete shall conform to the requirements of ASTM C171.

501.2.10 Admixtures

(1) Admixtures shall conform to the following specifications.

501.2.10.1 Air-Entraining Admixtures

(1) Air-entraining admixtures shall meet the requirements of ASTM C260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entraining agent and any water reducer admixture shall be compatible.

501.2.10.2 Water-Reducing Admixtures

(1) Water-reducing admixture shall meet the requirements of ASTM C494, Type A, B, or D. ASTM C494, Type F and G high range water reducing admixtures and ASTM C1017 flowable admixtures shall not be used.

501.2.10.3 Other Admixtures

(1) The use of set retarding, and set-accelerating admixtures shall be approved by the Engineer. Retarding shall meet the requirements of ASTM C494, Type A, B, or D and set-accelerating shall meet the requirements of ASTM C494, Type C. Calcium chloride and admixtures containing calcium chloride shall not be used.

501.2.10.4 Lithium Nitrate.

(1) The lithium admixture shall be a nominal 30 percent aqueous solution of Lithium Nitrate, with a density of 10 pounds/gallon (1.2 kg/L), and shall have the approximate chemical form as shown below:

Table 501.2.10.4

Lithium Admixture

Constituent	Limit (Percent by Mass)
LiNO3 (Lithium Nitrate)	30 ±0.5
SO4 (Sulfate Ion)	0.1 (max)

Cl (Chloride Ion)	0.2 (max)
Na (Sodium Ion)	0.1 (max)
K (Potassium Ion)	0.1 (max)

(2) The lithium nitrate admixture dispensing and mixing operations shall be verified and certified by the lithium manufacturer's representative.

501.2.11 Epoxy-Resin

(1) All epoxy-resin materials shall be two-component materials conforming to the requirements of ASTM C881, Class as appropriate for each application temperature to be encountered, except that in addition, the materials shall meet the following requirements:

a. Material for use for embedding dowels and anchor bolts shall be Type IV, Grade 3.

b. Material for use as patching materials for complete filling of spalls and other voids and for use in preparing epoxy resin mortar shall be Type III, Grade as approved.

c. Material for use for injecting cracks shall be Type IV, Grade 1.

d. Material for bonding freshly mixed Portland cement concrete or mortar or freshly mixed epoxy resin concrete or mortar to hardened concrete shall be Type V, Grade as approved.

501.2.12 Bond Breaker

(1) If required, Bond Breaker is shown on Plans or specified in Special Provisions.

501.3 Mix Design

501.3.1 General

(1) No concrete shall be placed until an acceptable concrete mix design has been submitted to the Engineer for review and the Engineer has taken appropriate action. The Engineer's review shall not relieve the Contractor of the responsibility to select and proportion the materials to comply with this section.

501.3.2 Concrete Mix Design Laboratory

(1) The laboratory used to develop the concrete mix design shall be accredited in accordance with ASTM C1077. The laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for developing the concrete mix design must be listed on the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods shall be submitted to the Engineer prior to start of construction.

501.3.3 Proportions

(1) Develop the mix using the procedures contained in Portland Cement Association (PCA) publication, "Design and Control of Concrete Mixtures." Concrete shall be proportioned to achieve a 28-day flexural strength that meets or exceeds the acceptance criteria contained in paragraph 501.6.6 for a flexural strength of 650 psi per ASTM C78.

(2) The minimum cementitious material shall be adequate to ensure a workable, durable mix. The minimum cementitious material (cement plus fly ash, or slag cement) shall be 517 pounds per cubic yard. The ratio of water to cementitious material, including free surface moisture on the aggregates but not including moisture absorbed by the aggregates shall be between 0.38 to 0.45 by weight.

(3) Flexural strength test specimens shall be prepared in accordance with ASTM C192 and tested in accordance with ASTM C78. At the start of the project, the Contractor shall determine an allowable slump as determined by ASTM C143, not to exceed two inches for slip-form placement. The selected slump shall be applicable to both pilot and fill-in lanes. For fixed-form placement the slump shall not exceed three inches. For hand placement, the slump shall not exceed four inches.

(4) The results of the mix design shall include a statement giving the maximum nominal coarse aggregate size and the weights and volumes of each ingredient proportioned on a one cubic yard basis. Aggregate quantities shall be based on the mass in a saturated surface dry condition.

(5) If a change in source(s) is made, or admixtures added or deleted from the mix, a new concrete mix must be submitted to the RPR for approval.

(6) The RPR may request samples at any time for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

501.3.4 Mix Design Submittal

(1) The concrete mix (mix design) shall be submitted to Engineer at least 30 days prior to the start of operations. The submitted concrete mix (mix design) shall not be more than 180 days old and must use

the materials to be used for production for the project. Production shall not begin until the concrete mix (mix design) is approved in writing by Engineer.

(2) Each of the submitted mix designs (i.e., slip form, side form machine finish and side form hand finish) shall be stamped or sealed by the responsible professional Engineer of the laboratory and shall include the following items and quantities as a minimum:

a. Certified material test reports for aggregate in accordance with paragraph 501.2.1. Certified reports must include all tests required; reporting each test, test method, test result, and requirement specified (criteria).

b. combined aggregate gradations and analysis; and including of the fine aggregate fineness modulus.

c. Reactivity Test Results.

d. Coarse aggregate quality test results, including deleterious materials.

e. Fine aggregate quality test results, including deleterious materials.

f. Mill certificates for cement and supplemental cementitious materials.

g. Certified test results for all admixtures, including Lithium Nitrate if applicable.

h. Specified flexural strength, slump, and air content.

i. Recommended proportions/volumes for proposed mixture and trial water-cementitious materials ratio, including actual slump and air content.

j. Flexural and compressive strength summaries and plots, including all individual beam and cylinder breaks.

k. Correlation ratios for acceptance testing and Contractor Quality Control testing, when applicable.

l. Historical record of test results documenting production standard deviation, when applicable.

501.3.5 Cementitious Materials

501.3.5.1 Fly Ash

(1) When fly ash is used as a partial replacement for cement, the replacement rate shall be determined from laboratory trial mixes, and shall be between 20 and 30 percent by weight of the total cementitious material. If fly ash is used in conjunction with slag cement the maximum replacement rate shall not exceed 10 percent by weight of total cementitious material.

501.3.5.2 Slag Cement (Ground Granulated Blast Furnace (GGBF))

(1) Slag cement may be used. The slag cement, or slag cement plus fly ash if both are used, may constitute between 25 to 55 percent of the total cementitious material by weight.

501.3.5.3 Raw Or Calcined Natural Pozzolan

(1) Natural pozzolan may be used in the mix design. When pozzolan is used as a partial replacement for cement, the replacement rate shall be determined from laboratory trial mixes, and shall be between 20 and 30 percent by weight of the total cementitious material. If pozzolan is used in conjunction with slag cement the maximum replacement rate shall not exceed 10 percent by weight of total cementitious material.

501.3.6 Admixtures

501.3.6.1 Air-Entraining Admixtures

(1) Air-entraining admixture are to be added in such a manner that will ensure uniform distribution of the agent throughout the batch. The air content of freshly mixed air-entrained concrete shall be based upon trial mixes with the materials to be used in the work adjusted to produce concrete of the required plasticity and workability. Air content shall be based upon the maximum aggregate size in the mix design in accordance with Table 501.3.6. Air content shall be determined by testing in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag and other highly porous coarse aggregate.

Table 501.3.6

Air Content (Percent)

Maximum Size Aggregate				
2 inch	1-1/2 inch	1 inch	3/4 inch	1/2 inch
5.0%	5.5%	6.0%	6.0%	7.0%

501.3.6.2 Water-Reducing Admixtures

(1) Water-reducing admixtures shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements. Tests shall be conducted on trial mixes, with the materials to be used in the work, in accordance with ASTM C494.

501.3.6.3 Other Admixtures

(1) Set controlling, and other approved admixtures shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements. Tests shall be conducted with the materials to be used in the work, in accordance with ASTM C 494.

501.3.6.4 Lithium Nitrate

(1) Lithium nitrate shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements in accordance with 501.2.10.4.

501.4 Construction Methods

501.4.1 Control Strip

(1) The control strip(s) shall be to the next planned joint after the initial 250 feet of each type of pavement construction (slip-form pilot lane, slip-form fill-in lane, or fixed form). Contractor shall demonstrate, in the presence of the Engineer, that the materials, concrete mix, equipment, and construction processes, and quality control processes meet the requirements of the specifications. The concrete mixture shall be extruded from the paver meeting the edge slump tolerance and with little or no finishing. Pilot, fill-in, and fixed-form control strips will be accepted separately. Minor adjustments to the mix design may be required to place an acceptable control strip. The production mix will be the adjusted mix design used to place the acceptable control strip. Upon acceptance of the control strip by Engineer, Contractor shall use the same equipment, materials, and construction methods for the remainder of concrete paving. Adjustments to processes or materials must be approved in advance by Engineer Acceptable control strips will meet edge slump tolerance and surface acceptable with little or no finishing, air content within action limits, strength equal or greater than requirements of 501.3.3. The control strip will be considered one lot for payment (no sublots required for control strip). Payment will only be made for an acceptable control strip in accordance with 501.8.1 using a lot pay factor equal to 100.

501.4.2 Equipment

(1) Contractor is responsible for the proper operation and maintenance of all equipment necessary for handling materials and performing all parts of the work to meet this specification.

501.4.2.1 Plant and Equipment

(1) The plant and mixing equipment shall conform to the requirements of ASTM C94 and/or ASTM C685. Each truck mixer shall have attached in a prominent place a manufacturer's nameplate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades. The truck mixers shall be examined daily for changes in condition due to accumulation of hard concrete or mortar or wear of blades. The pickup and throw-over blades shall be replaced when they have worn down 3/4 inch or more. The Contractor shall have a copy of the manufacturer's design on hand showing dimensions and arrangement of blades in reference to original height and depth.

(2) Equipment for transferring and spreading concrete from the transporting equipment to the paving lane in front of the finishing equipment shall be provided. The equipment shall be specially manufactured, self-propelled transfer equipment which will accept the concrete outside the paving lane and will spread it evenly across the paving lane in front of the paver and strike off the surface evenly to a depth which permits the paver to operate efficiently.

501.4.2.2 Finishing Equipment

(1) Slip-form. The standard method of constructing concrete pavements shall be with an approved slip-form paving equipment designed and operated to spread, consolidate, screed, and finish the freshly placed concrete in one complete pass of the machine so that the end result is a dense and homogeneous pavement which is achieved with a minimum of hand finishing. The paver-finisher shall be a heavy duty, self-propelled machine designed specifically for paving and finishing high quality concrete pavements.

(2) Fixed-form. On projects requiring less than 10,000 cubic yards of PCC pavement, or irregular areas at locations inaccessible to slip-form paving equipment, concrete pavement may be placed with equipment specifically designed for placement and finishing using stationary side forms. Methods and equipment shall be reviewed and accepted by the Engineer. Hand screeding and float finishing may only be used on small irregular areas as allowed by the Engineer.

501.4.2.3 Vibrators

(1) Vibrator shall be the internal type. The rate of vibration of each vibrating unit shall be sufficient to consolidate the pavement without segregation or voids. The number, spacing, and frequency shall be as necessary to provide a dense and homogeneous pavement and meet the recommendations of American Concrete Institute (ACI) 309R, Guide for Consolidation of Concrete. Adequate power to operate all vibrators shall be available on the paver. The vibrators shall be automatically controlled so that they shall be stopped as forward motion ceases. The Contractor shall provide an electronic or mechanical means to monitor vibrator status. The checks on vibrator status shall occur a minimum of two times per day or when requested by the Engineer.

(3) Hand held vibrators may be used in irregular areas and shall meet the recommendations of ACI 309R, Guide for Consolidation of Concrete.

501.4.2.4 Concrete Saws

(1) The Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing to the required dimensions. Contractor shall provide at least one standby saw in good working order and a supply of saw blades at the site of the work at all times during sawing operations.

501.4.2.5 Fixed Forms

(1) Straight side fixed forms shall be made of steel and shall be furnished in sections not less than 10 feet in length. Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms with battered top surfaces and bent, twisted or broken forms shall not be used. Built-up forms shall not be used, except as approved by the Engineer. The top face of the form shall not vary from a true plane more than 1/8 inch in 10 feet, and the upstanding leg shall not vary more than 1/4 inch. The forms shall contain provisions for locking the ends of abutting sections together tightly for secure setting. Wood forms may be used under special conditions, when approved by Engineer. The forms shall extend the full depth of the pavement section.

501.4.3 Form Setting

(1) Forms shall be set to line and grade as shown on the Plans, sufficiently in advance of the concrete placement, to ensure continuous paving operation. Forms shall be set to withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms shall be cleaned and oiled prior to the concrete placement.

501.4.4 Base Surface Preparation Prior to Placement

(1) The compacted underlying surface on which the pavement will be constructed the width shown on the Plans. After the underlying surface has been placed and compacted to the required density, the areas that will support the paving machine and the area to be paved shall be trimmed or graded to the plan grade elevation and profile by means of a properly designed machine. Damage to the prepared base, subbase, and subgrade shall be corrected full depth by the Contractor. If traffic is allowed to use the prepared grade, the grade shall be checked and corrected immediately before the placement of concrete. The prepared grade shall be moistened with water, without saturating, immediately ahead of concrete placement to prevent rapid loss of moisture from concrete. The underlying surface shall be protected so that it will be entirely free of frost when concrete is placed. Damage to the prepared base, subbase, and subgrade shall be corrected full depth by the Contractor prior to concrete placement. The underlying surface shall be entirely free of frost when concrete is placed. The prepared grade shall be moistened with water, without saturating, immediately ahead of concrete placement to prevent rapid loss of moisture from concrete.

501.4.5 Handling, Measuring, And Batching Material

(1) Aggregate stockpiles shall be constructed and managed in such a manner that prevents segregation and intermixing of deleterious materials. Aggregates from different sources shall be stockpiled, weighed and batched separately at the concrete batch plant. Aggregates that have become segregated or mixed with earth or foreign material shall not be used. All aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or binned for draining at least 12 hours before being batched. Store and maintain all aggregates at a uniform moisture content prior to use A continuous supply of materials shall be provided to the work to ensure continuous placement.

501.4.6 Mixing Concrete

(1) The concrete may be mixed at the work site, in a central mix plant or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials are placed

into the drum until the drum is emptied into the truck. All concrete shall be mixed and delivered to the site in accordance with the requirements of ASTM C94 or ASTM C685.

(2) Mixed concrete from the central mixing plant shall be transported in truck mixers, truck agitators, or non-agitating trucks. The elapsed time from the addition of cementitious material to the mix until the concrete is discharged from the truck should not exceed 30 minutes when the concrete is hauled in non-agitating trucks, nor 90 minutes when the concrete is hauled in truck mixers or truck agitators. In no case shall the temperature of the concrete when placed exceed 90 degrees Fahrenheit. Retempering concrete by adding water or by other means will not be permitted. With transit mixers additional water may be added to the batch materials and additional mixing performed to increase the slump to meet the specified requirements provided the addition of water is performed within 45 minutes after the initial mixing operations and provided the water/cementitious ratio specified in the approved mix design is not exceeded.

501.4.7 Limitations on Mixing and Placing

(1) No concrete shall be mixed, placed, or finished when the natural light is insufficient, unless an adequate and approved artificial lighting system is operated.

501.4.7.1 Cold Weather

(1) Unless authorized in writing by the Engineer, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40°F and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F.

(2) The aggregate shall be free of ice, snow, and frozen lumps before entering the mixer. The temperature of the mixed concrete shall not be less than 50°F at the time of placement. Concrete shall not be placed on frozen material nor shall frozen aggregates be used in the concrete.

(3) When concreting is authorized during cold weather, water and/or the aggregates may be heated to not more than 150°F. The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might be detrimental to the materials.

(4) Curing during cold weather shall be in accordance with 501.4.13.4.

501.4.7.2 Hot Weather

(1) During periods of hot weather when the maximum daily air temperature exceeds 85°F, the following precautions shall be taken.

(2) The forms and the underlying surface shall be sprinkled with water immediately before placing the concrete. The concrete shall be placed at the coolest temperature practicable, and in no case shall the temperature of the concrete when placed exceed 90°F. The aggregates and/or mixing water shall be cooled as necessary to maintain the concrete temperature at or not more than the specified maximum.

(3) The concrete placement shall be protected from exceeding an evaporation rate in excess of 0.2 pound per square foot per hour. When conditions are such that problems with plastic cracking can be expected, and particularly if plastic cracking begins to occur, the Contractor shall immediately take such additional measures as necessary to protect the concrete surface. Such measures shall consist of wind screens, more effective fog sprays, and similar measures commencing immediately behind the paver. If the Contractor's measures are not effective in preventing plastic cracking, paving operations shall be immediately stopped.

(4) Curing during hot weather shall be in accordance with 501.4.13.5.

501.4.7.3 Temperature Management Program

(1) Prior to the start of paving operation for each day of paving, the Contractor shall provide the Engineer with a Temperature Management Program for the concrete to be placed to assure that uncontrolled cracking is avoided. (Federal Highway Administration HIPERPAV 3 is one example of a temperature management program.) As a minimum the program shall address the following items:

a. Anticipated tensile strains in the fresh concrete as related to heating and cooling of the concrete material.
b. Anticipated weather conditions such as ambient temperatures, wind velocity, and relative humidity; and anticipated evaporation rate using Figure 19-9, PCA, Design and Control of Concrete Mixtures.
c. Anticipated timing of initial sawing of joint.
d. Anticipated number and type of saws to be used.

501.4.7.4 Rain

(1) Contractor shall have available materials for the protection of the concrete during inclement weather. Such protective materials shall consist of rolled polyethylene sheeting at least 4 mils thick of sufficient

length and width to cover the plastic concrete slab and any edges. The sheeting may be mounted on either the paver or a separate movable bridge from which it can be unrolled without dragging over the plastic concrete surface. When rain appears imminent, all paving operations shall stop and all available personnel shall begin covering the surface of the unhardened concrete with the protective covering.

501.4.8 Concrete Placement

(1) At any point during concrete conveyance, the free vertical drop of the concrete from one point to another or to the underlying surface shall not exceed three feet. The finished concrete product must be dense and homogeneous, without segregation and conforming to the standards in this specification. Backhoes and grading equipment shall not be used to distribute the concrete in front of the paver. Front end loaders will not be used. All concrete shall be consolidated without voids or segregation, including under and around all load-transfer devices, joint assembly units, and other features embedded in the pavement. Hauling equipment or other mechanical equipment can be permitted on adjoining previously constructed pavement when the concrete strength reaches a flexural strength of 450 psi or a compressive strength of 2500 psi; based on the average of four field cured specimens per 2,000 cubic yards of concrete placed. Contractor must determine that the above minimum strengths are adequate to protect the pavement from overloads due to the construction equipment proposed for the project.

(2) Contractor shall have available materials for the protection of the concrete during cold, hot and/or inclement weather in accordance with 501.4.7.

501.4.8.1 Slip-form Construction

(1) The concrete shall be distributed uniformly into final position by a self-propelled slip-form paver without delay. The alignment and elevation of the paver shall be regulated from outside reference lines established for this purpose. The paver shall vibrate the concrete for the full width and depth of the strip of pavement being placed and the vibration shall be adequate to provide a consistency of concrete that will stand normal to the surface with sharp well defined edges. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms. The plastic concrete shall be effectively consolidated by internal vibration with transverse vibrating units for the full width of the pavement and/or a series of equally placed longitudinal vibrating units. The space from the outer edge of the pavement to longitudinal unit shall not exceed 9 inches for slip-form and at the end of the dowels for the fill-in lanes Spacing of internal units shall be uniform and shall not exceed 18 inches.

(2) The term internal vibration means vibrating units located within the specified thickness of pavement section.

(3) The rate of vibration of each vibrating unit shall be sufficient to consolidate the pavement without, segregation, voids, or vibrator trails and the amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete along the entire length of the vibrating unit and for a distance of at least one foot. The frequency of vibration or amplitude should be adjusted proportionately with the rate of travel to result in a uniform density and air content. The paving machine shall be equipped with a tachometer or other suitable device for measuring and indicating the actual frequency of vibrations.

(4) The concrete shall be held at a uniform consistency. The slip-form paver shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering, and spreading concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. If for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

(5) When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement shall be equipped with protective pads on crawler tracks or rubber-tired wheels on which the bearing surface is offset to run a sufficient distance from the edge of the pavement to avoid breaking the pavement edge.

(6) Not more than 15 percent of the total free edge of each 500 foot segment of pavement, or fraction thereof, shall have an edge slump exceeding 1/4 inch, and none of the free edge of the pavement shall have an edge slump exceeding 3/8 inch. (The total free edge of 500 feet of pavement will be considered the cumulative total linear measurement of pavement edge originally constructed as nonadjacent to existing pavement; that is, 500 feet of paving lane originally constructed as a separate lane will have 1,000 feet of free edge, 500 feet of fill-in lane will have no free edge, etc.). The area affected by the downward movement of the concrete along the pavement edge shall be limited to not more than 18 inches from the edge.

(7) When excessive edge slump cannot be corrected before the concrete has hardened, the area with excessive edge slump will be removed the full width of the slip form lane and replaced at the expense of the Contractor as directed by the Engineer.

501.4.8.2 Fixed-Form Construction

(1) Forms shall be drilled in advance of being placed to line and grade to accommodate tie bars/ dowel bars where these are specified.

(2) Immediately in advance of placing concrete and after all subbase operations are completed, side forms shall be trued and maintained to the required line and grade for a distance sufficient to prevent delay in placing.

(3) Side forms shall remain in place at least 12 hours after the concrete has been placed, and in all cases until the edge of the pavement no longer requires the protection of the forms. Curing compound shall be applied to the concrete immediately after the forms have been removed.

(4) Side forms shall be thoroughly cleaned and coated with a release agent each time they are used and before concrete is placed against them.

(5) Concrete shall be spread, screeded, shaped and consolidated by one or more self-propelled machines. These machines shall uniformly distribute and consolidate concrete without segregation so that the completed pavement will conform to the required cross-section with a minimum of handwork.

(6) The number and capacity of machines furnished shall be adequate to perform the work required at a rate equal to that of concrete delivery. The equipment must be specifically designed for placement and finishing using stationary side forms. Methods and equipment shall be reviewed and accepted by the Engineer.

(7) Concrete for the full paving width shall be effectively consolidated by internal vibrators. The rate of vibration of each vibrating unit shall be sufficient to consolidate the pavement without segregation, voids, or leaving vibrator trails.

(8) Power to vibrators shall be connected so that vibration ceases when forward or backward motion of the machine is stopped.

501.4.8.3 Consolidation

(1) Concrete shall be consolidated with the specified type of lane-spanning, gang-mounted, mechanical, immersion type vibrating equipment mounted in front of the paver, supplemented, in rare instances as specified, by hand-operated vibrators. The vibrators shall be inserted into the concrete to a depth that will provide the best full-depth consolidation but not closer to the underlying material than 2 inches. Vibrators shall not be used to transport or spread the concrete. For each paving train, at least one additional vibrator spud, or sufficient parts for rapid replacement and repair of vibrators shall be maintained at the paving site at all times. Evidence of inadequate consolidation (honeycomb along the edges, large air pockets, or any other evidence) or over-consolidation (vibrator trails, segregation, or other evidence) shall require the immediate stopping of the paving operation and adjustment of the equipment or procedures as approved by the Engineer.

(2) If a lack of consolidation of the concrete is suspected by the Engineer, referee testing may be required. Referee testing of hardened concrete will be performed by the Engineer by cutting cores from the finished pavement after a minimum of 24 hours curing. The Engineer shall visually examine the cores for evidence of lack of consolidation. Density determinations will be made by the Engineer based on the water content of the core as taken. ASTM C642 shall be used for the determination of core density in the saturated-surface dry condition. When required, referee cores will be taken at the minimum rate of one for each 500 cubic yards of pavement, or fraction. The Contractor shall be responsible for cores: and for all referee testing cost if they fail to meet the required density.

(3) The average density of the cores shall be at least 97 percent of the original mix design density, with no cores having a density of less than 96 percent of the original mix design density. Failure to meet the referee tests will be considered evidence that the minimum requirements for vibration are inadequate for the job conditions. Additional vibrating units or other means of increasing the effect of vibration shall be employed so that the density of the hardened concrete conforms to the above requirements.

501.4.9 Strike-Off of Concrete and Placement of Reinforcement

(1) Following the placing of the concrete, it shall be struck off to conform to the cross-section shown on the Plans and to an elevation that when the concrete is properly consolidated and finished, the surface of the pavement shall be at the elevation shown on the Plans. When reinforced concrete pavement is placed in two layers, the bottom layer shall be struck off to such length and depth that the sheet of reinforcing steel fabric or bar mat may be laid full length on the concrete in its final position without

further manipulation. The reinforcement shall then be placed directly upon the concrete, after which the top layer of the concrete shall be placed, struck off, and screeded. Portions of the bottom layer of concrete has been placed more than 30 minutes without being covered with the top layer or if initial set has taken place, it shall be removed and replaced with freshly mixed concrete at the Contractor's expense. When reinforced concrete is placed in one layer, the reinforcement may be positioned in advance of concrete placement or it may be placed in plastic concrete by mechanical or vibratory means after spreading.

(2) Reinforcing steel, at the time concrete is placed, shall be free of mud, oil, or other organic matter that may adversely affect or reduce bond. Reinforcing steel with rust, mill scale or a combination of both will be considered satisfactory, provided the minimum dimensions, weight, and tensile properties of a hand wire-brushed test specimen are not less than the applicable ASTM specification requirements.

501.4.10 Joints

(1) Joints shall be constructed as shown on the Plans and in accordance with these requirements. All joints shall be constructed with their faces perpendicular to the surface of the pavement and finished or edged as shown on the Plans. Joints shall not vary more than 1/2 inch from their designated position and shall be true to line with not more than 1/4 inch variation in 10 feet. The surface across the joints shall be tested with a 12 feet straightedge as the joints are finished and any irregularities in excess of 1/4 inch shall be corrected before the concrete has hardened. All joints shall be so prepared, finished, or cut to provide a groove of uniform width and depth as shown on the Plans.

501.4.10.1 Construction

(1) Longitudinal construction joints shall be slip-formed or formed against side forms as shown in the Plans.

(2) Transverse construction joints shall be installed at the end of each day's placing operations and at other points within a paving lane when concrete placement is interrupted for more than 30 minutes or it appears that the concrete will obtain its initial set before fresh concrete arrives. The installation of the joint shall be located at a planned contraction or expansion joint. If placing of the concrete is stopped, the Contractor shall remove the excess concrete back to the previous planned joint.

501.4.10.2 Contraction

(1) Contraction joints shall be installed at the locations and spacing as shown on the Plans. Contraction joints shall be installed to the dimensions required by forming a groove or cleft in the top of the slab while the concrete is still plastic or by sawing a groove into the concrete surface after the concrete has hardened. When the groove is formed in plastic concrete the sides of the grooves shall be finished even and smooth with an edging tool. If an insert material is used, the installation and edge finish shall be according to the manufacturer's instructions. The groove shall be finished or cut clean so that spalling will be avoided at intersections with other joints. Grooving or sawing shall produce a slot at least 1/8 inch wide and to the depth shown on the Plans.

501.4.10.3 Isolation (expansion)

(1) Isolation joints shall be installed as shown on the Plans. The pre-molded filler of the thickness as shown on the Plans, shall extend for the full depth and width of the slab at the joint, except for space for sealant at the top of the slab. The filler shall be fastened uniformly along the hardened joint face with no buckling or debris between the filler and the concrete interface, including a temporary filler for the sealant reservoir at the top of the slab. The edges of the joint shall be finished and tooled while the concrete is still plastic.

501.4.10.4 Dowels and Tie Bars for Joints

(1) Tie bars shall consist of deformed bars installed in joints as shown on the Plans. Tie bars shall be placed at right angles to the centerline of the concrete slab and shall be spaced at intervals shown on the Plans. They shall be held in position parallel to the pavement surface and in the middle of the slab depth and within the tolerances in 501.4.10.6. When tie bars extend into an unpaved lane, they may be bent against the form at longitudinal construction joints, unless threaded bolt or other assembled tie bars are specified. Tie bars shall not be painted, greased, or enclosed in sleeves. When slip-form operations call for tie bars, two-piece hook bolts can be installed.

501.4.10.5 Dowel Bars

(1) Dowel bars shall be placed across joints in the proper horizontal and vertical alignment as shown on the plans. The dowels shall be coated with a bond-breaker or other lubricant recommended by the manufacturer and approved by Engineer. Dowels bars at longitudinal construction joints shall be bonded in drilled holes.

501.4.10.6 Placing Dowels and Tie Bars

(1) Horizontal spacing of dowels shall be within a tolerance of ±3/4 inch. The vertical location on the face of the slab shall be within a tolerance of plus or minus 1/2 inch. The method used to install dowels shall ensure that the horizontal and vertical alignment will not be greater than 1/4 inch per feet, except for those across the crown or other grade change joints. Dowels across crowns and other joints at grade changes shall be measured to a level surface. Horizontal alignment shall be checked perpendicular to the joint edge. The portion of each dowel intended to move within the concrete or expansion cap shall be wiped clean and coated with a thin, even film of lubricating oil or light grease before the concrete is placed. Dowels shall be installed as specified in the following subparagraphs.

501.4.10.6.1 Contraction Joints

(1) Dowels and tie bars in longitudinal and transverse contraction joints within the paving lane shall be held securely in place by means of rigid metal frames or basket assemblies of an approved type. The basket assemblies shall be held securely in the proper location by means of suitable pins or anchors. Do not cut or crimp the dowel basket tie wires.

(2) At the Contractor's option, dowels and tie bars in contraction joints may be installed by insertion into the plastic concrete using approved equipment and procedures per the paver manufacturer's design. Approval of installation methods will be based on the results of the control strip showing that the dowels and tie bars are installed within specified tolerances as verified by cores or non-destructive rebar location devices approved by Engineer.

501.4.10.6.2 Construction Joints

(1) Install dowels and tie bars by the cast-in- place or the drill-and-dowel method. Installation by removing and replacing in preformed holes will not be permitted. Dowels and tie bars shall be prepared and placed across joints where indicated, correctly aligned, and securely held in the proper horizontal and vertical position during placing and finishing operations, by means of devices fastened to the forms.

501.4.10.6.3 Joints in Hardened Concrete

(1) Install dowels in hardened concrete by bonding the dowels into holes drilled into the concrete. The concrete shall have cured for seven days or reached a minimum compressive strength of 3100 psi or flexural strength of 450 psi before drilling commences. Holes 1/8 inch greater in diameter than the dowels shall be drilled into the hardened concrete using rotary-core drills. Rotary-percussion drills may be used, provided that excessive spalling does not occur. Spalling beyond the limits of the grout retention ring will require modification of the equipment and operation. Depth of dowel hole shall be within a tolerance of plus or minus 1/2 inch of the dimension shown on the drawings. On completion of the drilling operation, the dowel hole shall be blown out with oil-free, compressed air. Dowels shall be bonded in the drilled holes using epoxy resin. Epoxy resin shall be injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by coating (buttering) the dowel will not be permitted. The dowels shall be held in alignment at the collar of the hole by means of a suitable metal or plastic grout retention ring fitted around the dowel.

501.4.10.7 Sawing of Joints

(1) Sawing shall commence, without regard to day or night, as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing and before uncontrolled shrinkage cracking of the pavement occurs and shall continue without interruption until all joints have been sawn. All slurry and debris produced in the sawing of joints shall be removed by vacuuming and washing. Curing compound or system shall be reapplied in the initial sawcut and maintained for the remaining cure period.

(2) Joints shall be cut in locations as shown on the plans. The initial joint cut shall be a minimum 1/8 inch wide and to the depth shown on the plans. Prior to placement of joint sealant or seals, the top of the joint shall be widened by sawing as shown on the Plans.

501.4.11 Finishing

(1) Finishing operations shall be a continuing part of placing operations starting immediately behind the strike-off of the paver. Initial finishing shall be provided by the transverse screed or extrusion plate. The sequence of operations shall be transverse finishing, longitudinal machine floating if used, straightedge finishing edging of joints, and then texturing. Finishing shall be by the machine method. The hand method shall be used only on isolated areas of odd slab widths or shapes and in the event of a breakdown of the mechanical finishing equipment. Supplemental hand finishing for machine finished pavement shall be kept to an absolute minimum. Machine finishing operation which requires appreciable hand finishing, other than a moderate amount of straightedge finishing, shall be immediately stopped

and proper adjustments made or the equipment replaced. Equipment mixture, and/or procedures which produce more than 1/4 inch of mortar-rich surface shall be immediately modified as necessary to eliminate this condition or operations shall cease. Compensation shall be made for surging behind the screeds or extrusion plate and settlement during hardening and care shall be taken to ensure that paving and finishing machines are properly adjusted so that the finished surface of the concrete (not just the cutting edges of the screeds) will be at the required line and grade. Finishing equipment and tools shall be maintained clean and in an approved condition. At no time shall water be added to the surface of the slab with the finishing equipment or tools, or in any other way. Fog (mist) sprays or other surface applied finishing aids specified to prevent plastic shrinkage cracking, approved by the Engineer, may be used in accordance with the manufacturers requirements.

501.4.11.1 Machine Finishing with Slip-form Pavers

(1) The slip-form paver shall be operated so that only a very minimum of additional finishing work is required to produce pavement surfaces and edges meeting the specified tolerances. Any equipment or procedure that fails to meet these specified requirements shall immediately be replaced or modified as necessary. A self-propelled non-rotating pipe float may be used while the concrete is still plastic, to remove minor irregularities and score marks. Only one pass of the pipe float shall be allowed. Equipment, mixture, and/or procedures which produce more than 1/4 inch of mortar-rich surface shall be immediately modified as necessary to eliminate this condition or operations shall cease. Excessive slurry should be removed from the surface with a cutting straightedge and wiped off the edge. Slurry which does run down the vertical edges shall be immediately removed by hand, using stiff brushes or scrapers. No slurry, concrete or concrete mortar shall be used to build up along the edges of the pavement to compensate for excessive edge slump, either while the concrete is plastic or after it hardens.

501.4.11.2 Machine Finishing with Fixed Forms

(1) The machine shall be designed to straddle the forms and shall be operated to screed and consolidate the concrete. Machines that cause displacement of the forms shall be replaced. The machine shall make only one pass over each area of pavement. If the equipment and procedures do not produce a surface of uniform texture, true to grade, in one pass, the operation shall be immediately stopped and the equipment, mixture, and procedures adjusted as necessary.

501.4.11.3 Other Types of Finishing Equipment

(1) Clary screeds, other rotating tube floats, or bridge deck finishers are not allowed on mainline paving (full width paving of 100 feet or more), but may be allowed on irregular or odd-shaped slabs, and near buildings or trench drains, subject to the Engineer’s approval.

(2) Bridge deck finishers shall have a minimum operating weight of 7500 pounds and shall have a transversely operating carriage containing a knock-down auger and a minimum of two immersion vibrators. Vibrating screeds or pans shall be used only for isolated slabs where hand finishing is permitted as specified, and only where specifically approved.

501.4.11.4 Hand Finishing

(1) Hand finishing methods will not be permitted, except under the following conditions: (1) in the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade and (2) in areas of narrow widths or of irregular dimensions where operation of the mechanical equipment is impractical.

501.4.11.5 Straightedge Testing and Surface Correction

(1) After the pavement has been struck off and while the concrete is still plastic, it shall be tested for trueness with a Contractor furnished 12-foot finishing straightedge swung from handles capable of spanning at least one-half the width of the slab. The straightedge shall be held in contact with the surface in successive positions parallel to the centerline and the whole area gone over from one side of the slab to the other, as necessary. Advancing shall be in successive stages of not more than one-half the length of the straightedge. Excess water and laitance in excess of 1/8 inch thick shall be removed from the surface of the pavement and wasted. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the smoothness requirements. Straightedge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straightedge and until the slab conforms to the required grade and cross-section. The use of long-handled wood floats shall be confined to a minimum; they may be used only in emergencies and in areas not accessible to finishing equipment.

501.4.12 Surface Texture

(1) The surface of the pavement shall be finished with a artificial turf finish unless a brush or broom finish, or a burlap drag finish is specifically required on the Plans or Special Provisions for all newly constructed concrete pavements. It is important that the texturing equipment not tear or unduly roughen the pavement surface during the operation. The texture shall be uniform in appearance and approximately 1/16 inch in depth. Imperfections resulting from the texturing operation shall be corrected to the satisfaction of the Engineer. Contractor may use the brush and broom finish or the burlap drag finish, unless other methods are specified on the Plans or in the Special Provisions.

501.4.12.1 Brush or Broom Finish

(1) If the pavement surface texture is to be a type of brush or broom finish, it shall be applied when the water sheen has practically disappeared. The equipment shall operate transversely across the pavement surface, providing corrugations that are uniform in appearance and approximately 1/16 inch in depth.

501.4.12.2 Burlap Drag Finish

(1) If a burlap drag is used to texture the pavement surface, burlap at 15 ounces per square yard, will typically produce acceptable texture. To obtain a textured surface, the transverse threads of the burlap shall be removed approximately one foot from the trailing edge. A heavy buildup of grout on the burlap threads produces the desired wide sweeping longitudinal striations on the pavement surface.

501.4.12.3 Artificial Turf Finish

(1) If artificial turf is used to texture the surface, it shall be applied by dragging the surface of the pavement in the direction of concrete placement with an approved full-width drag made with artificial turf. The leading transverse edge of the artificial turf drag will be securely fastened to a lightweight pole on a traveling bridge. At least 2 feet of the artificial turf shall be in contact with the concrete surface during dragging operations. A variety of different types of artificial turf are available and approval of any one type will be done only after it has been demonstrated by the Contractor to provide a satisfactory texture. One type that has provided satisfactory texture consists of 7,200 approximately 0.85 inch-long polyethylene turf blades per square foot. The corrugations shall be uniform in appearance and approximately 1/16 inch in depth.

501.4.13 Curing

(1) Immediately after finishing operations are completed, after bleed water is gone from the surface, and marring of the concrete will not occur, the entire surface of the newly placed concrete shall be cured for a 7-day cure period in accordance with one of the methods below. Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or lack of water to adequately take care of both curing and other requirements, shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than 30 minutes during the curing period.

(2) When a two-sawcut method is used to construct the contraction joint, the curing compound shall be applied to the sawcut immediately after the initial cut has been made. The sealant reservoir shall not be sawed until after the curing period has been completed. When the one cut method is used to construct the contraction joint, the joint shall be cured with wet rope, wet rags, or wet blankets. The rags, ropes, or blankets shall be kept moist for the duration of the curing period.

(3) Use impervious membrane method unless other methods are required on the Plans or in the Special Provisions.

501.4.13.1 Impervious Membrane Method

(1) Curing with liquid membrane compounds should not occur until all bleed and surface moisture has evaporated. The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place. The curing compound shall not be applied during rainfall. Curing compound shall be applied by mechanical sprayers under pressure at the rate of one gallon to not more than 150 sq. ft., or in accordance with manufacturer's recommendation. The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application the compound shall be stirred continuously by mechanical means. Hand spraying of odd widths or shapes and concrete surfaces exposed by the removal of forms will be permitted. When hand spraying is approved by the Engineer, a double application rate shall be used to ensure coverage. The curing compound shall be of such character that the film will harden within 30 minutes after application. Should the film become damaged from any cause, including sawing operations, within the required curing period, the damaged portions shall be repaired immediately with additional compound or other approved

means. Upon removal of side forms, the sides of the exposed slabs shall be protected immediately to provide a curing treatment equal to that provided for the surface. Curing shall be applied immediately after the bleed water is gone from the surface.

501.4.13.2 White Burlap-Polyethylene Sheets

(1) The surface of the pavement shall be entirely covered with the sheeting. The sheeting used shall be such length (or width) that it will extend at least twice the thickness of the pavement beyond the edges of the slab. The sheeting shall be placed so that the entire surface and both edges of the slab are completely covered. The sheeting shall be placed and weighted to remain in contact with the surface covered, and the covering shall be maintained fully saturated and in position for seven days after the concrete has been placed.

501.4.13.3 Water Method

(1) The entire area shall be covered with burlap or other water absorbing material. The material shall be of sufficient thickness to retain water for adequate curing without excessive runoff. The material shall be kept wet at all times and maintained for seven days. When the forms are stripped, the vertical walls shall also be kept moist. It shall be the responsibility of the Contractor to prevent ponding of the curing water on the subbase.

501.4.13.4 Concrete Protection for Cold Weather

(1) The concrete shall be maintained at an ambient temperature of at least 50°F for a period of 72 hours after placing and at a temperature above freezing for the remainder of the seven-day curing time. The Contractor shall be responsible for the quality and strength of the concrete placed during cold weather; and any concrete damaged shall be removed and replaced at the Contractor's expense.

501.4.13.5 Concrete Protection for Hot Weather

(1) Concrete should be continuous moisture cured for the entire curing period and shall commence as soon as the surfaces are finished and continue for at least 24 hours. However, if moisture curing is not practical beyond 24 hours, the concrete surface shall be protected from drying with application of a liquid membrane-forming curing compound while the surfaces are still damp. Other curing methods may be approved by the Engineer.

501.4.14 Removing Forms

(1) Unless otherwise specified, forms shall not be removed from freshly placed concrete until it has hardened sufficiently to permit removal without chipping, spalling, or tearing. After the forms have been removed, the sides of the slab shall be cured as per the methods indicated in 501.4.13.

(2) If honeycombed areas are evident when the forms are removed, materials, placement, and consolidation methods must be reviewed and appropriate adjustments made to assure adequate consolidation at the edges of future concrete placements. Honeycombed areas that extend into the slab less than approximately one inch, shall be repaired with an approved grout, as directed by the Engineer. Honeycombed areas that extend into the slab greater than a depth of one inch shall be considered as defective work and shall be removed and replaced in accordance with 501.4.19.

501.4.15 Saw-Cut Grooving

(1) If shown on the Plans, grooved surfaces shall be provided in accordance with the requirements of Specification P621.

501.4.16 Sealing Joints

(1) The joints in the pavement shall be sealed in accordance with Specification P605.

501.4.17 Protection of Pavement

(1) Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by the Contractor's employees and agents until accepted by the Engineer. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges, crossovers, and protection of unsealed joints from intrusion of foreign material. Damage to the pavement occurring prior to final acceptance shall be repaired or the pavement replaced at the Contractor's expense.

(2) Aggregates, rubble, or other similar construction materials shall not be placed on airfield pavements. Traffic shall be excluded from the new pavement by erecting and maintaining barricades and signs until the concrete is at least seven days old, or for a longer period if required.

(3) In paving intermediate lanes between newly paved pilot lanes, operation of the hauling and paving equipment will be permitted on the new pavement after the pavement has been cured for seven (7) days and the joints have been sealed or otherwise protected, and the concrete has attained a minimum field cured flexural strength of [450 psi], and the slab edge is protected.

(4) All new and existing pavement carrying construction traffic or equipment shall be continuously kept completely clean, and spillage of concrete or other materials shall be cleaned up immediately.

(5) Damaged pavements shall be removed and replaced at the Contractor's expense. Slabs shall be removed to the full depth, width, and length of the slab.

501.4.18 Opening to Construction Traffic

(1) Pavement shall not be opened to traffic until test specimens molded and cured in accordance with ASTM C31 have attained a flexural strength of [450 lb./square-inch] when tested in accordance with ASTM C78. If such tests are not conducted, the pavement shall not be opened to traffic until 14 days after the concrete was placed. Prior to opening the pavement to construction traffic, all joints shall either be sealed or protected from damage to the joint edge and intrusion of foreign materials into the joint. As a minimum, backer rod or tape may be used to protect the joints from foreign matter intrusion.

501.4.19 Repair, Removal, or Replacement of Slabs

501.4.19.1 General

(1) New pavement slabs that are broken or contain cracks or are otherwise defective or unacceptable, as defined by acceptance criteria in 501.6.2, shall be removed and replaced or repaired, as directed by the Engineer and as specified hereinafter at no cost to the Owner. Spalls along joints shall be repaired as specified. Removal of partial slabs is not permitted. Removal and replacement shall be full depth, shall be full width of the slab, and the limit of removal shall be normal to the paving lane and to each original transverse joint. The Engineer will determine whether cracks extend full depth of the pavement and may require cores to be drilled on the crack to determine depth of cracking. Such cores shall be two inches to four inches diameter, shall be drilled by the Contractor and shall be filled by the Contractor with a well consolidated concrete mixture bonded to the walls of the hole with a bonding agent, using approved procedures. Drilling of cores and refilling holes shall be at no expense to the Owner. Repair of cracks as described in this section shall not be allowed if in the opinion of the Engineer the overall condition of the pavement indicates that such repair is unlikely to achieve an acceptable and durable finished pavement. No repair of cracks shall be allowed in any panel that demonstrates segregated aggregate with an absence of coarse aggregate in the upper 1/8 inch of the pavement surface.

501.4.19.2 Shrinkage Cracks

(1) Shrinkage cracks which do not exceed one-third of the pavement depth shall be cleaned and either high molecular weight methacrylate (HMWM) applied; or epoxy resin (Type IV, Grade 1) pressure injected using procedures recommended by the manufacturer and approved by the 1Engineer. Sandblasting of the surface may be required following the application of HMWM to restore skid resistance. Care shall be taken to ensure that the crack is not widened during epoxy resin injection. All epoxy resin injection shall take place in the presence of the Engineer. Shrinkage cracks which exceed one-third the pavement depth shall be treated as full depth cracks in accordance with 501.4.19.3 and 501.4.19.4.

501.4.19.3 Slabs with Cracks through Interior Areas

(1) Interior area is defined as that area more than 6 inches from either adjacent original transverse joint. The full slab shall be removed and replaced at no cost to the Owner, when there are any full depth cracks, or cracks greater than one-third the pavement depth, that extend into the interior area.

501.4.19.4 Cracks Close to and Parallel to Joints

(1) All full depth cracks within six inches either side of the joint and essentially parallel to the original joints, shall be treated as follows.

501.4.19.4.1 Full Depth Cracks and Original Joint Not Cracked

(1) The full-depth crack shall be treated as the new joint and the original joint filled with an epoxy resin.

501.4.19.4.1.1 Full-depth crack.

(1) The joint sealant reservoir for the crack shall be formed by sawing to a depth of 3/4 inches, plus or minus 1/16 inch, and to a width of 5/8 inch, plus or minus 1/8 inch. The crack shall be sawed with equipment specially designed to follow random cracks. Equipment or procedure which causes raveling or spalling along the crack shall be modified or replaced to prevent raveling or spalling. The joint shall be sealed with sealant in accordance with P605 or as directed by Engineer.

501.4.19.4.1.2 Original joint.

(1) If the original joint sealant reservoir has been sawed out, the reservoir and as much of the lower saw cut as possible shall be filled with epoxy resin, Type IV, Grade 2, thoroughly tooled into the void using approved procedures.

(2) If only the original narrow saw cut has been made, it shall be cleaned and pressure injected with epoxy resin, Type IV, Grade 1, using approved procedures.

(3) Where a parallel crack goes part way across paving lane and then intersects and follows the original joint which is cracked only for the remained of the width, it shall be treated as specified above for a parallel crack, and the cracked original joint shall be prepared and sealed as originally designed.

501.4.19.4.2 Full Depth Cracks and Original Cracked

(1) If there is any place in the lane width where a parallel crack and a cracked portion of the original joint overlap, the entire slab containing the crack shall be removed and replaced.

501.4.19.5 Removal and Replacement of Full Slabs

(1) Make a full depth cut perpendicular to the slab surface along all edges of the slab with a concrete saw cutting any dowels or tie-bars. Remove damaged slab protecting adjacent pavement from damage. Damage to adjacent slabs may result in removal of additional slabs as directed by Engineer at the Contractor's expense.

(2) The underlying material shall be repaired, re-compacted and shaped to grade.

(3) Dowels of the size and spacing specified for other joints in similar pavement on the project shall be installed along all four edges of the new slab in accordance with 501.4.10.4.

(4) Placement of concrete shall be as specified for original construction. The joints around the new slab shall be prepared and sealed as specified for original construction.

501.4.19.6 Spalls Along Joints

(1) Spalls less than one inch wide and less than the depth of the joint sealant reservoir, shall be filled with joint sealant material.

(2) Spalls larger than one inch and/or deeper than the joint reservoir, but less than ½ the slab depth, and less than 25% of the length of the adjacent joint shall be repaired as follows:

a. Make a vertical saw cut at least one inch outside the spalled area and to a depth of at least two inches. Saw cuts shall be straight lines forming rectangular areas surrounding the spalled area.

b. Remove unsound concrete and at least 1/2 inch of visually sound concrete between the saw cut and the joint or crack with a light chipping hammer.

c. Clean cavity with high-pressure water jets supplemented with compressed air as needed to remove all loose material.

d. Apply a prime coat of epoxy resin, Type III, Grade I, to the dry, cleaned surface of all sides and bottom of the cavity, except any joint face.

e. Fill the cavity with low slump concrete or mortar or with epoxy resin concrete or mortar.

f. An insert or other bond-breaking medium shall be used to prevent bond at all joint faces.

g. A reservoir for the joint sealant shall be sawed to the dimensions required for other joints, or as required to be routed for cracks. The reservoir shall be thoroughly cleaned and sealed with the sealer specified for the joints.

(3) Spalls deeper than 1/2 of the slab depth or spalls longer than 25 percent of the adjacent joint require replacement of the entire slab.

501.4.19.7 Diamond Grinding of PCC Surfaces

(1) Diamond grinding shall be completed prior to pavement grooving. Diamond grinding of the hardened concrete should not be performed until the concrete is at least 14 days old and has achieved full minimum strength. Equipment that causes ravels, aggregate fractures, spalls or disturbance to the joints will not be permitted. The depth of diamond grinding shall not exceed 1/2 inch and all areas in which diamond grinding has been performed will be subject to the final pavement thickness tolerances specified.

(2) Diamond grinding shall be performed with a machine specifically designed for diamond grinding capable of cutting a path at least three feet wide. The saw blades shall be 1/8-inch wide with sufficient number of flush cut blades that create grooves between 0.090 and 0.130 inches wide; and peaks and ridges approximately 1/32 inch higher than the bottom of the grinding cut. Contractor shall determine the number and type of blades based on the hardness of the aggregate. Contractor shall demonstrate to Engineer that the grinding equipment will produce satisfactory results prior to making corrections to surfaces.

(3) Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The slurry resulting from the grinding operation shall be continuously removed and the pavement left in a clean condition. All grinding shall be at the expense of the Contractor.

501.4.20 Existing Concrete Pavement Removal and Repair

(1) All operations shall be carefully controlled to prevent damage to the concrete pavement and to the underlying material to remain in place. All saw cuts shall be made perpendicular to the slab surface.

501.4.20.1 Removal of Existing Pavement Slab.

(1) When it is necessary to remove existing concrete pavement and leave adjacent concrete in place, the joint between the removal area and adjoining pavement to stay in place, including dowels or tie bars, shall first be cut full depth with a standard diamond-type concrete saw. Dowels of the size and spacing indicated shall be installed as shown on the drawings by epoxy resin bonding them in holes drilled in the joint face as specified in 501.4.10.7 All this work shall be at no additional cost to the Owner.

(2) Areas or sections of concrete that is removed and replaced shall be removed and replaced back to planned joints. The Contractor shall replace damaged dowels and the requirements for doweled longitudinal construction joints in 501.4.10 shall apply to all contraction joints exposed by concrete removal. Removal and replacement shall be in accordance with 501.4.20.

501.4.20.2 Edge Repair.

(1) The edge of existing concrete pavement against which new pavement abuts shall be protected from damage at all times. Areas that are damaged during construction shall be repaired at no cost to the Owner.

501.4.20.2.1 Spall Repair

(1) Spalls shall be repaired where indicated and where directed by the Engineer. Repair materials and procedures shall be as previously specified in 501.4.19.6.

501.4.20.2.2 Under-break Repair

(1) All under-break shall be repaired. First, all delaminated and loose material shall be carefully removed. Next, the underlying material shall be re-compacted, without addition of any new material. Finally, the void shall be completely filled with concrete, thoroughly consolidated. Care shall be taken to produce an even joint face from top to bottom. Prior to placing concrete, the underlying material shall be thoroughly moistened. After placement, the exposed surface shall be heavily coated with curing compound.

501.4.20.2.3 Underlying Material

(1) The underlying material adjacent to the edge and under the existing pavement which is to remain in place shall be protected from damage or disturbance during removal operations and until placement of new concrete, and shall be shaped as shown on the drawings or as directed. Sufficient material shall be kept in place outside the joint line to prevent disturbance (or sloughing) of material under the pavement that is to remain in place. Material under the portion of the concrete pavement to remain in place, which is disturbed or loses its compaction shall be carefully removed and replaced with concrete as specified in 501.4.20.2.2 The underlying material outside the joint line shall be thoroughly compacted and moist when new concrete is placed.

501.5 Contractor Quality Control

501.5.1 Quality Control Program

(1) Contractor shall develop a Quality Control Program in accordance with Section 100 of the General Provisions. No partial payment will be made for materials that are subject to specific quality control requirements without an approved quality control program.

501.5.2 Contractor Quality Control (CQC)

(1) The Contractor shall provide or contract for testing facilities in accordance with Section 100. The Engineer shall be permitted unrestricted access to inspect the Contractor's QC facilities and witness QC activities. The Engineer will advise the Contractor in writing of any noted deficiencies concerning the QC facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting the test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

501.5.3 Contractor Quality Control Testing

(1) Contractor shall perform all quality control tests necessary to control the production and construction processes applicable to this specification and as set forth in the Quality Control Program. The testing program shall include, but not necessarily be limited to, tests for aggregate gradation, aggregate moisture content, slump, and air content. A QC Testing Plan shall be developed and approved by the Engineer as part of the CQCP.

(2) The Engineer may at any time, notwithstanding previous plant acceptance, reject and require the Contractor to dispose of any batch of concrete mixture which is rendered unfit for use due to contamination, segregation, or improper slump. Such rejection may be based on only visual inspection. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the Engineer, and if it can be demonstrated in the laboratory, in the presence of the Engineer, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

501.5.3.1 Fine Aggregate

501.5.3.1.1 Gradation

(1) A sieve analysis shall be made at least twice daily in accordance with ASTM C136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

501.5.3.1.2 Moisture Content

(1) If an electric moisture meter is used, at least two direct measurements of moisture content shall be made per week to check the calibration. If direct measurements are made in lieu of using an electric meter, two tests shall be made per day. Tests shall be made in accordance with ASTM C70 or ASTM C566.

501.5.3.1.3 Deleterious Substances

(1) Fine aggregate as delivered to the mixer shall be tested for deleterious substances in fine aggregate for concrete as specified in 501.2.1.2, prior to production of the control strip, and a minimum of every 30-days during production or more frequently as necessary to control deleterious substances.

501.5.3.2 Coarse Aggregate

501.5.3.2.1 Gradation

(1) A sieve analysis shall be made at least twice daily for each size of aggregate. Tests shall be made in accordance with ASTM C136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

501.5.3.2.2 Moisture Content

(1) If an electric moisture meter is used, at least two direct measurements of moisture content shall be made per week to check the calibration. If direct measurements are made in lieu of using an electric meter, two tests shall be made per day. Tests shall be made in accordance with ASTM C566.

501.5.3.2.3 Deleterious Substances

(1) Coarse aggregate as delivered to the mixer shall be tested for deleterious substances in coarse aggregate for concrete as specified in 501.2.1.3, prior to production of the control strip, and a minimum of every 30-days during production or more frequently as necessary to control deleterious substances.

501.5.3.3 Slump

(1) One test shall be made for each sublot. Slump tests shall be performed in accordance with ASTM C143 from material randomly sampled from material discharged from trucks at the paving site. Material samples shall be taken in accordance with ASTM C172.

501.5.3.4 Air Content

(1) One test shall be made for each sublot. Air content tests shall be performed in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag or other porous coarse aggregate, from material randomly sampled from trucks at the paving site. Material samples shall be taken in accordance with ASTM C172.

501.5.3.5 Unit Weight and Yield

(1) One test shall be made for each sublot. Unit weight and yield tests shall be made in accordance with ASTM C138. The samples shall be taken in accordance with ASTM C172 and at the same time as the air content tests.

501.5.3.6 Temperatures

(1) Temperatures shall be checked at least four times per lot at the job site in accordance with ASTM C1064.

501.5.3.7 Smoothness for Contractor Quality Control

(1) Contractor shall perform smoothness testing in transverse and longitudinal directions daily to verify that the construction processes are producing pavement with variances less than ¼ inch in 12 feet, identifying areas that may pond water which could lead to hydroplaning of aircraft. If the smoothness criteria is not met, appropriate changes and corrections to the construction process shall be made by the Contractor before construction continues.

(2) Contractor may use a 12-foot straight-edge, a rolling inclinometer meeting the requirements of ASTM E2133 or rolling external reference device that can simulate a 12-foot straightedge approved by Engineer. Straight-edge testing shall start with one-half the length of the straight-edge at the edge of pavement section being tested and then moved ahead one-half the length of the straight-edge for each successive measurement. Testing shall be continuous across all joints. The surface irregularity shall be determined by placing the freestanding (unleveled) straight-edge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straight-edge and the pavement surface in the area between the two high points. If the rolling inclinometer or external reference device is used, the data may be evaluated using either the FAA profile program, ProFAA, or FHWA profile program ProVal, using the 12-foot straight-edge simulation function.

(3) Smoothness readings shall not be made across grade changes or cross slope transitions. The transition between new and existing pavement shall be evaluated separately for conformance with the plans.

a. Transverse measurements. Transverse measurements shall be taken for each day's production placed. Transverse measurements shall be taken perpendicular to the pavement centerline each 50 feet or more often as determined by the Engineer. The joint between lanes shall be tested separately to facilitate smoothness between lanes.

b. Longitudinal measurements. Longitudinal measurements shall be taken for each day's production placed. Longitudinal tests shall be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet; and at the third points of paving lanes when widths of paving lanes are 20 feet or greater. When placement abuts previously placed material the first measurement shall start with one half the length of the straight edge on the previously placed material.

(4) Deviations on the final surface course in either the transverse or longitudinal direction that will trap water greater than 1/4 inch shall be corrected with diamond grinding per 501.4.19.7 or by removing and replacing the surface course to full depth. Grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. All areas in which diamond grinding has been performed shall be subject to the final pavement thickness tolerances specified in 501.6.6.

(5) Control charts shall be kept to show area of each day's placement and the percentage of corrective grinding required. Corrections to production and placement shall be initiated when corrective grinding is required. If the Contractor's machines and/or methods produce significant areas that need corrective actions in excess of 10 percent of a day's production, production shall be stopped until corrective measures are implemented by the Contractor.

501.5.3.8 Grade

(1) Grade will be evaluated prior to and after placement of the concrete surface.

(2) Measurements will be the final finished surface of the pavement will not vary from the gradeline elevations and cross-sections shown on the Plans by more than 1/2 inch vertically and 0.1 feet laterally. The documentation will be provided by the Contractor to the Engineer within 48 hours.

(3) Areas with humps or depression that that exceed grade or smoothness and that retain water on the surface must be ground off provided the course thickness after grinding is not more than 1/2 inch less than the thickness specified on the plans. If these areas cannot be corrected with grinding then the slabs that are retaining water must be removed and replaced in accordance with 501.4.19.5. Grinding shall be in accordance with 501.4.19.7. All corrections will be at the Contractors expense.

501.5.4 Control Charts

(1) The Contractor shall maintain linear control charts for fine and coarse aggregate gradation, slump, moisture content and air content. Contractor shall also maintain a control chart plotting the coarseness factor/workability factor from the combined gradations in accordance with 501.2.1.4.

(2) Control charts shall be posted in a location satisfactory to the Engineer and shall be kept up to date at all times. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the Action and Suspension limits, or Specification limits, applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor's projected data during production indicates a potential problem and the Contractor is not taking satisfactory corrective action, the Engineer may halt production or acceptance of the material.

501.5.4.1 Fine and Coarse Aggregate Gradation

(1) Contractor shall record the running average of the last five gradation tests for each control sieve on linear control charts. Superimposed on the control charts shall be the action and suspension limits.

Gradation tests shall be performed by the Contractor per ASTM C136. Contractor shall take at least two samples per lot to check the final gradation. Sampling shall be per ASTM D75 from the flowing aggregate stream or conveyor belt.

501.5.4.2 Slump and Air Content

(1) Contractor shall maintain linear control charts both for individual measurements and range (that is, difference between highest and lowest measurements) for slump and air content in accordance with the following Action and Suspension Limits.

501.5.4.3 Combined Gradation

(1) Contractor shall maintain a control chart plotting the coarseness factor and workability factor on a chart in accordance with 501.2.1.4.

Table 501.5.4.3

Control Chart Limits[1]

Control Parameter	Individual Measurements	
	Action Limits	**Suspension Limits**
Gradation[2]	[3]	[3]
Coarseness Factor (CF)	± 3.5	± 5
Workability Factor (WF)	±2	±3
Slump	+0.5 to -1 inch	+1 to -1.5 inch
Air Content	±1.5 percent	±2.0 percent

[1] Control charts shall be developed and maintained for each control parameter indicated.

[2] Control charts shall be developed and maintained for each sieve size.

[3] Action and suspension limits shall be determined by the Contractor.

501.5.5 Corrective Action at Suspension Limit

(1) Contractor Quality Control Program (CQCP) shall indicate that appropriate action shall be taken when the process is believed to be out of control. The CQCP shall detail what action will be taken to bring the process into control and shall contain sets of rules to gauge when a process is out of control. As a minimum, a process shall be deemed out of control and corrective action taken if any one of the following conditions exists.

501.5.5.1 Fine and Coarse Aggregate Gradation

(1) When two consecutive averages of five tests are outside of the suspension limits, immediate steps, including a halt to production, shall be taken to correct the grading.

501.5.5.2 Coarseness and Workability Factor

(1) When the CF or WF reaches the applicable suspension limits, the Contractor, immediate steps, including a halt to production, shall be taken to correct the CF and WF.

501.5.5.3 Fine and Coarse Aggregate Moisture Content

(1) Whenever the moisture content of the fine or coarse aggregate changes by more than 0.5 percent, the scale settings for the aggregate batcher and water batcher shall be adjusted.

501.5.5.4 Slump

(1) Contractor shall halt production and make appropriate adjustments whenever:

a. one point falls outside the Suspension Limit line for individual measurements or range, or
b. two points in a row fall outside the Action Limit line for individual measurements.

501.5.5.5 Air Content

(1) The Contractor shall halt production and adjust the amount of air-entraining admixture whenever:

a. one point falls outside the Suspension Limit line for individual measurements, or
b. two points in a row fall outside the Action Limit line for individual measurements.

501.6 Quality Assurance (QA)

501.6.1 Acceptance Sampling and Testing

(1) All acceptance sampling and testing necessary to determine conformance with the requirements specified in this section, with the exception of coring for thickness determination, and profilograph and smoothness equipment and testing, will be performed by the Engineer. The Contractor shall provide adequate facilities for the initial curing of beams. The Contractor shall bear the cost of providing initial curing facilities and coring and filling operations, per 501.6.5.2.1.

(2) The samples will be transported while in the molds. The curing, except for the initial cure period, will be accomplished using the immersion in saturated lime water method. The Contractor shall provide adequate facilities for the initial curing of beams. During the 24 hours after molding, the temperature immediately adjacent to the specimens must be maintained in the range of 60 degrees to 80 degrees Fahrenheit, and loss of moisture from the specimens must be prevented. The specimens may be stored in tightly constructed wooden boxes, damp sand pits, temporary buildings at construction sites, under wet burlap in favorable weather, or in heavyweight closed plastic bags, or using other suitable methods, provided the temperature and moisture loss requirements are met.

501.6.2 Quality Assurance (QA) Testing Laboratory

(1) Quality assurance testing organizations performing these acceptance tests will be accredited in accordance with ASTM C1077. The quality assurance laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for acceptance sampling and testing must be listed on the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods will be submitted to the Engineer prior to start of construction.

501.6.3 Lot Size

(1) Concrete will be accepted for strength and thickness on a lot basis. A lot will consist of a day's production not to exceed 2,000 cubic yards. Each lot will be divided into approximately equal sublots with individual sublots between 400 to 600 cubic yards. Where three sublots are produced, they will constitute a lot. Where one or two sublots are produced, they will be incorporated into the previous or next lot. Where more than one plant is simultaneously producing concrete for the job, the lot sizes will apply separately for each plant.

501.6.4 Partial Lots

(1) When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot or for overages or minor placements to be considered as partial lots, the following procedure will be used to adjust the lot size and the number of tests for the lot.

(2) Where three sublots have been produced, they will constitute a lot. Where one or two sublots have been produced, they will be incorporated into the next lot or the previous lot and the total number of sublots will be used in the acceptance criteria calculation, that is, n=5 or n=6.

501.6.5 Acceptance Sampling and Testing

501.6.5.1 Strength

501.6.5.1.1 Sampling

(1) Each lot will be divided into four equal sublots. One sample will be taken for each sublot from the plastic concrete delivered to the job site. Sampling locations will be determined by the Engineer in accordance with random sampling procedures contained in ASTM D3665. The concrete will be sampled in accordance with ASTM C172.

501.6.5.1.2 Test Specimens

(1) Engineer will be responsible for the casting, initial curing, transportation, and curing of specimens in accordance with ASTM C31. Two specimens will be made from each sample and slump, air content, unit weight, and temperature tests will be conducted for each set of strength specimens. Within 24 to 48 hours, the samples will be transported from the field to the laboratory while in the molds. Samples will be cured in saturated lime water.

(2) The strength of each specimen will be determined in accordance with ASTM C78. The strength for each sublot will be computed by averaging the results of the two test specimens representing that sublot.

501.6.5.1.3 Acceptance

(1) Acceptance of pavement for flexural strength will be determined by the Engineer in accordance with 501.6.6.2.1. All individual strength tests within a lot will be checked for an outlier (test criterion) in accordance with ASTM E178, at a significance level of 5 percent. Outliers will be discarded and the remaining test values will be used to determine acceptance in accordance with 501.6.5.2.

501.6.5.2 Pavement Thickness

501.6.5.2.1 Sampling

(1) One core shall be taken by the Contractor for each sublot in the presence of Engineer. Sampling locations will be determined by the Engineer in accordance with random sampling procedures contained in ASTM D3665. Areas, such as thickened edges, with planned variable thickness, will be excluded from sample locations.

(2) Cores be a minimum 4 inch in diameter neatly cut with a core drill. The Contractor shall furnish all tools, labor, and materials for cutting samples and filling the cored hole. Core holes shall be filled by the Contractor with a non-shrink grout approved by the Engineer within one day after sampling.

501.6.5.2.2 Testing

(1) The thickness of the cores shall be determined by the Engineer by the average caliper measurement in accordance with ASTM C174. Each core shall be photographed and the photograph included with the test report.

501.6.5.2.3 Acceptance

(1) Acceptance of pavement for thickness will be determined by the Engineer in accordance with 501.6.6.2.2.

501.6.6 Acceptance Criteria

501.6.6.1 General

(1) Acceptance will be based on the following characteristics of the completed pavement discussed in 501.6.6.2.

a. Strength
b. Thickness
c. Smoothness
d. Grade
e. Profilograph smoothness (on runways and taxiways greater than 500 feet)
f. Adjustments for repairs

(2) Acceptance for strength, thickness, and grade will be based on the criteria contained in accordance with 501.6.6.2.1, 501.6.6.2.2, and 501.6.6.2.3, respectively. Acceptance for profilograph smoothness will be based on the criteria contained in 501.6.6.2.4.

(3) Production quality must achieve 90 PWL or higher to receive full payment.

(4) Strength and thickness will be evaluated for acceptance on a lot basis using the method of estimating PWL. Production quality must achieve 90 PWL or higher to receive full payment. The PWL shall be determined in accordance with procedures specified in C110.

(5) The lower specification tolerance limit (L) for strength and thickness shall be:

Lower Specification Tolerance Limit (L)

Strength	0.93 × strength specified in 501.3.3
Thickness	Lot Plan Thickness in inches, - 0.50 in

501.6.6.2 Acceptance Criteria

501.6.6.2.1 Strength

(1) If the PWL of the lot equals or exceeds 90 percent, the lot will be acceptable. Acceptance and payment for the lot will be determined in accordance with 501.8.1.

501.6.6.2.2 Thickness

(1) If the PWL of the lot equals or exceeds 90 percent, the lot will be acceptable. Acceptance and payment for the lot will be determined in accordance with 501.8.1.

501.6.6.2.3 Grade

(1) The final finished surface of the pavement of the completed project will not vary from the gradeline elevations and cross-sections shown on the Plans by more than 1/2 inch vertically or 0.1 feet laterally. The documentation, stamped and signed by a licensed surveyor in accordance with paragraph 501.5.3.8. Payment for sublots that do not meet grade for over 25% of the sublot shall be reduced by 5% and not be more than 95%.

(2) If the Plans or Special Provisions indicate that the Engineer will provide staking, Contractor shall verify the pavement has been constructed to meet the Plan grades based upon measurements transferred from Engineer staking provided for the project. If Engineer provided staking is not specified, Contractor shall provide the required survey data. The documentation, stamped and signed by a licensed surveyor, will be provided by the Contractor to the Engineer. The Contractor will pay the cost of the surveying and level runs.

501.6.6.2.4 Profilograph Roughness for QA Acceptance

(1) The final profilograph shall be the full length of the project to facilitate testing of roughness between lots. Contractor, in the presence of Engineer, shall perform a profilograph roughness test on the completed project with a profilograph meeting the requirements of ASTM E1274 or a Class I inertial profiler meeting ASTM E950. Data and results shall be provided within 48 hrs of profilograph roughness tests. The pavement shall have an average profile index less than 15 inches per mile per 1/10 mile. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate “must grind” bumps and the Profile Index for the pavement using a 0.2 inch blanking band. The bump template must span one inch with an offset of 0.4 inches. The profilograph must be calibrated prior to use and operated by a factory or State DOT approved, trained operator. Profilograms shall be recorded on a longitudinal scale of one inch equals 25 feet and a vertical scale of one inch equals one inch. Profilograph be performed one foot right and left of project centerline and 15 feet right and left of project centerline. Areas that indicate “must grind” shall be corrected with diamond grinding per 501.4.19.7 or by removing and replacing full depth of surface course, as directed by the Engineer. Where corrections are necessary, second profilograph runs will be performed to verify that the corrections produced an average profile index of 15 inches per mile per 1/10 mile or less.

501.6.6.2.5 Adjustments for Repair

(1) Panels with spall repairs, partial panel replacement or grinding over 50 percent of panel will be limited to no more than 95 percent payment.

501.6.6.2.6Adjustment for Grinding

(1) For sublots with grinding over 25 percent of a sublot, payment will be reduced 5 percent.

501.6.7 Small Project Quality Assurance

(1) Where the project has multiple small placements or the total project size is less than 2000 cubic yards, the use of percent within limits (PWL) is not appropriate. If this is the case, replace 501.6.5.1 and 501.6.5.2 with the following:

a. Concrete for each placement will be accepted on the basis of the compressive strength requirement of 4,400 psi. The concrete will be sampled in accordance with ASTM C172. Concrete strength test specimens will be made in accordance with ASTM C31 and tested in accordance with ASTM C39. The Contractor will cure and store the test specimens under such conditions as directed by the Engineer. The Engineer will make the actual tests on the specimens at no expense to the Contractor.

b. For each day’s placement and mix type, the concrete will be sampled in accordance with ASTM C172; two specimens made in accordance with ASTM C31; and the strength of each specimen determined in accordance with ASTM C39 or ASTM C78. If one day’s placement will exceed 200 CY, ensure multiple tests are taken such that the quantity placed for each set of two specimens does not exceed 200 CY. Slump, air content, unit weight, and temperature tests will also be conducted for each set of strength test samples, per ASTM C31.

501.7 Measurement

501.7.1 General

(1) Portland cement concrete pavement shall be measured by the number of square yards of either plain or reinforced pavement as specified in-place, completed and accepted.

501.8 Payment

501.8.1 Payment

(1) Payment for concrete pavement meeting all acceptance criteria as specified in 501.6. Acceptance Criteria shall be based on results of strength, thickness, and smoothness tests. Payment for acceptable lots of concrete pavement shall be adjusted in accordance with 501.8.1.1 for strength and thickness; 501.8.1.2 for repairs; 501.8.1.3 for grinding; and 501.8.1.4 and 501.8.1.3 for smoothness, subject to the following limitations.

a. The total project payment for concrete pavement shall not exceed 103 percent of the product of the contract unit price and the total number of square yards of PCC pavement used in the accepted work (See Note 1 under following the Price Adjustment Schedule).

b. Payment shall be full compensation for all labor, materials, tools, equipment, and incidentals required to complete the work as specified herein and on the drawings.

501.8.1.1 Basis of Adjusted Payment

(1) The pay factor for each individual lot shall be calculated in accordance with the following Price Adjustment Schedule table. A pay factor shall be calculated for both strength and thickness. The lot pay factor shall be the higher of the two values when calculations for both flexural strength and thickness are 100 percent or higher. The lot pay factor shall be the product of the two values when only one of the calculations for either flexural strength or thickness is 100 percent or higher. The lot pay factor shall be the lower of the two values when calculations for both flexural strength and thickness are less than 100 percent.

Price Adjustment Schedule[1]

Percentage of Materials Within Specification Limits (PWL)	**Lot Pay Factor (Percent of Contract Unit Price)**
96 – 100	106
90 – 95	PWL + 10
75 – 90	0.5 PWL + 55
55 – 74	1.4 PWL – 12
Below 55	Reject[2]

[1] Although it is theoretically possible to achieve a pay factor of 106 percent for each lot, actual payment in excess of 100 percent shall be subject to the total project payment limitation specified in 501.8.1.

[2] The lot shall be removed and replaced unless, after receipt of FAA concurrence, the Owner and Contractor agree in writing that the lot will remain; the lot at 50 percent of the contract unit price; and the total project payment limitation reduced by the amount withheld for that lot.

For each lot accepted, the adjusted contract unit price shall be the product of the lot pay factor for the lot and the contract unit price. Payment shall be subject to the total project payment limitation specified in 501.8.1. Payment in excess of 100 percent for accepted lots of concrete pavement shall be used to offset payment for accepted lots of concrete pavement that achieve a lot pay factor less than 100 percent except for rejected lots which remain in place and/or sublots with adjustments for repairs.

501.8.1.2 Adjusted payment for repairs

(1) The PWL lot pay factor shall be reduced by 5 percent and be no higher than 95 percent for sublots which contain repairs in accordance with 501.4.19 on more than 20 percent of the slabs within the sublot. Payment factors greater than 100 percent for the strength and thickness cannot be used to offset adjustments for repairs.

501.8.1.3 Adjusted payment for grinding

(1) The PWL lot pay factor shall be reduced by 5 percent and be no higher than 95 percent for sublots with grinding over 25 percent of a sublot.

501.8.1.4 Profilograph Roughness.

(1) Contractor will receive full payment when the profilograph average profile index is in accordance with 501.6.6.2.4. When the final average profile index for the entire length of pavement does not exceed 15 inches per mile per 1/10 mile, payment will be made at the contract unit price for the completed pavement.

501.8.1.5 Payment.

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items:

Pay Item	Description	Unit
P501.006	Portland Cement Concrete Pavement 6-Inch	Square yard (SY)
P501.007	Portland Cement Concrete Pavement 7-Inch	Square yard (SY)
P501.008	Portland Cement Concrete Pavement 8-Inch	Square yard (SY)
P501.009	Portland Cement Concrete Pavement 9-Inch	Square yard (SY)
P501.010	Portland Cement Concrete Pavement 10-Inch	Square yard (SY)
P501.011	Portland Cement Concrete Pavement 11-Inch	Square yard (SY)
P501.012	Portland Cement Concrete Pavement 12-Inch	Square yard (SY)
P501.013	Portland Cement Concrete Pavement 13-Inch	Square yard (SY)
P501.014	Portland Cement Concrete Pavement 14-Inch	Square yard (SY)
P501.015	Portland Cement Concrete Pavement 15-Inch	Square yard (SY)
P501.016	Portland Cement Concrete Pavement 16-Inch	Square yard (SY)
P501.017	Portland Cement Concrete Pavement 17-Inch	Square yard (SY)
P501.018	Portland Cement Concrete Pavement 18-Inch	Square yard (SY)
P501.019	Portland Cement Concrete Pavement 19-Inch	Square yard (SY)
P501.020	Portland Cement Concrete Pavement 20-Inch	Square yard (SY)
P501.021	Portland Cement Concrete Pavement 21-Inch	Square yard (SY)
P501.022	Portland Cement Concrete Pavement 22-Inch	Square yard (SY)
P501.023	Portland Cement Concrete Pavement 23-Inch	Square yard (SY)
P501.024	Portland Cement Concrete Pavement 24-Inch	Square yard (SY)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM A184	Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A704	Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
ASTM A706	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A775	Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A884	Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM A934	Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars

ASTM A996	Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM A1035	Standard Specification for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement
ASTM A1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A1078	Standard Specification for Epoxy-Coated Steel Dowels for Concrete Pavement
ASTM C29	Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate
ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C70	Standard Test Method for Surface Moisture in Fine Aggregate
ASTM C78	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C114	Standard Test Methods for Chemical Analysis of Hydraulic Cement
ASTM C117	Standard Test Method for Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C123	Standard Test Method for Lightweight Particles in Aggregate
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C138	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C143	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C174	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
ASTM C227	Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C295	Standard Guide for Petrographic Examination of Aggregates for Concrete

ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C311	Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland Cement Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C566	Standard Test Method for Total Evaporable Moisture Content of Aggregates by Drying
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C642	Standard Test Method for Density, Absorption, and Voids in Hardened Concrete
ASTM C666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
ASTM C685	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C881	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1017	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1064	Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1157	Standard Performance Specification for Hydraulic Cement
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1365	Standard Test Method for Determination of the Proportion of Phases in Portland Cement and Portland-Cement Clinker Using X-Ray Powder Diffraction Analysis
ASTM C1567	Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
ASTM D1752	Standard Specification for Preformed Sponge Rubber and Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM E178	Standard Practice for Dealing with Outlying Observations
ASTM E1274	Standard Test Method for Measuring Pavement Roughness Using a Profilograph

ASTM E2133	Standard Test Method for Using a Rolling Inclinometer to Measure Longitudinal and Transverse Profiles of a Traveled Surface

American Concrete Institute (ACI)

ACI 305R	Guide to Hot Weather Concreting
ACI 306R	Guide to Cold Weather Concreting
ACI 309R	Guide for Consolidation of Concrete

Advisory Circulars (AC)

AC 150/5320-6	Airport Pavement Design and Evaluation

Federal Highway Administration (FHWA)

HIPERPAV 3, version 3.2

Portland Concrete Association (PCA)

PCA	Design and Control of Concrete Mixtures, 16th Edition

U.S. Army Corps of Engineers (USACE) Concrete Research Division (CRD)

CRD C662	Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar-Bar Method)

United States Air Force Engineering Technical Letter (ETL)

ETL 97-5	Proportioning Concrete Mixtures with Graded Aggregates for Rigid Airfield Pavements

END SPECIFICATION P501

Part 8 – Surface Treatments

Specification P626 - Emulsified Asphalt Slurry Seal Surface Treatment

626.1 Description

626.1.1 General

(1) This Work shall consist of a mixture of emulsified asphalt, polymer, mineral aggregate, and water properly proportioned, mixed, and spread on an asphalt pavement surface, including airport pavements serving small airplanes less than 12,500 lbs., roads, and other general applications. The application of the surface treatment shall be in accordance with these specifications and shall conform to the dimensions shown on the Plans or as directed by the Engineer.

626.2 Materials

626.2.1 Aggregate

(1) Aggregate shall consist of sound and durable manufactured sand, slag, crusher fines, crushed stone, or a combination. Aggregate shall be clean and free from vegetable matter, dirt, and other deleterious substances. Aggregate shall have a sand equivalent of not less than 45 percent when tested in accordance with ASTM D2419. The aggregate shall show a loss of not more than 35 percent when tested in accordance with ASTM C131. The sodium sulfate soundness loss shall not exceed 12 percent, or the magnesium soundness loss shall not exceed 20 percent after 5 cycles when tested in accordance with ASTM C88. Aggregate shall be 100 percent crushed.

(2) The combined aggregate shall conform to the gradation shown in Table 626.2.1 when tested in accordance with ASTM C136 and ASTM C117.

Table 626.2.1 Gradation of Aggregates

Sieve Size	Percent by Weight Passing Sieve
3/8 inch (9 mm)	100
No. 4 (4.75 mm)	99-100
No. 8 (2.36 mm)	85-96
No. 16 (1.18 mm)	55-80
No. 30 (600 micro m)	35-55
No. 50 (300 micro m)	18-35
No. 100 (150 micro m)	-
No. 200 (75 micro m)	-
Residual asphalt content percent dry weight of aggregate	7.5 percent to 13.5 percent
Pounds of Aggregate Dry Square Yard	15 - ±3

(3) The job mix formula (mix design) shall be run using aggregate within the gradation band for the desired type shown in Table 626.2.1. Once the mix design has been submitted and approved by the Engineer, the aggregate used on the project shall not vary by more than the tolerances shown in Table 626.2.1.1. At no time shall the aggregate used go out of the gradation band in Table 626.2.1.

(4) The aggregate will be accepted at the job location or stockpile based on five gradation test samples in accordance with ASTM D75. Contractor shall provide sampling and testing. If the average of the five tests is within the gradation tolerances, then the materials will be accepted. If the tests show the material to be out of tolerance, the Contractor will be given the choice either to remove the material or blend other aggregates with the stockpile material to bring it into specification. Materials used in blending shall meet the quality tests before blending and shall be blended in a manner to produce a consistent gradation. This blending may require a new mix design.

(5) Screening shall be required at the project stockpile site if there are oversize materials in the mix.

(6) Precautions shall be taken to prevent segregation of the aggregate in storing and handling. The stockpile shall be kept in areas that drain readily.

626.2.1.1 Aggregate Tolerance

(1) Once the mix design has been accepted, the aggregate gradation used on the project may vary from the aggregate gradation used in the mix design on each sieve by the percentages shown in Table 626.2.1.1. If the project aggregate fails to remain within this tolerance, a new mix design will be required by the Engineer at the expense of the Contractor.

Table 626.2.1.1 Aggregate Tolerance

Sieve Size	Tolerance, percent by weight passing sieve
3/8 inch (9 mm)	
No. 4 (4.75 mm)	±5 percent
No. 8 (2.36 mm)	±5 percent
No. 16 (1.18 mm)	±5 percent
No. (600 micro m)	±5 percent
No. 50 (300 micro m)	±4 percent
No. 100 (150 micro m)	±3 percent
No. 200 (75 micro m)	±2 percent
Residual Asphalt, percent dry weight of aggregate	±1 percent

626.2.2 Mineral Filler

(1) If mineral filler, in addition to that naturally present in the aggregate, is necessary, it shall meet the requirements of ASTM D242 and shall be used in the amounts required by the mix design. The mineral filler shall be considered as part of the aggregate.

626.2.3 Emulsified Asphalt

(1) Emulsified asphalt shall conform to the requirements of ASTM D 2397 and shall be SS, CSS, CQS, or QS type emulsions.

(2) The Contractor shall provide a copy of the manufacturer's Certificate of Analysis (COA) for the emulsified asphalt delivered to the project. If the asphalt emulsion is diluted at other than the manufacturer's facility, the Contractor shall provide a supplemental COA from an independent laboratory verifying the asphalt emulsion properties.

(3) The COA shall be provided to and approved by the Engineer before the emulsified asphalt is applied. The furnishing of the vendor's certified test report for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

626.2.4 Polymer

(1) The Contractor shall submit manufacturer's technical data, the manufacturer's certification indicating that the polymer meets the requirements of the specification, and the asphalt material manufacturer's approval of its use to the Engineer. The polymer must be approved for use by the Engineer.

626.2.5 Water

(1) All water used in mixing or curing shall be from potable water sources free from harmful soluble salts and chemicals. Other sources tested in accordance with ASTM C1602 prior to use.

626.3 Composition and Application
626.3.1 Composition

(1) Slurry seal shall consist of a mixture of emulsified asphalt, mineral aggregate, a minimum of 1% polymer, additives as necessary, and water.

626.3.2 Job Mix Formula

(1) The mix design shall be developed by a laboratory with experience in designing slurry seal mixes and a signed copy shall be submitted in writing by the Contractor to the Engineer at least 10 days prior to the start of operations. No slurry seal for payment shall be placed until a mix design has been approved by the Engineer.

(2) The laboratory report (mix design) shall indicate the proportions of aggregates, mineral filler (minimum and maximum), water (minimum and maximum) and asphalt emulsion based on the dry aggregate weight. It shall also report the quantitative effects of moisture content on the unit weight of the aggregate (bulking effects). The mix design shall be in effect until modified in writing by the Engineer. If the sources of materials change, a new mix design shall be established before the new material is used.

(3) Contractor shall submit to the Engineer for approval a complete mix design on the materials proposed for use, prepared and certified by an approved laboratory**.** Compatibility of the aggregate, emulsion, mineral filler, and other additives shall be verified by the mix design. The mix design shall be made with the same aggregate and grade of emulsified asphalt that the Contractor will provide on the project. At a minimum the required tests and values needed are as follows:

Slurry Mix Tests

ISSA Technical Bulletin No.	**Description**	**Specification**
ISSA TB-100	Wet track abrasion loss one hour soak	50 g/ft² Max
ISSA TB-115	Determination of Slurry System Compatibility	Pass

626.3.3 Application Rate.

(1) Unless otherwise specified, the slurry seal shall be applied at the application rates shown in Table 626.3.3. The rate of application shall not vary more than plus or minus two pounds per square yard.

Table 626.3.3 Slurry Application Rates

Mix Measurement	**Type II**
Pounds of mixture per square yard	12 -20

626.3.4 Control Sections

(1) Control sections shall be placed prior to the start of the slurry seal work in the presence of the Engineer. The control area will be located on the existing pavement and designated by the Engineer. Control sections shall be made by each machine after calibration. The control sections should be separated by a minimum of 200 feet between control sections. Samples of the slurry seal may be taken and the mix consistency verified by using ISSA TB-106 Measurement of Slurry Seal Consistency test. In addition, the proportions of the individual materials may be verified by the Engineer by using the calibration information provided after machine calibration. If a test does not meet specification requirements, additional tests shall be made at the expense of the Contractor, until an acceptable test strip is placed.

(2) A qualified slurry seal contractor's representative shall be present in the field to assist the Contractor in applying test areas and control sections to determine the optimum application rate of both emulsion and aggregate.

626.4 Construction

626.4.1 Weather Limitations

(1) The slurry seal shall not be applied if either the pavement or air temperature is below 50 degrees Fahrenheit and falling but may be applied when both pavement and air temperature are above 45 degrees Fahrenheit and rising. No slurry seal shall be applied when there is danger that the finished product will freeze before 24 hours. Do not apply slurry seal during rain or other adverse weather conditions. The mixture shall not be applied when weather conditions prolong opening to traffic beyond a reasonable time.

626.4.2 Equipment and Tools

(1) The Contractor shall furnish all equipment, tools, and machinery necessary for the performance of this work.

626.4.2.1 Slurry Mixing Equipment

(1) The machine shall be specifically designed and manufactured to lay slurry seal. The material shall be mixed by a self-propelled slurry seal mixing machine of either truck mounted or continuous run design. Either type machine shall be able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler, and water to a revolving mixer and discharge the mixed product on a continuous flow basis. The machine shall have sufficient storage capacity for materials to maintain an adequate supply to the proportioning controls.

(2) If continuous run equipment is used, the machine shall be equipped to allow the operator full control of the forward and reverse speed of the machine during application of the slurry seal, with a self-loading device, with opposite side driver stations, all part of original equipment manufacturer design.

(3) The aggregate shall be pre-wetted immediately prior to mixing with the emulsion. The mixing unit of the mixing chamber shall be capable of thoroughly blending all ingredients. No excessive mixing shall be permitted. The mixing machine shall be equipped with a fines feeder that provides an accurate metering device or method to introduce a predetermined proportion of mineral filler into the mixer at the same time and location that the aggregate is fed into the mixer.

(4) The mixing machine shall be equipped with a water pressure system and fog-type spray bar adequate for complete fogging of the surface with an application of 0.05 to 0.10 gallon per square yard preceding the spreading equipment.

(5) Sufficient machine storage capacity to mix properly and apply a minimum of 5 tons of the slurry shall be provided. Proportioning devices shall be calibrated prior to placing the slurry seal.

626.4.2.2 Slurry Spreading Equipment

(1) The mixture shall be spread uniformly by means of a conventional surfacing spreader box attached to the mixer and equipped to agitate and spread the material evenly throughout the box. A front seal shall be provided to ensure no loss of the mixture at the surface contact point. The rear seal shall act as the final strike-off and shall be adjustable. The spreader box and rear strike-off shall be designed and operated to produce a free flow of material of uniform consistency to the rear strike-off. The spreader box shall provide suitable means to side shift the box to compensate for variations in the pavement geometry. A burlap drag or other approved screed may be attached to the rear of the spreader box to provide a uniform mat.

626.4.2.3 Auxiliary Equipment

(1) Other tools or equipment such as brushes, hand squeegees, hose equipment, tank trucks, water distributors and flushers, power blowers, barricades, etc., shall be provided as required.

626.4.2.4 Roller

(1) The roller, if required, shall be a self-propelled pneumatic-tired roller capable of exerting a contact pressure during rolling of 50 lb/sq inch. It shall be equipped with a water spray system, to be used if the slurry is picking up on the tires during rolling.

626.4.2.5 Tack Coat and Distributor

(1) Normally a tack coat is not required unless the surface to be covered is extremely dry and raveled or is concrete or brick. If required, the tack coat should consist of one part emulsified asphalt and three parts water. The emulsified asphalt may be the same as that used in the mix. Pressure distributors used for application of the diluted asphalt emulsion tack coat shall be self-propelled, equipped with pneumatic tires, and capable of uniformly applying 0.05 to 0.15 gallon per square yard of the diluted emulsion over the required width of application. Distributors shall be equipped with tachometers, pressure gauges, and volume-measuring devices. The tack coat shall be applied at least two hours before the slurry seal but within the same day.

626.4.3 Equipment Calibration

(1) Each slurry mixing unit to be used on the project shall be calibrated in the presence of the Engineer prior to construction. Previous calibration documentation covering the exact materials to be used may be accepted by the Engineer provided they were made during the calendar year. The documentation shall include an individual calibration of each material at various settings, which can be related to the machine's metering devices. No machine will be allowed to work on the project until the calibration has been completed and/or accepted by the Engineer.

626.4.4 Preparation of Existing Surface

(1) Clean pavement surface immediately prior to placing the seal coat by sweeping, flushing well with water leaving no standing water, or a combination of both, so that it is free of dust, dirt, grease, vegetation, oil or objectionable surface film. Remove oil or grease that has not penetrated the asphalt pavement by scraping or by scrubbing with a detergent, then wash thoroughly with clean water. After cleaning, treat these areas with the oil spot primer. Additional surface preparation, such as crack repair, shall be completed as required on the Plans or Special Provisions.

626.4.5 Application of Slurry Seal Surface Treatment

(1) The surface shall be pre-wet ahead of the slurry spreader box by fogging at a rate that dampens the surface with no apparent standing water. The slurry mixture shall be at the desired consistency when exiting the mixer. Total time of mixing shall not exceed two minutes. A sufficient amount of slurry shall be carried in all parts of the spreader box at all times so that complete coverage of all surface voids and cracks is obtained. Care shall be taken not to overload the spreader box which shall be towed at a slow and uniform rate not to exceed five miles per hour. No lumping, balling, or unmixed aggregate shall be permitted. No segregation of the emulsion and fines from the coarse aggregate will be permitted. If the coarse aggregate settles to the bottom of the mix, the slurry shall be removed from the pavement surface. A sufficient amount of slurry shall be fed into the box to keep a full supply across the full width of the spreader box. The mixture shall not be permitted to overflow the sides of the spreader box. No breaking of the emulsion will be allowed in the spreader box. The finished surface shall have no more than four tear or drag marks greater than 1/2 inch wide and four inch long in any 12-foot by 22-foot section. It shall have no tear or drag marks greater than one inch wide and three inch long.

(2) The finished surface shall have no transverse ripples of 1/4 inch or more in depth, as measured with a 12-foot straightedge laid upon the surface.

(3) Adjacent lanes shall be lapped at the edges a minimum of two inch with a maximum of four inch to provide complete sealing at the overlap. Construction longitudinal and transverse joints shall be neat and uniform without buildup, uncovered areas, or unsightly appearance. All joints shall have no more than 1/4 inch difference in elevation when measured across with a 12-foot straightedge.

(4) The fresh slurry seal application shall be protected by barricades and markers and permitted to dry for four to 24 hours, depending on weather conditions. Damage to uncured slurry shall be repaired at the expense of the Contractor.

(5) In areas where the spreader box cannot be used, the slurry shall be applied by means of a hand squeegee. Upon completion of the work, the seal coat shall have no holes, bare spots, or cracks through which liquids or foreign matter could penetrate to the underlying pavement. The finished surface shall present a uniform and skid resistant texture satisfactory to the Engineer. All wasted and unused material and all debris shall be removed from the site prior to final acceptance.

(6) Upon completion of the project, the Contractor shall sweep the finished surface with a conventional power rotary broom, to remove any potential loose material from the surface. The material removed by sweeping shall be disposed of in a manner satisfactory to the Engineer.

626.4.6 Emulsion Material (Contractor's Responsibility)

(1) Samples of the emulsion that the Contractor proposes to use, together with a statement as to its source, shall be submitted, and approval shall be obtained before using such material. The Contractor shall submit to the Engineer a manufacturer's certified report for each consignment of the emulsion. The manufacturer's certified report shall not be interpreted as a basis for final acceptance. All such reports shall be subject to verification by testing samples of the emulsion received for use on the project.

626.5 Measurement

626.5.1 General

(1) Emulsified Asphalt Slurry Seal (including emulsified asphalt tack coat) will be measured by the square yard based on the actual quantity of Work shown in the Plans or ordered by the Engineer.

626.6 Payment

626.6.1 General

(1) Payment shall be made at the contract unit price per square yard for the emulsified asphalt slurry seal surface treatment and at the contract price per ton for aggregate.

(2) This price shall be full compensation for furnishing all materials, for preparing, mixing, and applying these materials (including emulsion and aggregate), and for all labor, equipment, tools, submittals, control strip, and incidentals necessary to complete the Work.

(3) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

626.6.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P626.010	Emulsified Asphalt Slurry Seal Surface Treatment	Square yard (SY)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D242	Standard Specification for Mineral Filler for Bituminous Paving Mixtures
ASTM D977	Standard Specification for Emulsified Asphalt
ASTM D1250	Standard Guide for the Use of Petroleum Measurement Tables
ASTM D2397	Standard Specification for Cationic Emulsified Asphalt
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D3628	Standard Practice for Selection and Use of Emulsified Asphalts

International Slurry Surfacing Association (ISSA)

ISSA A-105	Recommended Performance Guidelines for Emulsified Asphalt Slurry Seal
ISSA TB-100	Laboratory Test Method for Wet Track Abrasion of Slurry Surfacing Systems
ISSA TB-106	Slurry Seal Consistency Template
ISSA TB-115	Test Method for Determination of Slurry System Compatibility

END OF SPECIFICATION P626

Part 9 – Miscellaneous

Specification P603 – Emulsified Asphalt Tack Coat

603.1 Description

603.1.1 General

(1) This Work shall consist of preparing and treating an asphalt or concrete surface with asphalt material in accordance with these specifications and in reasonably close conformity to the lines shown on the Plans.

603.2 Materials

603.2.1 Asphalt Materials

(1) Asphalt material shall be an emulsified asphalt as specified in ASTM D3628 as an asphalt application for tack coat appropriate to local conditions. The emulsified asphalt shall not be diluted. Contractor shall provide a copy of the manufacturer's Certificate of Analysis (COA) for the asphalt material to Engineer before the asphalt material is applied for review and acceptance. Furnishing the COA for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

603.3 Construction

603.3.1 Weather Limitations

(1) The tack coat shall be applied only when the existing surface is dry and the atmospheric temperature is 50 degrees Fahrenheit or above; the temperature has not been below 35 degrees Fahrenheit for 12 hours prior to application; and when the weather is not foggy or rainy. The temperature requirements may be waived when directed by the Engineer in writing.

603.3.2 Equipment

(1) Contractor shall provide equipment for heating and applying the emulsified asphalt material. The emulsion shall be applied with a manufacturer-approved computer rate-controlled asphalt distributor. The equipment shall be in good working order and contain no contaminants or diluents in the tank. Spray bar tips must be clean, free of burrs, and of a size to maintain an even distribution of the emulsion. Any type of tip or pressure source is suitable that will maintain predetermined flow rates and constant pressure during the application process with application speeds under eight miles per hour or seven-hundred feet per minute.

(2) The equipment will be tested under pressure for leaks and to ensure proper set-up before use to verify truck set-up (via a test-shot area), including but not limited to, nozzle tip size appropriate for application, spray-bar height and pressure and pump speed, evidence of triple-overlap spray pattern, lack of leaks, and any other factors relevant to ensure the truck is in good working order before use.

(3) The distributor truck shall be equipped with a 12-foot, minimum, spreader spray bar with individual nozzle control. The distributor truck shall be capable of specific application rates in the range of 0.02 to 1.0 gallon per square yard. These rates shall be computer-controlled rather than mechanical. The distributor truck shall have an easily accessible thermometer that constantly monitors the temperature of the emulsion, and have an operable mechanical tank gauge that can be used to cross-check the computer accuracy. The distributor shall be equipped with an operable quick shutoff valve.

(4) The distributor truck shall be provided, if necessary, equipped to effectively heat and mix the material to the required temperature prior to application. Heating and mixing shall be done in accordance with the manufacturer's recommendations. Care shall be taken not to overheat or over mix the material.

(5) The distributor shall be equipped to hand spray the emulsion in areas identified either on the Plans or by the Engineer.

(6) Asphalt distributors must be calibrated annually in accordance with ASTM D2995. The Contractor must furnish a current calibration certification for the asphalt distributor truck from any State or other agency as approved by the Engineer.

(7) A power broom or power blower suitable for cleaning the surfaces to which the bituminous tack coat is to be applied shall be provided.

603.3.3 Application of Emulsified Asphalt Material

(1) The emulsified asphalt shall not be diluted. Immediately before applying the emulsified asphalt tack coat, the full width of surface to be treated shall be swept with a power broom or power blower to remove all loose dirt and other objectionable material.

(2) Emulsified Asphalt material shall be uniformly applied with an asphalt distributor based on the following Table depending on the condition of the existing surface. The type of asphalt material and application rate shall be approved by the Engineer prior to application.

Table 603.3.3 Emulsified Asphalt		
	Residual Rate, gal./SY	Emulsion Application Bar Rate, gal./SY
NEW HMA	0.02-0.05	0.03-0.07
Existing HMA	0.04-0.07	0.06-0.11
Milled Surface	0.04-0.08	0.06-0.12
PCC	0.03-0.05	0.05-0.08

(3) After application of the tack coat, the surface shall be allowed to cure without being disturbed for the period of time necessary to permit drying and setting of the tack coat. This period shall be determined by the Engineer. The Contractor shall protect the tack coat and maintain the surface until the next course has been placed. When the tack coat has been disturbed by the Contractor, tack coat shall be reapplied at the Contractor's expense.

(4) Turn outside edges nozzles to spray parallel to the road centerline. Do not operate with any clogged nozzles.

603.3.4 Freight and Weigh Bills

(1) Contractor shall submit waybills and delivery tickets, during progress of the work. Before the final statement is allowed, file with the Engineer certified waybills and certified delivery tickets for all emulsified asphalt materials used in the construction of the pavement covered by the Contract. Do not remove emulsified asphalt material from storage until the initial outage and temperature measurements have been taken. The delivery or storage units will not be released until the final outage has been taken.

603.4 Measurement

603.4.1 General

(1) Emulsified asphalt material for tack coat shall be measured by the gallon or ton. Volume shall be corrected to the volume at 60 degrees Fahrenheit in accordance with ASTM D1250. The emulsified asphalt material paid for will be the measured quantities used in the accepted work, provided that the measured quantities are not ten percent over the specified application rate. Quantities of emulsified asphalt material more than ten percent over the specified application rate for each application will be deducted from the measured quantities, except for irregular areas where hand spraying of the emulsified asphalt material is necessary. Water added to emulsified asphalt will not be measured for payment.

603.5 Payment

603.5.1 General

(1) Payment shall be made at the contract unit price per gallon or ton of emulsified asphalt material. This price shall be full compensation for furnishing all materials, for all preparation, delivery, and application of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the Work.

603.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P603.010	Emulsified Asphalt Tack Coat	Gallon (GAL)
P603.020	Emulsified Asphalt Tack Coat	TON

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D1250 Standard Guide for Use of the Petroleum Measurement Tables

ASTM D2995	Standard Practice for Estimating Application Rate and Residual Application Rate of Bituminous Distributors
ASTM D3628	Standard Practice for Selection and Use of Emulsified Asphalts

END SPECIFICATION P603

Specification P605 - Joint Sealants for Concrete Pavements

605.1 Description

605.1.1 General

(1) This item shall consist of providing and installing a resilient and adhesive joint sealing material capable of effectively sealing joints in pavement; joints between different types of pavements; and cracks in existing pavement.

605.2 Materials

605.2.1 Joint Sealants

(1) Provide joint sealant material indicated by the Pay Item description. Joint sealant materials shall meet the requirements of:

a. ASTM D5893 for Pay Item for Silicone Joint Sealant
b. ASTM D6690 for Pay Item for Hot Applied Joint Sealant
c. ASTM D7116 for Pay Item for Hot Applied Fuel Resistant Joint Sealant.

(2) Each lot or batch of sealant shall be delivered to the jobsite in the manufacturer's original sealed container. Each container shall be marked with the manufacturer's name, batch or lot number, the safe heating temperature, and shall be accompanied by the manufacturer's certification stating that the sealant meets the requirements of this specification.

605.2.2 Backer Rod

(1) The material furnished shall be a compressible, non-shrinking, non-staining, non-absorbing material that is non-reactive with the joint sealant in accordance with ASTM D5249. The backer-rod material shall be 25 percent plus or minus five percent larger in diameter than the nominal width of the joint.

605.2.3 Bond Breaking Tapes

(1) Provide a bond breaking tape or separating material that is a flexible, non-shrinkable, non-absorbing, non-staining, and non-reacting adhesive-backed tape. The material shall have a melting point at least five degrees Fahrenheit greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D789. The bond breaker tape shall be approximately 1/8 inch wider than the nominal width of the joint and shall not bond to the joint sealant.

605.2.4 Submittals

(1) Submit manufacturer's product descriptions and certifications that the materials meet the required standards. Submittals shall be numbered and identified by specification section. Provide submittals for sealants and appurtenant materials ten days prior to delivery to the site.

605.3 Construction Methods

605.3.1 Time of Application

(1) Joints shall be sealed as soon after completion of the curing period as feasible and before the pavement is opened to traffic, including construction equipment. The pavement temperature shall be 50 degrees Fahrenheit and rising at the time of application of the poured joint sealing material. Do not apply sealant if moisture is observed in the joint.

605.3.2 Equipment

(1) Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started and maintained in satisfactory condition at all times. Submit a list of proposed equipment to be used in performance of construction work including descriptive data, 10 days prior to use on the project.

605.3.2.1 Tractor-Mounted Routing Tool

(1) Provide a routing tool, used for removing old sealant from the joints, of such shape and dimensions and so mounted on the tractor that it will not damage the sides of the joints. The tool shall be designed so that it can be adjusted to remove the old material to varying depths as required. The use of V-shaped tools or rotary impact routing devices will not be permitted. Hand-operated spindle routing devices may be used to clean and enlarge random cracks.

605.3.2.2 Concrete Saw

(1) Provide a self-propelled power saw, with water-cooled diamond or abrasive saw blades, for cutting joints to the depths and widths specified or for re-facing joints or cleaning sawed joints where sandblasting does not provide a clean joint.

605.3.2.3 Sandblasting Equipment

(1) The Contractor must demonstrate sandblasting equipment including the air compressor, hose, guide and nozzle size, under job conditions, before approval in accordance with 605.3.3. The Contractor shall demonstrate, in the presence of the Engineer, that the method adequately cleans the joint and does not cause damage.

605.3.2.4 Waterblasting Equipment

(1) The Contractor must demonstrate waterblasting equipment including the pumps, hose, guide and nozzle size, under job conditions, before approval in accordance with 605.3.3. The Contractor shall demonstrate, in the presence of the Engineer, that the method adequately cleans the joint and does not cause damage.

605.3.2.5 Hand Tools

(1) Hand tools may be used, when approved, for removing defective sealant from a crack and repairing or cleaning the crack faces. Hand tools should be carefully evaluated for potential spalling effects prior to approval for use.

605.3.2.6 Hot-Poured Sealing Equipment

(1) The unit applicators used for heating and installing ASTM D6690 joint sealant materials shall be mobile and shall be equipped with a double-boiler, agitator-type kettle with an oil medium in the outer space for heat transfer; a direct-connected pressure-type extruding device with a nozzle shaped for inserting in the joint to be filled; positive temperature devices for controlling the temperature of the transfer oil and sealant; and a recording type thermometer for indicating the temperature of the sealant. The applicator unit shall be designed so that the sealant will circulate through the delivery hose and return to the inner kettle when not in use.

605.3.2.7 Cold-applied, Single-component Sealing Equipment

(1) The equipment for installing ASTM D5893 single component joint sealants shall consist of an extrusion pump, air compressor, following plate, hoses, and nozzle for transferring the sealant from the storage container into the joint opening. The dimension of the nozzle shall be such that the tip of the nozzle will extend into the joint to allow sealing from the bottom of the joint to the top. Maintain the initially approved equipment in good working condition, serviced in accordance with the supplier's instructions, and unaltered in any way without obtaining prior approval. Small hand-held air-powered equipment (such as caulking guns) may be used for small applications.

605.3.3 Preparation of Joints

(1) Pavement joints for application of material in this specification must be dry, clean of all scale, dirt, dust, curing compound, and other foreign matter. The Contractor shall demonstrate, in the presence of the Engineer, that the method cleans the joint and does not damage the joint.

605.3.3.1 Sawing

(1) All joints shall be sawed in accordance with Specifications and Plan details. Immediately after sawing the joint, the resulting slurry shall be completely removed from joint and adjacent area by flushing with a jet of water, and by use of other tools as necessary.

605.3.3.2 Sealing

(1) Immediately before sealing, the joints shall be thoroughly cleaned of all remaining laitance, curing compound, filler, protrusions of hardened concrete, old sealant and other foreign material from the sides and upper edges of the joint space to be sealed. Cleaning shall be accomplished by sandblasting, tractor-mounted routing equipment, concrete saw, or waterblaster as specified in 605.3.2 or as specified on the Plans or in Special Provisions. The newly exposed concrete joint faces and the pavement surface extending a minimum of 1/2 inch from the joint edge shall be sandblasted clean. Sandblasting shall be accomplished in a minimum of two passes. One pass per joint face with the nozzle held at an angle directly toward the joint face and not further away than three inches. After final cleaning and immediately prior to sealing, blow out the joints with compressed air and leave them completely free of debris and water. The joint faces shall be surface dry when the seal is applied.

605.3.3.3 Backer Rod

(1) When the joint opening is of a greater depth than indicated for the sealant depth, plug or seal off the lower portion of the joint opening using a backer rod in accordance with 605.2.2 to prevent the entrance of the sealant below the specified depth. Take care to ensure that the backup material is placed at the specified depth and is not stretched or twisted during installation.

605.3.3.4 Bond-Breaking Tape

(1) Where inserts or filler materials contain bitumen, or the depth of the joint opening does not allow for the use of a backup material, insert a bond-breaker separating tape breaker in accordance with 605.2.3 to prevent incompatibility with the filler materials and three-sided adhesion of the sealant. Securely bond the tape to the bottom of the joint opening so it will not float up into the new sealant.

605.3.4 Installation of Sealants

(1) Joints shall be inspected for proper width, depth, alignment, and preparation, and shall be approved by the Engineer before sealing is allowed. Sealants shall be installed in accordance with the following requirements:

(2) Immediately preceding, but not more than 50 feet ahead of the joint sealing operations, perform a final cleaning with compressed air. Fill the joints from the bottom up to 1/8 (unless 1/4 inch is shown on the Plans) plus or minus 1/16 inch below the top of pavement surface; or bottom of groove for grooved pavement. Remove and discard excess or spilled sealant from the pavement by approved methods. Install the sealant in such a manner as to prevent the formation of voids and entrapped air. In no case shall gravity methods or pouring pots be used to install the sealant material. Traffic shall not be permitted over newly sealed pavement until authorized by the Contracting Officer. When a primer is recommended by the manufacturer, apply it evenly to the joint faces in accordance with the manufacturer's instructions. Check the joints frequently to ensure that the newly installed sealant is cured to a tack-free condition within the time specified.

605.3.5 Inspection

(1) Contractor shall inspect the joint sealant for proper rate of cure and set, bonding to the joint walls, cohesive separation within the sealant, reversion to liquid, entrapped air and voids. Sealants exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed from the joint, wasted, and replaced as specified at no additional cost to the airport.

605.3.6 Clean-up

(1) Upon completion of the project, remove all unused materials from the site and leave the pavement in a clean condition.

605.4 Measurement

605.4.1 General

(1) Joint Sealant of the type bid shall be measured by the gallon, pound, or linear foot of sealant in place, completed, and accepted.

605.5 Payment

605.5.1 General

(1) Payment for Joint Sealant shall be made at the Contract unit price per gallon, pound, or linear foot. The price shall be full compensation for furnishing joint sealant materials, backer rod, all incidental materials, for all preparation, delivering, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the Work.

(2) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

605.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P605.010	Silicone Joint Sealant	Gallon (GAL)
P605.012	Silicone Joint Sealant	Pound (LB)
P605.014	Silicone Joint Sealant	Lineal Feet (LF)
P605.020	Hot Applied Joint Sealant	Gallon (GAL)
P605.022	Hot Applied Joint Sealant	Pound (LB)
P605.024	Hot Applied Joint Sealant	Lineal Feet (LF)
P605.030	Hot Applied Fuel Resistant Joint Sealant	Gallon (GAL)
P605.032	Hot Applied Fuel Resistant Joint Sealant	Pound (LB)
P605.034	Hot Applied Fuel Resistant Joint Sealant	Lineal Feet (LF)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D789	Standard Test Method for Determination of Relative Viscosity of Polyamide (PA)
ASTM D5249	Standard Specification for Backer Material for Use with Cold- and Hot- Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints
ASTM D5893	Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements
ASTM D6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM D7116	Standard Specification for Joint Sealants, Hot Applied, Jet Fuel Resistant Types for Portland Cement Concrete Pavements

Advisory Circulars (AC)

AC 150/5340-30	Design and Installation Details for Airport Visual Aids

END SPECIFICATION P605

Specification P606 - Adhesive Compounds, Two-Component for Sealing Wire and Lights in Pavement

606.1 Description

606.1.1 General

(1) This specification for two-component, adhesive compounds for sealing wire and lights in pavements covers two types of material; a liquid suitable for sealing electrical wire in saw cuts in pavement and for sealing light fixtures or bases in pavement, and a paste suitable for embedding light fixtures in the pavement. Both types of material are two-component filled formulas with the characteristics specified in 606.2.4. Materials supplied for use with asphalt pavements must be formulated so they are compatible with the asphalt. Materials supplied for use with concrete pavements must be formulated so they are compatible with the asphalt and/or concrete.

606.2 Equipment and Materials

606.2.1 Curing

(1) When pre-warmed to 77 degrees Fahrenheit, mixed, and placed in accordance with manufacturer's directions, the materials shall cure at temperatures of 45 degrees Fahrenheit or above without the application of external heat.

606.2.2 Storage

(1) The adhesive components shall not be stored at temperatures over 86 degrees Fahrenheit unless otherwise specified by the manufacturer.

606.2.3 Caution

(1) Installation and use shall be in accordance with the manufacturer's recommended procedures. Avoid prolonged or repeated contact with skin. In case of contact, wash with soap and flush with water. If taken internally, call doctor. Keep away from heat or flame. Avoid vapor. Use in well-ventilated areas. Keep in cool place. Keep away from children.

606.2.4 Characteristics

(1) When mixed and cured in accordance with the manufacturer's directions, the materials shall have the following properties shown in Table 606.2.4.

Table 606.2.4. Property Requirements

Physical or Electrical Property	Minimum	Maximum	ASTM Method
Tensile			
Portland cement concrete	1,000 psi (70 kg/sq cm)		D 638
Asphalt concrete	500 psi (35 kg/sq cm)		
Elongation			
Portland cement concrete		See note [1]	D 638
Asphalt concrete	50 percent		D 638
Coef. of cub. exp. cu. cm/cu. cm/°C	0.00090	0.00120	D 1168
Coef. of lin. exp. cm/cm/°C	0.000030	0.000040	D 1168
Dielectric strength, short time test	350 volts/mil.		D 149
Arc resistance	125 sec		

Physical or Electrical Property	Minimum	Maximum	ASTM Method
Pull-off			
Adhesion to steel	1,000 psi (70 kg/sq cm)		
Adhesion to Portland cement concrete	200 psi (14 kg/sq cm)		
Adhesion to asphalt concrete	No test available.		
Adhesion to aluminum	250 psi		

[1] 20 percent or more (without filler) for formulations to be supplied for areas subject to freezing.

606.3 Sampling, Inspection, and Test Procedures

606.3.1 Tensile Properties.

(1) Tests for tensile strength and elongation shall be conducted in accordance with ASTM D638.

606.3.2 Expansion.

(2) Tests for coefficients of linear and cubical expansion shall be conducted in accordance with, Method B, except that mercury shall be used instead of glycerine. The test specimen shall be mixed in the proportions specified by the manufacturer, and cured in a glass tub approximately 2 inch (50 mm) long by 3/8 inch in diameter. The interior of the tube shall be pre-coated with a silicone mold release agent. The hardened sample shall be removed from the tube and aged at room temperature for one week before conducting the test. The test temperature range shall be from 35 degrees Fahrenheit to 140 degrees Fahrenheit.

606.3.3 Test for Dielectric Strength.

(1) Test for dielectric strength shall be conducted in accordance with ASTM D149 for sealing compounds to be furnished for sealing electrical wires in pavement.

606.3.4 Test for Arc Resistance

(1) Test for arc resistance shall be conducted for sealing compounds to be furnished for sealing electrical wires in pavement.

606.3.5 Test for Adhesion To Steel

(1) The ends of two smooth, clean, steel specimens of convenient size (one inch by one inch by six inch) would be satisfactory when bonded together with adhesive mixture and allowed to cure at room temperature for a period of time to meet formulation requirements and then tested to failure on a Riehle (or similar) tensile tester. The thickness of adhesive to be tested shall be 1/4 inch.

606.3.6 Adhesion to Portland Cement Concrete

606.3.6.1 Concrete Test Block Preparation

(1) The aggregate grading shall be as shown in Table 606.3.6.

(2) The coarse aggregate shall consist of crushed rock having a minimum of 75 percent of the particles with at least one fractured face and having a water absorption of not more than 1.5 percent. The fine aggregate shall consist of crushed sand manufactured from the same parent rock as the coarse aggregate. The concrete shall have a water-cement ratio of 5.5 gallons of water per bag of cement, a cement factor of six, plus or minus 0.5, bags of cement per cubic yard of concrete, and a slump of 2-1/2 inch, plus or minus1/2 inch. The ratio of fine aggregate to total aggregate shall be approximately 40 percent by solid volume. The air content shall be 5.0 percent, plus or minus 0.5 percent, and it shall be obtained by the addition to the batch of an air-entraining admixture such as Vinsol® resin. The mold shall be of metal and shall be provided with a metal base plate.

(3) Means shall be provided for securing the base plate to the mold. The assembled mold and base plate shall be watertight and shall be oiled with mineral oil before use. The inside measurement of the mold shall be such that several one inch by two inch by three inch test blocks can be cut from the specimen with a concrete saw having a diamond blade. The concrete shall be prepared and cured in accordance with ASTM C192.

Table 606.3.6 Aggregate For Bond Test Blocks

Type	Sieve Size	Percent Passing
Coarse Aggregate	3/4 inch (19 mm)	97 to 100
	1/2 inch (12 mm)	63 to 69
	3/8 inch (9 mm)	30 to 36
	No. 4 (4.75 mm)	0 to 3
Fine Aggregate	No. 4 (4.75 mm)	100
	No. 8 (2.36 mm)	82 to 88
	No. 16 (1.18 mm)	60 to 70
	No. 30 (600 µm)	40 to 50
	No. 50 (300 µm)	16 to 26
	No. 100 (150 µm)	5 to 9

606.3.6.2 Bond Test

(1) Prior to use, oven-dry the test blocks to constant weight at a temperature of 220 degrees Fahrenheit to 230 degrees Fahrenheit, cool to room temperature, 73.4 degrees Fahrenheit plus or minus 3 degrees Fahrenheit, in a desiccator, and clean the surface of the blocks of film or powder by vigorous brushing with a stiff-bristled fiber brush. Two test blocks shall be bonded together on the one inch by 3 inch sawed face with the adhesive mixture and allowed to cure at room temperature for a period of time to meet formulation requirements and then tested to failure in a Riehle (or similar) tensile tester. The thickness of the adhesive to be tested shall be 1/4 inch.

606.3.7 Compatibility with Asphalt Concrete

(1) Test for compatibility with asphalt in accordance with ASTM D5329.

606.3.8 Adhesive Compounds - Contractor's Responsibility

(1) Contractor shall furnish the vendor's certified test reports for each batch of material delivered to the project. The report shall certify that the material meets specification requirements and is suitable for use in the type of pavement in which it will be placed (Portland Cement Concrete or asphalt concrete). The report shall be provided to and accepted by the Engineer before permission is granted for use of the material. In addition the Contractor shall obtain a statement from the supplier or manufacturer that guarantees the material for one year. The supplier or manufacturer shall furnish evidence that the material has performed satisfactorily on other projects.

606.3.9 Application

(1) Adhesive shall be applied on a dry, clean surface, free of grease, dust, and other loose particles. The method of mixing and application shall be in strict accordance with the manufacturer's recommendations. When used with Specification P605, such as light can installation, Specification P605 shall not be applied until the Specification P606 has fully cured.

606.4 Measurement

606.4.1 General

(1) The adhesive compound shall be measured by the pound or gallon of adhesive as specified, in place, complete and accepted. When required in the installation of an in-pavement lighting system or portion thereof, no measurement will be made for direct payment of adhesive, as the cost of furnishing and installing shall be considered as a subsidiary obligation in the completion of the installation.

606.5 Payment

606.5.1 General

(1) Payment shall be made, where applicable, at the contract unit price per pound or gallon for the adhesive compound. This price shall be full compensation for furnishing all materials, and for all preparation,

delivering, and application of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the Work.

(2) Measurement and payment will only be made for Pay Items included in the Schedule of Prices. Include the cost of all Work required in the Contract Documents in the Pay Items in the Schedule of Prices.

606.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P606.010	Adhesive Compound for Sealing Wire in Pavement	Pound (LB)
P606.020	Adhesive Compound for Sealing Wire in Pavement	Gallon (GAL)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C192	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM D149	Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D5329	Standard Test Methods for Sealants and Fillers, Hot-applied, for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements

END OF SPECIFICATION P606

Specification P610 - Structural Portland Cement Concrete (PCC)

610.1 Description

610.1.1 General

(1) This Work shall consist of plain or reinforced structural Portland cement concrete (PCC), prepared and constructed in accordance with these specifications, at the locations and of the form and dimensions shown on the Plans. This specification shall be used for all concrete, other than airfield pavement, which is cast-in-place.

610.2 Materials

610.2.1 General

(1) Only approved materials, conforming to the requirements of these specifications, shall be used in the Work. Materials may be subject to inspection and tests at any time during their preparation or use. The source of all materials shall be approved by the Engineer before delivery or use in the work. Representative preliminary samples of the materials shall be submitted by the Contractor, when required, for examination and test. Materials shall be stored and handled to ensure preservation of their quality and fitness for use and shall be located to facilitate prompt inspection. All equipment for handling and transporting materials and concrete must be clean before any material or concrete is placed in them.

(2) The use of pit-run aggregates shall not be permitted unless the pit-run aggregate has been screened and washed, and all fine and coarse aggregates stored separately and kept clean. The mixing of different aggregates from different sources in one storage stockpile or alternating batches of different aggregates shall not be permitted.

610.2.1.1 Reactivity

(1) Fine and Coarse aggregates to be used in all concrete shall have been tested separately within six months of the project in accordance with ASTM C1260. Test results shall be submitted to the Engineer. The aggregate shall be considered innocuous if the expansion of test specimens, tested in accordance with ASTM C1260, does not exceed 0.08 percent at 28 days (16 days from casting). If the expansion either or both test specimen is greater than 0.08 percent at 14 days but less than 0.20 percent, a minimum of 25 percent of Type F fly ash, or between 40% and 55% of slag cement shall be used in the PCC mix.

(2) If the expansion is greater than 0.20 percent the aggregates shall not be used, and test results for other aggregates must be submitted for evaluation; or aggregates that meet P-501 reactivity test requirements may be utilized.

(3) Testing will not be required for projects containing less than 500 cubic yards, unless the source of the aggregate is in Clark, Marathon, Portage, or Wood Counties.

610.2.2 Coarse Aggregate

(1) The coarse aggregate for concrete shall meet the requirements of ASTM C33 and the requirements of Table 4, Class Designation 5S; and the grading requirements shown below, as required for the project.

Table 610.2.2

Coarse Aggregate Grading Requirements

Maximum Aggregate Size	ASTM C33, Table 3 Grading Requirements (Size No.)
1 1/2 inch (37.5 mm)	467 or 4 and 67
1 inch (25 mm)	57
¾ inch (19 mm)	67
½ inch (12.5 mm)	7

610.2.2.1 Aggregate Susceptibility to Durability (D) Cracking

(1) Coarse aggregate may be accepted from sources that have a 20-year service history for the same gradation to be supplied with no history of D-Cracking. Aggregates that do not have a 20-year record of service free from major repairs (less than five percent of slabs replaced) in similar conditions without D-cracking shall not be used unless the material currently being produced has a durability factor greater than or equal to 95 per ASTM C666 procedure B. The Contractor shall submit a current certification and test results to verify the aggregate acceptability. Test results will only be accepted from a State Department of Transportation (DOT) materials laboratory or an accredited laboratory. Certification and test results which are not dated or which are over one year old or which are for different gradations will not be accepted.

(2) Crushed granite, calcite cemented sandstone, quartzite, basalt, diabase, rhyolite or trap rock are considered to meet the D-cracking test requirements but must meet all other quality tests specified in P501.

610.2.3 Fine Aggregate

(1) Fine aggregate for concrete shall meet all fine aggregate requirements of ASTM C33.

610.2.4 Cement

(1) Cement shall conform to the requirements of ASTM C150, Type I, II, or III; ASTM C595, Type IP (provided maximum less on ignition is 2 percent) or ASTM C595, Type IS.

610.2.5 Cementitious Materials

610.2.5.1 Fly Ash

(1) Fly ash shall meet the requirements of ASTM C618, with the exception of loss of ignition, where the maximum shall be less than six percent. Fly ash for use in mitigating alkali-silica reactivity shall have a Calcium Oxide (CaO) content of less than 13 percent and a total available alkali content less than three percent per ASTM C311. Fly ash produced in furnace operations using liming materials or soda ash (sodium carbonate) as an additive shall not be acceptable. The Contractor shall furnish the previous three most recent, consecutive ASTM C618 reports for each source of fly ash proposed in the mix design, and shall furnish each additional report as they become available during the project. The reports can be used for acceptance or the material may be tested independently by the Engineer.

610.2.5.2 Slag Cement (Ground Granulated Blast Furnace (GGBF))

(1) Slag cement shall conform to ASTM C989, Grade 100 or Grade 120. Slag cement shall be used only at a rate between 25 percent and 55 percent of the total cementitious material by mass.

610.2.6 Water

(1) The water used in mixing or curing shall be fresh, clean and potable water sources. Other sources shall be tested in accordance with ASTM C1602.

610.2.7 Admixtures

(1) The Contractor shall submit certificates indicating that the material to be furnished meets all of the requirements indicated by the following. In addition, the Engineer may require the Contractor to submit complete test data from an approved laboratory showing that the material to be furnished meets all of the requirements of the cited specifications. Subsequent tests may be made of samples taken by the Engineer from the supply of the material being furnished or proposed for use on the work to determine whether the admixture is uniform in quality with that approved.

610.2.7.1 Air-Entraining Admixtures

(1) Air-entraining admixtures shall meet the requirements of ASTM C260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entrainment agent and any water reducer admixture shall be compatible.

610.2.7.2 Water-Reducing Admixtures

(1) Water-reducing admixture shall meet the requirements of ASTM C494, Type A, B, or D. ASTM C494, Type F and G high range water reducing admixtures and ASTM C1017 flowable admixtures shall not be used.

610.2.7.3 Other Chemical Admixtures

(1) The use of set retarding, and set-accelerating admixtures shall be approved by the Engineer. Retarding shall meet the requirements of ASTM C494, Type A, B, or D and set-accelerating shall meet the requirements of ASTM C494, Type C. Calcium chloride and admixtures containing calcium chloride shall not be used.

610.2.7.4 Fly ash

(1) Fly ash shall meet the requirements of ASTM C618, with the exception of loss of ignition, where the maximum shall be less than six percent. Fly ash for use in mitigating alkali-silica reactivity shall have a Calcium Oxide (CaO) content of less than 13 percent.

610.2.8 Premolded Joint Material

(1) Premolded joint material for expansion joints shall meet the requirements of ASTM D1751 or ASTM D1752**.**

610.2.9 Joint Filler

(1) The filler for joints shall meet the requirements of Specification P605, unless otherwise specified.

610.2.10 Steel Reinforcement

(1) Reinforcement shall conform to the following requirements unless a specific type is indicated on the Plans**.**

Table 610.2.10
Reinforcement

Reinforcing Steel	ASTM A615, ASTM A706, ASTM A775, ASTM A934
Welded Steel Wire Fabric	ASTM A1064
Welded Deformed Steel Fabric	ASTM A1064
Bar Mats	ASTM A184 or ASTM A704

610.2.11 Materials for Curing Concrete

(1) Curing materials shall conform to one of the following, unless a specific type is indicated on the Plans.

Table 610.2.10
Curing Compound

Waterproof paper	ASTM C171
Clear or white Polyethylene Sheeting	ASTM C171
White-pigmented Liquid Membrane-Forming Compound, Type 2, Class B	ASTM C309

610.3 Construction
610.3.1 General

(1) The Contractor shall furnish all labor, materials, and services necessary for, and incidental to, the completion of all work as shown on the drawings and specified here. All machinery and equipment used by the Contractor on the work, shall be of sufficient size to meet the requirements of the work. All work shall be subject to the inspection and approval of the Engineer.

610.3.2 Concrete Composition

(1) The concrete shall develop a compressive strength of 4000 psi in 28 days, or as shown on the Plans or in the Special Provisions, as determined by test cylinders made in accordance with ASTM C31 and tested in accordance with ASTM C39. The concrete shall contain not less than 470 pounds of cementitious material per cubic yard. The water cementitious ratio shall not exceed 0.45 by weight. The air content of the concrete shall contain five percent of entrained air, plus or minus 1.2 percent, as determined by ASTM C231 and shall have a slump of not more than four inches as determined by ASTM C143.

610.3.3 Mixing

(1) Concrete may be mixed at the construction site, at a central point, or wholly or in part in truck mixers. The concrete shall be mixed and delivered in accordance with the requirements of ASTM C94 or ASTM C685.

(2) Concrete shall be mixed only in quantities required for immediate use. Concrete shall not be mixed while the air temperature is below 40 degrees Fahrenheit without the Engineer's approval. If approval is granted for mixing under such conditions, aggregates or water, or both, shall be heated and the concrete

shall be placed at a temperature not less than 50 degrees Fahrenheit nor more than 100 degrees Fahrenheit. Contractor shall be held responsible for defective work, resulting from freezing or injury in any manner during placing and curing, and shall replace such work at his expense.

(3) Retempering of concrete by adding water or other material shall not be permitted.

(4) The rate of delivery of concrete to the job shall be sufficient to allow uninterrupted placement of the concrete.

610.3.4 Forms

(1) Concrete shall not be placed until all the forms and reinforcements have been inspected and approved by the Engineer. Forms shall be of suitable material and shall be of the type, size, shape, quality, and strength to build the structure as shown on the Plans. Forms shall be true to line and grade and shall be mortar-tight and sufficiently rigid to prevent displacement and sagging between supports. Surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes. Contractor shall be responsible for their adequacy.

(2) The internal form ties shall be arranged so no metal will show in the concrete surface or discolor the surface when exposed to weathering when the forms are removed. All forms shall be wetted with water or with a non-staining mineral oil, which shall be applied immediately before the concrete is placed. Forms shall be constructed so they can be removed without injuring the concrete or concrete surface. The forms shall not be removed until at least 30 hours after concrete placement for vertical faces, walls, slender columns, and similar structures. Forms supported by false work under slabs, beams, girders, arches, and similar construction shall not be removed until tests indicate the concrete has developed at least 60 percent of the design strength.

610.3.5 Placing Reinforcement

(1) All reinforcement shall be accurately placed, as shown on the Plans, and shall be firmly held in position during concrete placement. Bars shall be fastened together at intersections. The reinforcement shall be supported by approved metal chairs. Shop drawings, lists, and bending details shall be supplied by the Contractor when required.

610.3.6 Embedded Items

(1) Before placing concrete, all embedded items shall be firmly and securely fastened in place as indicated. All embedded items shall be clean and free from coating, rust, scale, oil, or any foreign matter. The concrete shall be spaded and consolidated around and against embedded items. The embedding of wood shall not be allowed.

610.3.7 Concrete Consistency.

(1) The Contractor shall monitor the consistency of the concrete delivered to the project site; collect each batch ticket; check temperature; and perform slump tests on each truck at the project site in accordance with ASTM C143.

610.3.8 Placing concrete

(1) All concrete shall be placed during daylight hours, unless otherwise approved. The concrete shall not be placed until the depth and condition of foundations, the adequacy of forms and false work, and the placing of the steel reinforcing have been approved by the Engineer. Concrete shall be placed as soon as practical after mixing, but in no case later than one hour after water has been added to the mix. The method and manner of placing shall avoid segregation and displacement of the reinforcement. Troughs, pipes, and chutes shall be used as an aid in placing concrete when necessary. The concrete shall not be dropped from a height of more than five feet. Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to procedures which cause segregation. Concrete shall be placed on clean, damp surfaces, free from running water, or on a properly consolidated soil foundation.

610.3.9 Vibration

(1) Vibration shall follow the guidelines in American Concrete Institute (ACI) Committee 309R, Guide for Consolidation of Concrete. The vibration at any point shall be of sufficient duration to accomplish consolidation without voids and shall not be prolonged to where segregation occurs.

610.3.10 Joints

(1) Joints shall be constructed at such points and dimensions as indicated on the Plans.

610.3.11 Surface Finish

(1) All exposed concrete surfaces shall be true, smooth, and free from open or rough areas, depressions, or projections. All concrete horizontal plane surfaces shall be brought flush to the proper elevation with

the finished top surface struck-off with a straightedge and floated. Mortar finishing shall not be permitted, nor shall dry cement or sand-cement mortar be spread over the concrete during the finishing of horizontal plane surfaces.

610.3.12 Curing and Protection

(1) All concrete shall be properly cured in accordance with the recommendations in American Concrete Institute (ACI) 308R, Guide to External Curing of Concrete. The concrete shall be protected from damage until project acceptance.

610.3.13 Cold Weather Placing

(1) When concrete is placed at temperatures below 40 degrees Fahrenheit, follow the cold weather concreting recommendations found in ACI 306R, Cold Weather Concreting.

610.3.14 Hot Weather Placing

(1) When concrete is placed in hot weather, follow the hot weather concreting recommendations found in ACI 305R, Hot Weather Concreting.

610.4 Quality Assurance (QA)

610.4.1 Quality Assurance sampling and testing.

(1) Concrete for each day's placement will be accepted on the basis of the compressive strength specified in 610.3.2. Engineer will sample the concrete in accordance with ASTM C172; test the slump in accordance with ASTM C143; test air content in accordance with ASTM C231; make and cure compressive strength specimens in accordance with ASTM C31; and test in accordance with ASTM C39. The QA testing agency will meet the requirements of ASTM C1077.

(2) Contractor shall provide adequate facilities for the initial curing of cylinders.

610.4.2 Defective work.

(1) Defective work that cannot be satisfactorily repaired as determined by Engineer, shall be removed and replaced at the Contractor's expense. Defective work includes, but is not limited to, uneven dimensions, honeycombing and other voids on the surface or edges of the concrete.

610.5 Measurement

610.5.1 General

(1) Portland cement concrete shall be measured by the number of cubic yards of concrete complete in place and accepted or per lump sum for a designated structure. In computing the yardage of concrete for payment, the dimensions used shall be those shown on the Plans or ordered by the Engineer. No measurements or other allowances shall be made for forms, false work, cofferdams, pumping, bracing, expansion joints, or finishing of the concrete. No deductions in yardage shall be made for the volumes of reinforcing steel or embedded items.

(2) Reinforcing steel shall be measured by the calculated theoretical number of pounds placed, as shown on the Plans, complete in place and accepted; or if no Pay Item for steel reinforcement is included in the Schedule of Prices, then steel reinforcement shall be incidental Work and the cost included in the price bid for Structural PC Concrete for the structure. The unit weight used for deformed bars shall be the weight of plain square or round bars of equal nominal size. If so indicated on the Plans, the poundage to be paid for shall include the weight of metal pipes and drains, metal conduits and ducts, or similar materials indicated and included.

610.6 Payment

610.6.1 General

(1) Payment shall be made at the Contract unit price per cubic yard for Structural Portland Cement Concrete and per pound for Steel Reinforcement for Structures. These prices shall be full compensation for furnishing all materials and for all preparation, delivery and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the Work.

(2) Payment shall be made at the Contract unit price per lump sum for Portland Cement Concrete for a designated structure. This price shall be full compensation for furnishing all materials, including steel reinforcement, and for all preparation, delivery and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the Work.

(3) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices.. Include the cost of all Work required by the Contract Documents in the Pay Items in the Schedule of Prices. When structural Portland cement concrete and steel reinforcement is required on the Plans and is designated as incidental Work, the cost shall be included in other Pay Items in the Schedule of Prices

610.6.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P610.010	Structural Portland Cement Concrete	Cubic yard (CY)
P610.020	Steel Reinforcement for Structures	Pound (LB)
P610.030 through P610.039	Portland Cement Concrete for Structure (No.___)	Lump Sum (LS)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM A184 Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement

ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM A704 Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement

ASTM A706 Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

ASTM A775 Standard Specification for Epoxy-Coated Steel Reinforcing Bars

ASTM A884 Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement

ASTM A934 Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars

ASTM A1064 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field

ASTM C33 Standard Specification for Concrete Aggregates

ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

ASTM C94 Standard Specification for Ready-Mixed Concrete

ASTM C114 Standard Test Methods for Chemical Analysis of Hydraulic Cement

ASTM C136 Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates

ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse AggregatesASTM C143 Standard Test Method for Slump of Hydraulic-Cement Concrete

ASTM C150 Standard Specification for Portland Cement

ASTM C171 Standard Specification for Sheet Materials for Curing Concrete

ASTM C172 Standard Practice for Sampling Freshly Mixed Concrete

ASTM C231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

ASTM C260 Standard Specification for Air-Entraining Admixtures for Concrete

ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C311	Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
ASTM C685	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1017	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1157	Standard Performance Specification for Hydraulic Cement
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1365	Standard Test Method for Determination of the Proportion of Phases in Portland Cement and Portland-Cement Clinker Using X-Ray Powder Diffraction Analysis
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types)
ASTM D1752	Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

American Concrete Institute (ACI)

ACI 305R	Hot Weather Concreting
ACI 306R	Cold Weather Concreting
ACI 308R	Guide to External Curing of Concrete
ACI 309R	Guide for Consolidation of Concrete

END OF SPECIFICATION P610

Specification P620 - Runway and Taxiway Marking

620.1 Description

620.1.1 General

(1) This Work shall consist of the preparation and painting of numbers, markings, and stripes on the surface of runways, taxiways, and aprons, in accordance with these specifications and at the locations shown on the Plans, or as directed by the Engineer. The terms “paint” and “marking material” as well as “painting” and “application of markings” are interchangeable throughout this specification.

620.2 Materials

620.2.1 Materials Acceptance

(1) Contractor shall furnish manufacturer’s certified test reports and manufacturers recommendations for application for materials shipped to the project. The certified test reports shall include a statement that the materials meet the specification requirements. This certification along with a copy of the paint manufacturer’s surface preparation; marking materials, including adhesion, flow promoting and/or floatation additive; and application requirements must be submitted and approved by the Engineer prior to the initial application of markings. The reports can be used for material acceptance or the Engineer may perform verification testing. The reports shall not be interpreted as a basis for payment. Contractor shall notify the Engineer upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers that are easily quantifiable for inspection by the Engineer. Material shall not be loaded into the equipment until inspected by the Engineer.

620.2.2 Marking Materials

(1) Paint shall be waterborne or epoxy, as indicated in the Contract Document, Plans, or Special Provisions, in accordance with the requirements of this Specification.

620.2.2.1 Paint

(1) Paint shall be waterborne or epoxy in accordance with the requirements of this paragraph. Paint colors shall comply with Federal Standard No. 595 and the following Table.

Paint Color	Fed Std. No 595 Color Number
White	37925
Red	31136
Yellow	33538 or 33655
Black	37038
Pink	1 part 31136 to 2 parts 37925
Green	34108

620.2.2.2 Waterborne

(1) Paint shall meet the requirements of Federal Specification TT-P-1952E, Type I, Type II, or Type III as specified. The non-volatile portion of the vehicle for all paint types shall be composed of a 100 percent acrylic polymer as determined by infrared spectral analysis. The acrylic resin used for Type III shall be 100 percent cross linking acrylic as evidenced by infrared peaks at wavelengths 1568, 1624, and 1672 cm-l with intensities equal to those produced by an acrylic resin known to be 100 percent cross linking.

620.2.2.3 Epoxy

(1) Paint shall be a two component, minimum 99 percent solids type system conforming to the following:

620.2.2.3.1 Pigments

(1) Component A. Percent by weight.

a. White:

i. Titanium Dioxide, ASTM D476, type II shall be 18 percent minimum (16.5 percent minimum at 100 percent purity).

b. Yellow and Colors:

i. Titanium Dioxide, ASTM D476, type II shall be 14 to 17 percent.

ii. Organic yellow, other colors, and tinting as required to meet color standard.

iii. Epoxy resin shall be 75 to 79 percent.

620.2.2.3.2 Epoxy Content

(1) Component A. The weight per epoxy equivalent, when tested in accordance with ASTM D1652 shall be the manufacturer's target plus or minus fifty.

620.2.2.3.3 Amine Number

(1) Component B. When tested in accordance with ASTM D2074 shall be the manufacturer's target plus or minus fifty.

620.2.2.3.4 Prohibited Materials

(1) The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant Federal Regulations.

620.2.2.3.5 Daylight Directional Reflectance

(1) Provide the following:

a. White: The daylight directional reflectance of the white paint shall not be less than 75 percent (relative to magnesium oxide), when tested in accordance with ASTM E2302.

b. Yellow: The daylight directional reflectance of the yellow paint shall not be less than 55 percent (relative to magnesium oxide), when tested in accordance with ASTM E2302. The x and y values shall be consistent with the Federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x .462	x .470	x .479	x .501
y .438	y .455	y .428	y .452

620.2.2.3.6 Accelerated Weathering

(1) Provide the following:

a. Sample preparation. Apply the paint at a wet film thickness of 0.013 inch to four three × six inch aluminum panels prepared as described in ASTM E2302. Air dry the sample 48 hours under standard conditions.

b. Testing conditions. Test in accordance with ASTM G154 using both Ultra Violet (UV-B) Light and condensate exposure, 72 hours total, alternating four hour UV exposure at 140 degrees Fahrenheit, and four hours condensate exposure at 104 degrees Fahrenheit.

c. Evaluation. Remove the samples and condition for 24 hours under standard conditions. Determine the directional reflectance and color match using the procedures in 620.2.2.3.5. Evaluate for conformance with the color requirements.

620.2.2.3.7 Volatile Organic Content

(1) Determine the volatile organic content in accordance with 40 CFR Part 60 Appendix A, Method 24.

620.2.2.3.8 Dry Opacity

(1) Use ASTM E2302. The wet film thickness shall be 0.015 inch. The minimum opacity for white and colors shall be 0.92.

620.2.2.3.9 Abrasion Resistance

(1) Subject the panels prepared in 620.2.2.3.6 to the abrasion test in accordance with ASTM D968, Method A, except that the inside diameter of the metal guide tube shall be from 0.747 to 0.750 inch. Seventeen and one-half pounds of unused sand shall be used for each test panel. The test shall be run on two test panels Both baked and weathered paint films shall require not less than 150 liters of sand for the removal of the paint films.

620.2.2.3.10 Hardness, Shore

(1) Hardness shall be at least 80 when tested in accordance with ASTM D2240.

620.2.2.4 Reflective Media

(1) Glass beads for white and yellow paint shall meet the requirements for Federal Specification TT-B-1325D and the following Table for Bead usage.

(2) Glass beads for red and pink paint shall meet the requirements in Table 620.2.2.1.Glass beads shall be treated with all compatible coupling agents recommended by the manufacturers of the paint and reflective media to ensure adhesion and embedment.

(3) Glass beads shall not be used in black and green paint.

(4) Type III glass beads shall not be used in red and pink paint.

Table 620.2.2.4

Glass Bead Usage

	Glass Beads		
Paint Color	**Type I, Gradation A**	**Type III**	**Type IV**
White	See Table 620.3.5	See Table 620.3.5	See Table 620.3.5
Yellow	See Table 620.3.5	See Table 620.3.5	See Table 620.3.5
Red	See Table 620.3.5 and Note	Not used	See Table 620.3.5 and Note
Pink	See Table 620.3.5 and Note	Not used	See Table 620.3.5 and Note
Black	Not used	Not used	Not used
Green	Not used	Not used	Not used

620.3 Construction

620.3.1 Weather Limitations

(1) Painting shall only be performed only when the surface is dry, and the ambient surface temperature and the pavement surface temperature meet the manufacturer's recommendations in accordance with 620.2.1. Painting operations shall be discontinued when the ambient or surface temperatures does not meet the manufacturer's recommendations. Markings shall not be applied when the pavement temperature is greater than 130 degrees Fahrenheit. Markings shall not be applied when the wind speed exceeds 10 miles per hour unless windscreens are used to shroud the material guns. Markings shall not be applied when weather conditions are forecast to not be within the manufacturers' recommendations for recommended application and dry time.

620.3.2 Equipment

(1) Equipment shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, a bead dispensing machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.

(2) The mechanical marker shall be an atomizing spray-type or atomizing type marking machine with automatic glass bead dispensers suitable for application of traffic paint. It shall produce an even and uniform film thickness and appearance of both paint and glass beads at the required coverage and shall apply markings of uniform cross-sections and clear-cut edges without running or spattering and without over spray. The marking equipment for both paint and beads shall be calibrated daily.

620.3.3 Preparation of Surfaces

(1) Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other contaminated material that would reduce the bond between the paint and the pavement. Use of any chemicals or impact abrasives during surface preparation shall be approved in advance by the Engineer. After the cleaning operations, sweeping, blowing, or rinsing with pressurized water shall be performed to ensure the surface is clean and free of grit or other debris left from the cleaning process.

(2) Prior to the application of markings, the Contractor shall certify in writing that the surface is dry and free from dirt, grease, oil, laitance, or other foreign material that would prevent the bond of the paint to the pavement or existing markings. This certification along with a copy of the paint manufactures application

and surface preparation requirements must be submitted to the Engineer prior to the initial application of markings.

620.3.3.1 Preparation of New Pavement Surfaces.

(1) The area to be painted shall be cleaned by broom and blower, water blasting, or by other methods approved by the Engineer to remove all contaminants, including PCC curing compounds, without damage to the pavement surface.

620.3.3.2 Preparation of Pavement to Remove Existing Markings.

(1) Existing pavement markings shall be removed by rotary grinding or by other methods approved by the Engineer minimizing damage to the pavement surface. The removal area may need to be larger than the area of the markings to eliminate ghost markings. After removal of markings on asphalt concrete pavements, apply a fog seal or seal coat to 'block out' the removal area to eliminate 'ghost' markings.

620.3.3.3 Preparation of Pavement Markings Prior to Remarking.

(1) Prior to remarking existing markings, loose existing markings must be removed with a method as approved by the Engineer. After removal, the surface shall be cleaned of all residue or debris.

620.3.4 Layout of Markings

(1) The proposed markings shall be laid out in advance of the paint application. Locations of markings to receive glass beads and silica sand are indicated on the Plans.

620.3.5 Application

(1) A period of 30 days shall elapse between placement of surface course or seal coat and application of the permanent paint markings. Paint shall be applied at the locations and to the dimensions and spacing shown on the Plans. Paint shall not be applied until the layout and condition of the surface has been approved by the Engineer.

(2) The edges of the markings shall not vary from a straight line more than 1/2 inch in 50 feet, and marking dimensions and spacing shall be within the following tolerances:

Marking Dimensions and Spacing Tolerance

Dimension and Spacing	Tolerance
36 inch or less	±1/2 inch
greater than 36 inch to 6 feet	±1 inch
greater than 6 feet to 60 feet	±2 inch
greater than 60 feet	±3 inch

(3) The paint shall be mixed in accordance with the manufacturer's instructions and applied to the pavement with a marking machine at the rate shown in Table 620.3.5. The addition of thinner will not be permitted. A period of 30 days, or as specified on the Plans or Special Provisions, shall elapse between placement of an asphalt surface course or seal coat and application of the paint.

(4) Glass beads shall be distributed upon the marked areas at the locations shown on the Plans to receive glass beads immediately after application of the paint. A dispenser shall be furnished that is properly designed for attachment to the marking machine and suitable for dispensing glass beads. Glass beads shall be applied at the rate shown in Table 620.3.5. Glass beads shall not be applied to black paint or green paint. Glass beads shall adhere to the cured paint or all marking operations shall cease until corrections are made. Different bead types shall not be mixed. Regular monitoring of glass bead embedment and distribution should be performed.

(5) All emptied containers shall be returned to the paint storage area for checking by the Engineer. The containers shall not be removed from the airport or destroyed until authorized by the Engineer.

620.3.6 Control Strip

(1) Prior to the full application of airfield markings, the Contractor shall prepare a control strip in the presence of the Engineer. Engineer shall determine the size and location of the control strip. Contractor shall demonstrate the surface preparation method and all striping equipment to be used on the project. The marking equipment must achieve the prescribed wet film thickness of paint and population of glass beads (per Table 620.3.5 - Application Rates for Paint and Glass Beads) that are properly embedded

and evenly distributed across the full width of the marking. Prior to acceptance of the control strip, markings must be evaluated during darkness to ensure a uniform appearance.

620.3.7 Retro-reflectance.

(1) Reflectance shall be measured with a portable retro-reflectometer meeting ASTM E1710 (or equivalent). A total of 6 reading shall be taken over a 6 square foot area with 3 readings taken from each direction. The average shall be equal to or above the minimum levels of all readings which are within 30% of each other.

Minimum Retro-Reflectance Values

Material	Retro-reflectance mcd/m^2/lux		
	White	Yellow	Red
Initial Type I	300	175	35
Initial Type III	600	300	35
Initial Thermoplastic	225	100	35
All materials, remark when less than[1]	100	75	10

[1] 'Prior to remarking determine if removal of contaminants on markings will restore retro-reflectance

620.3.8 Protection And Cleanup

(1) After application of the markings, all markings shall be protected from damage until dry. All surfaces shall be protected from excess moisture and/or rain and from disfiguration by spatter, splashes, spillage, or drippings. Contractor shall remove from the work area all debris, waste, loose or unadhered reflective media, and by-products generated by the surface preparation and application operations to the satisfaction of the Engineer. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and Federal environmental statutes and regulations.

620.4 Measurement

620.4.1 General

(1) The quantity of runway and taxiway markings to be paid for shall be the number of square feet of painting and the number of pounds of reflective media performed in accordance with the specifications and accepted by the Engineer.

620.5 Payment

620.5.1 General

(1) Payment shall be made at the respective Contract price per square foot painting, and price per pound for reflective media. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the Work.

(2) Payment shall be made at the Contract price per square foot temporary marking of the color and type indicated. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the Work.

(3) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

620.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P620.111	Painting White Waterborne Type I	Square Feet (SF)
P620.112	Painting White Waterborne Type II	Square Feet (SF)
P620.113	Painting White Waterborne Type III	Square Feet (SF)
P620.211	Painting Red Waterborne Type I	Square Feet (SF)
P620.212	Painting Red Waterborne Type II	Square Feet (SF)
P620.213	Painting Red Waterborne Type III	Square Feet (SF)

P620.311	Painting Yellow Waterborne Type I	Square Feet (SF)
P620.312	Painting Yellow Waterborne Type II	Square Feet (SF)
P620.313	Painting Yellow Waterborne Type III	Square Feet (SF)
P620.411	Painting Black Waterborne Type I	Square Feet (SF)
P620.412	Painting Black Waterborne Type II	Square Feet (SF)
P620.413	Painting Black Waterborne Type III	Square Feet (SF)
P620.511	Painting Pink Waterborne Type I	Square Feet (SF)
P620.512	Painting Pink Waterborne Type II	Square Feet (SF)
P620.513	Painting Pink Waterborne Type III	Square Feet (SF)
P620.611	Painting Green Waterborne Type I	Square Feet (SF)
P620.612	Painting Green Waterborne Type II	Square Feet (SF)
P620.613	Painting Green Waterborne Type III	Square Feet (SF)
P620.120	Painting White Epoxy	Square Feet (SF)
P620.220	Painting Red Epoxy	Square Feet (SF)
P620.320	Painting Yellow Epoxy	Square Feet (SF)
P620.420	Painting Black Epoxy	Square Feet (SF)
P620.520	Painting Pink Epoxy	Square Feet (SF)
P620.620	Painting Green Epoxy	Square Feet (SF)
P620.710	Reflective Media Type I Gradation A	Pound (LB)
P620.720	Reflective Media Type II	Pound (LB)
P620.730	Reflective Media Type IV	Pound (LB)
P620.740 though P620.759	Temporary Marking (color) Waterborne (type)	Square Foot (SF)
P620.800	Marking Removal	Square Feet (SF)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D476 Standard Classification for Dry Pigmentary Titanium Dioxide Products

ASTM D968 Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive

ASTM D1652 Standard Test Method for Epoxy Content of Epoxy Resins

ASTM D2074 Standard Test Method for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method

ASTM D2240 Standard Test Method for Rubber Property - Durometer Hardness

ASTM D7585 Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments

ASTM E303 Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester

ASTM E1710 Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer

ASTM E2302 Standard Test Method for Measurement of the Luminance Coefficient Under Diffuse Illumination of Pavement Marking Materials Using a Portable Reflectometer

ASTM G154 Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

Code of Federal Regulations (CFR)

40 CFR Part 60, Appendix A-7, Method 24
Determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings

29 CFR Part 1910.1200 Hazard Communication

Federal Specifications FED SPEC)

FED SPEC TT-B-1325D Beads (Glass Spheres) Retro-Reflective

FED SPEC TT-P-1952E Paint, Traffic and Airfield Marking, Waterborne

FED STD 595 Colors used in Government Procurement

Commercial Item Description

A-A-2886B Paint, Traffic, Solvent Based

Advisory Circulars (AC)

AC 150/5340-1 Standards for Airport Markings

AC 150/5320-12 Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces

END OF SPECIFICATION P620

Specification P621 - Saw-Cut Grooves

621.1 Description

621.1.1 General

(1) This Work consists of constructing saw-cut grooves to minimize hydroplaning during wet weather, providing a skid resistant surface in accordance with these specifications and at the locations shown on the Plans, or as directed Engineer.

621.2 Construction

621.2.1 Procedures.

(1) Contractor shall submit to the Engineer the grooving sequence and method of placing guide lines to control grooving operation. Transverse grooves saw-cut in the pavement must form a 1/4 inch (+1/16 inch, -0 inch) wide by 1/4 inch (plus or minus 1/16 inch) deep by 1-1/2 inch (-1/8 inch, +0 inch) center-to-center configuration. The grooves must be continuous for the entire runway length. They must be saw-cut transversely (perpendicular to centerline) in the runway and high-speed taxiway pavement to not less than 10 feet from the runway pavement edge to allow adequate space for equipment operation.

(2) The saw-cut grooves must meet the following tolerances. The tolerances apply to each day's production and to each piece of grooving equipment used for production. Contractor is responsible for all controls and process adjustments necessary to meet these tolerances. Contractor shall routinely spot check for compliance each time the equipment aligns for a grooving pass.

621.2.1.1 Alignment tolerance.

(1) The grooves shall not vary more than plus or minus 1-1/2 inch in alignment for 75 feet along the runway length, allowing for realignment every 500 feet along the runway length.

621.2.1.2 Groove tolerance.

(1) Depth. The standard depth is 1/4 inch. At least 90 percent of the grooves must be at least 3/16 inch at least 60 percent of the grooves must be at least 1/4 inch, and not more than 10 percent of the grooves may exceed 5/16 inch.

621.2.1.3 Width.

(1) The standard width is 1/4 inch. At least 90 percent of the grooves must be at least 3/16 inch, at least 60 percent of the grooves must be at least 1/4 inch, and not more than 10 percent of the grooves may exceed 5/16 inch.

621.2.1.4 Center-to-center spacing.

(1) The standard spacing is 1-1/2 inch. Minimum spacing 1-3/8 inch. Maximum spacing 1-1/2 inch.

(2) Saw-cut grooves must not be closer than three inches or more than nine inches from transverse joints in concrete pavements. Grooves must not be closer than six inches and no more than 18 inches from in-pavement light fixtures. Grooves may be continued through longitudinal construction joints. Where neoprene compression seals have been installed and the compression seals are recessed sufficiently to prevent damage from the grooving operation, grooves may be continued through the longitudinal joints. Where neoprene compression seals have been installed and the compression seals are not recessed sufficiently to prevent damage from the grooving operation, grooves must not be closer than three inches or more than five inches from the longitudinal joints. Where lighting cables are installed, grooving through longitudinal or diagonal saw kerfs shall not be allowed.

621.2.2 Environmental Requirements.

(1) Grooving operations will not be permitted when freezing conditions prevent the immediate removal of debris and drainage of water from the grooved area. Discharge and disposal of waste slurry shall be the Contractor's responsibility.

621.2.3 Control Strip

(1) Groove a control strip in an area of the pavement outside of the trafficked area, as approved by the Engineer. The area shall be 300 feet long by two lanes wide. Demonstrate the setup and alignment process, the grooving operation, and the waste slurry disposal.

621.2.4 Existing Pavements.

(1) Bumps, depressed areas, bad or faulted joints, and badly cracked or spalled areas in the pavement shall not be grooved until such areas are adequately repaired or replaced.

621.2.5 New Pavements.

(1) New asphalt concrete pavements shall be allowed to cure for a minimum of 30 days before grooving, to allow the material to become stable enough to prevent closing of the grooves under normal use. If it can be demonstrated that grooves are stable, and can be installed with no spalling, tearing or raveling of the groove edge, grooving may occur sooner that 30 days with approval of the Engineer. All grade corrections must be completed prior to grooving. Spalling along or tearing or raveling of the groove edges shall not be allowed.

621.2.6 Grooving Machine.

(1) Provide a grooving machine that is power driven, self-propelled, specifically designed and manufactured for pavement grooving, and has a self-contained and integrated continuous slurry vacuum system as the primary method for removing waste slurry. The grooving machine shall be equipped with diamond-saw cutting blades, and capable of making at least 18 inches in width of multiple parallel grooves in one pass of the machine. Thickness of the cutting blades shall be capable of making the required width and depth of grooves in one pass of the machine. The cutting head shall not contain a mixture of new and worn blades or blades of unequal wear or diameter. Match the blade type and configuration with the hardness of the existing airfield pavement. The wheels on the grooving machine shall be of a design that will not scar or spall the pavement. Provide the machine with devices to control depth of groove and alignment.

621.2.7 Water Supply.

(1) Water for the grooving operation shall be provided by the Contractor.

621.2.8 Clean-Up.

(1) During and after installation of saw-cut grooves, the Contractor must remove from the pavement all debris, waste, and by-products generated by the operations to the satisfaction of the Engineer. Cleanup of waste material must be continuous during the grooving operation. Flush debris produced by the machine to the edge of the grooved area or pick it up as it forms. The dust coating remaining shall be picked up or flushed to the edge of the area if the resultant accumulation is not detrimental to the vegetation or storm drainage system. Accomplish all flushing operations in a manner to prevent erosion on the shoulders or damage to vegetation. Waste material must be disposed of in an approved manner. Waste material must not be allowed to enter the airport storm sewer system. The Contractor must dispose of these wastes in strict compliance with all applicable state, local, and Federal environmental statutes and regulations

621.2.9 Repair of Damaged Pavement.

(1) Grooving must be stopped and damaged pavement repaired at the Contractor's expense when directed by Engineer.

621.3 Acceptance

621.3.1 Acceptance Testing.

(1) Grooves will be accepted based on results of zone testing. All acceptance testing necessary to determine conformance with the groove tolerances specified will be performed by the Engineer.

(2) Instruments for measuring groove width and depth must have a range of at least 0.5 inch and a resolution of at least 0.005 inch. Gauge blocks or gauges machined to standard grooves width, depth, and spacing may be used.

(3) Instruments for measuring center-to-center spacing must have a range of at least 3 inches and a resolution of at least 0.02 inch.

(4) The Engineer will measure grooves in five zones across the pavement width. Measurements will be made at least three times during each day's production. Measurements in all zones will be made for each cutting head on each piece of grooving equipment used for each day's production.

(5) The five zones are as follows:

Zone 1	Centerline to 5 feet left or right of the centerline.
Zone 2	5 feet to 25 feet left of the centerline.
Zone 3	5 feet 25 feet right of the centerline.
Zone 4	25 feet to edge of grooving left of the centerline.
Zone 5	25 feet to edge of grooving right of the centerline.

(6) At a random location within each zone, five consecutive grooves sawed by each cutting head on each piece of grooving equipment will be measured for width, depth, and spacing. The five consecutive measurements must be located about the middle blade of each cutting head plus or minus 4 inches. Measurements will be made along a line perpendicular to the grooves.

a. Width or depth measurements less than 0.170 inch shall be considered less than 3/16 inch.
b. Width or depth measurements more than 0.330 inch shall be considered more than 5/16 inch.
c. Width or depth measurements more than 0.235 inch shall be considered more than 1/4 inch.

(7) Production must be adjusted when more than one groove on a cutting head fails to meet the standard depth, width, or spacing in more than one zone.

621.4 Measurement

621.4.1 General

(1) The quantity of grooving to be paid for shall be the number of square yards of grooving performed in accordance with the specifications and accepted by the Engineer per 621.3.1.

621.5 Payment

621.5.1 Payment for Saw-Cut Grooving.

(1) Payment for saw-cut grooving for asphalt or Portland cement concrete pavement will be made at the Contract unit price per square yard for saw-cut grooving. This price shall be full compensation for furnishing all materials, and for all preparation, delivering, and application of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

(2) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

621.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P621.010	Saw-Cut Grooves	Square yard (SY)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5320-12 Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces

END OF SPECIFICATION P621

Specification P628 - Crack Sealing Asphalt Pavement

628.1 Description

628.1.1 General

(1) This Work shall consist of routing, cleaning, preparing and sealing 1/4 inch wide or wider cracks in existing bituminous pavement. Cracks shall be sealed with a petroleum–based crack sealant.

628.1.2 Experience

(1) The Department will only allow crack sealing work to be performed by a contractor (whether a subcontractor or a prime contractor) who has demonstrated the ability to successfully perform crack sealing work. Successful performance is defined as having sealed cracks on runways or taxiways (40,000 S.Y. total) at one airport in Wisconsin, Minnesota or upper Michigan utilizing similar methods and materials as required on this project. This crack sealing work must have survived one winter with no more than 10 percent cumulative failure of the sealant during the winter. Provide documentation of use and performance.

628.2 Materials

628.2.1 General

(1) Material for crack sealing shall be Poly-Fiber type pavement sealant, which is a blend of high quality modified asphalt and polyester fibers. Polyester fibers shall constitute four percent to six percent of the weight when blended with high quality modified asphalt cement. Material shall conform to ASTM D5167 as manufactured by Crafco Company, or equal. A sample of sealant material to be used shall be submitted to the Engineer.

(2) Each lot or batch of sealing compound shall be delivered to the jobsite in the manufacturer's original sealed container. Each container shall be marked with the manufacturer's name, batch or lot number, and the safe heating temperature and shall be accompanied by the manufacturer's certification stating that the compound meets the requirements of this Specification.

628.3 Construction

628.3.1 Equipment

(1) Contractor shall furnish all equipment necessary to complete the routing, cleaning, preparing and sealing of cracks in accordance with the requirements specified. Equipment required for this operation include the following:

a. Mechanical router capable of routing the bituminous pavement to provide a depth to width ratio of all routed cracks of one to one.
b. High pressure air equipment capable of blowing sand and other foreign materials from a crack.
c. Air chisel or hand tools to remove loose or spalled material adjacent to cracks.
d. Pressure distributor for applying sealing material through a hand–operated wand or nozzle in accordance with sealant manufacturer's instructions.

628.3.2 Construction

(1) Existing cracks to be sealed will be marked by the Engineer. Cracks to be sealed shall be routed to a minimum width of 3/4 inch and a minimum depth of 3/4 inch. Where existing cracks have been previously sealed, remove failed sealant to the depth of the route, and overbond.

(2) At locations where water jetting does not remove broken or spalled material adjacent to the crack, use an air chisel or hand tools to remove the material.

(3) Remove vegetation from cracks.

(4) Contractor shall provide a power vacuum or equivalent to immediately remove all debris, including failed sealant, as soon as the cracks are cleaned.

(5) When being filled, the cleaned cracks shall be dry, either by air drying or a high capacity torch. Immediately prior to sealing, the dried crack shall be blown out with compressed air, 80 psi minimum.

(6) Crack sealant shall be applied as per manufacturer's instructions and as outlined in Specification P605. The crack shall be overfilled to approximately three times the width of the routed crack and approximately 1/8 inch thick on adjacent pavement surfaces.

(7) In wide cracks, Contractor shall insert closed cell backer rod material, rope, or other pliable fill material approved by the Engineer in the bottom of the crack in order to maintain the one to one depth to width ratio of the sealant and reduce the amount of material used. Backer rod shall be installed as necessary to limit the amount of sealing material on average (for the project) to 0.5 lbs. per lineal foot of cracks sealed.

(8) At locations where crack sealant settles into the crack opening more than 1/4 inch below adjacent pavement, apply additional material to meet filling Specification.

(9) Hot Poured Sealants. The joint sealant shall be applied uniformly from bottom to top and shall be sealed without formation of entrapped air or voids. A backing material shall be placed as shown on the Plans and shall not adhere to the concrete or the sealant material. The heating kettle shall be an indirect heating type, constructed as a double boiler. A positive temperature control and mechanical agitation shall be provided. The sealant shall not be heated to more than 20 degrees Fahrenheit below the safe heating temperature. The safe heating temperature can be obtained from the manufacturer's shipping container. A direct connecting pressure type extruding device with nozzles shaped for insertion into the joint shall be provided. Sealant spilled on the surface of the pavement shall be removed immediately.

628.3.3 Guarantee

(1) Crack repairs shall be guaranteed for a period of two years following acceptance of the Work. Not more than five percent of the footage of cracks shall have material pulled away from the side of the crack; shall have cracks within the material; shall be missing sealant from the crack; or shall allow entrance of water into the crack. If more than five percent of the footage of cracks is judged to have failed, the Contractor is required to repair failed cracks to the Engineer's satisfaction. If less than five percent of the cracks have failed, repairs will not be necessary. The Engineer shall determine which cracks have failed.

(2) Contractor shall return to the project site each of the following two summers and repair sealed cracks that have failed in accordance with the above guarantee. Crack repair shall be done at no additional cost.

628.4 Measurement

628.4.1 Method of Measurement

(1) Crack Sealing Asphalt Pavement shall be measured by the pound of sealant installed and accepted.

628.5 Payment

628.5.1 Basis of Payment

(1) Crack Sealing Asphalt Pavement shall be paid for at the Contract unit price per pound of crack sealant used. The price bid shall be full compensation for labor, materials, equipment required to rout cracks, clean and dry, install sealant, and appurtenant work.

(2) Measurement and payment will only be made for Pay Items included in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

628.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P628.010	Crack Sealing Asphalt Pavement	Pound (LB)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications 14369 are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D 3405 Joint Sealants, Hot–Poured, for Concrete and Asphalt Pavements

ASTM D5167 Standard Practice for Melting of Hot-Applied Joint and Crack Sealant and Filler for Evaluation

END OF SPECIFICATION P628

Specification P640 – Sawing

640.1 Description

640.1.1 General

(1) This section describes sawing of existing concrete or asphalt including pavement, curb and gutter, driveways, sidewalks, and similar work.

640.2 (Vacant)

640.3 Construction

640.3.1 Equipment

(1) Use diamond blades for sawing concrete where a full-depth cut is required. Contractor may use carbide cutting wheels to saw concrete that will be overlaid or for full-depth cuts where the cut face does not join the new concrete.

640.3.2 Sawing Asphalt

(1) Saw asphalt pavement full depth unless the Plan indicates otherwise. Make straight saw cuts. Saw so the surface remaining is generally vertical over its full depth.

640.3.3 Sawing Concrete

(1) Do not extend saw cuts into newly placed concrete pavement or into existing pavements more than 12-inches beyond the limits the Engineer designates. Saw full-depth unless the Plans indicate otherwise.

(2) Remove sawing sludge after completing each saw cut. Minimize sludge on pavement surface. Dispose of sludge at an acceptable material disposal site provided by Contractor.

640.4 Measurement

(1) The department will measure Sawing Asphalt and Sawing PC Concrete by the linear foot acceptably completed. Department will not measure overcuts beyond the limits the Plans show or the Engineer directs.

(1) If performing Sawing Concrete in conjunction with concrete pavement repair and replacement or concrete base patching, the Department will measure the applicable total quantity of the following:

a. One full-depth longitudinal cut through the repair area if the Engineer deems that cut necessary.

b. Two full-depth transverse cuts, one at each limit of the repair area.

c. Additional transverse cuts as necessary to reduce the removal slabs to a transportable size. The department will not measure cuts made to reduce removal slabs to a width less than seven feet.

d. Additional full-depth cuts the Engineer directs to extend the repair limits, unless those cuts were required because of damage contractor operations caused.

(2) The department will measure and pay for composite cuts through both asphalt and concrete as concrete.

640.5 Payment

640.5.1 General

(1) Payment shall be made at the contract unit price per linear foot as provided in the Schedule of Prices for Sawing Asphalt or Sawing Concrete. This price shall be full compensation for furnishing all materials; for all preparation, sawing, removal and disposal of sludge and debris, sweeping; and for all labor, equipment, tools, testing and incidentals necessary to complete the Work.

(2) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

(3) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P640.015	Sawing Asphalt	Linear Foot (LF)
P640.025	Sawing Concrete	Linear Foot (LF)

END OF SPECIFICATION P640

Specification P642 - Field Facilities

642.1 Description

(1) This section describes furnishing, placing or erecting, equipping, and maintaining field offices office equipment, and field laboratories as required in the Contract at Engineer-approved locations.

642.2 Materials

642.2.1 General

(1) Provide field offices and field laboratories that are mobile, house-type trailers, or houses, or other Engineer-approved types that are floored, roofed, and weatherproofed, and have a minimum ceiling height of six feet, nine inches.

(2) Equip these facilities with suitable artificial lighting and adequate heating equipment along with the necessary fuel to maintain a minimum temperature of 68 degrees Fahrenheit during the hours occupied.

(3) Provide and maintain an adequate supply of bottled drinking water.

(4) Provide and maintain suitable interior or exterior sanitary facilities conforming to State and local health requirements, in clean and good working condition, and stock with sanitary supplies for the duration of the Contract.

(5) Supply a first aid kit in each field office and field laboratory provided under the Contract. Ensure the kits are readily accessible to project personnel. Check the contents of each kit at least once each week and replenish expended items. Ensure each kit contains, at a minimum, a supply of latex or nitrile gloves, CPR masks, adhesive tape, pressure and cling bandages, antiseptic wipes, bite/sting swabs, cold packs, and safety goggles.

(6) For situations that may expose the eyes or body of a worker to corrosive or potentially harmful materials, provide emergency use facilities capable of flushing the eyes, or drenching the body of an exposed worker with water for 15 minutes.

(7) Provide at least four windows, positioned for cross ventilation, and equipped with required locks and screens. Securely fasten heavy screening over all windows. Use screening made of No. 2 mesh, 14-gauge or heavier, steel wire cloth, zinc coated after weaving.

(8) Equip with a six pound or larger fire extinguisher conforming to class A, B, and C of the NFPA Code.

(9) Equip the exterior doors with heavy-duty clasps bolted through the door and jamb with heavy-duty padlocks.

642.2.2 Field Office

642.2.2.1 General

(1) Provide each field office with two rooms, separated by an interior door with a padlock. Provide each room with a separate exterior door and its own air conditioner.

642.2.2.2 Communication Equipment

(1) Provide high-speed internet and voice with long distance communications services via a land line for exclusive Department use that have the following:

a. A dynamic IP address (DHCP).

b. Ability to accommodate IPSec based VPN products.

c. A modem router with a capacity for four or more personal computers with wireless network capabilities.

d. A connection speed of five Mbps download and one Mbps upload or more, with four computers operating simultaneously.

e. Two programmable touch-tone phones, one of which is cordless. Ensure that phone operations will not interfere with other telecommunications equipment.

f. Telephone voice mail service or a telephone answering machine.

(2) Communication equipment may be bid as a separate Pay Item with the intent that it will provide service to an existing Airport building or a field facility furnished by others. The service location shall be as indicated on the Plans or Special Provisions.

642.2.2.3 Copier and Scanner

(1) Provide and maintain a Windows 7 and Windows 10 plain-paper photocopier with scanner capability that can accommodate both 8 ½-inch x 11-inch and 11-inch x 17-inch paper. Replenish paper, toner cartridges, and other supplies before fully expended.

(2) Copier and scanning equipment may be bid as a separate Pay Item with the intent that it will be utilized by Engineer during construction at a location indicated on the Plans or in the Special Provisions.

642.2.2.4 Field Office Furniture

(1) Equip with a drafting table with a drafter's stool. Except as specified in 642.2.5, provide two ergonomically correct office chairs in working condition with, at a minimum, the following:

a. Five-legged base with casters.

b. Seat adjustable from 15 inches to 22 inches from the floor with a seamless waterfall, rounded, front edge.

c. High backrest with no arms or adjustable arms.

642.2.3 Field Office Type B

(1) Under Pay Item Field Office Type B, furnish a facility with minimum exterior dimensions of 8 feet wide and 20 feet long, excluding hitch; and equipped as specified in 642.2.2.2, 642.2.2.3, and 642.2.2.4

642.2.4 Field Office Type C

(1) Under Pay Item Field Office Type C, furnish a facility with minimum exterior dimensions of 10 feet wide and 30 feet long or 8 feet wide and 40 feet long, excluding hitch; equipped as specified in 642.2.2.2, 642.2.2.3, and 642.2.2.4 and with the following:

a. Two suitable office desks with drawers and locks.

b. Three folding chairs.

642.2.5 Field Office Type D

(1) Under Pay Item Field Office Type D, furnish a facility with minimum exterior dimensions of 10 feet wide and 30 feet long, excluding hitch; and equipped as specified in 642.2.2.2; 642.2.2.3, and 642.2.2.4 and with the following:

a. Three suitable office desks with drawers and locks.

b. One additional office chair for a total of 3.

c. Two folding tables.

d. Nine folding chairs.

642.2.6 Field Laboratory

(1) Under the Field Laboratory Pay Item, furnish a facility of minimum exterior dimensions of 8 feet wide and 16 feet long, excluding hitch; and equipped as specified in 642.2.2.1 except as follows:

a. Provide a suitable workbench.

b. Provide at least 15-linear feet of shelving, approximately 14 inches wide.

c. Provide an adequate water supply for testing purposes.

d. Only one air conditioner is required.

e. No office chairs are required.

(2) If using the laboratory for HMA pavement work, equip it with a suitable fan with a minimum capacity of 1000-cubic feet per minute, in good working condition. Install the fan in an outside wall above the work bench used for asphalt extraction testing. Enclose the fan inlet and work bench top in a suitable hood or enclosure that allows effective removal of the fumes from the extraction testing.

642.3 Construction

(1) Locate field offices and field facilities at engineer-approved locations. The field office and laboratory shall be located on the airport unless otherwise approved by the Engineer in writing.

(2) Do not combine field offices and field laboratories, or combine them with, or attached them to, buildings used by the Contractor, unless the Engineer allows in writing.

(3) Anchor or secure the field offices and field laboratories to prevent them from overturning by high velocity winds. Locate the field office in a dust-reduced and vibration-free environment.

(4) Do not begin construction operations requiring the use of the field office and laboratory by the Department, until the required field office and laboratory are furnished, leveled, secured, fully equipped, and made ready for use at the locations the Engineer directs.

(5) The field office and laboratory shall remain available for Department use for the duration of the Contract, or until the Engineer approves their closure or removal.

(6) These field facilities are for the sole use of the Department and upon Contract completion remain the Contractor's property.

(7) Contractor may furnish, if the Contract allows, the field office and field laboratory facilities jointly in cooperation with other contractors on designated projects.

642.4 Measurement

(1) Department will measure the Field Office, Communication Equipment, Copier and Scanner, and Field Laboratory Pay Items as a single unit for each field office and laboratory acceptably completed.

642.5 Payment

642.5.1 General

(1) Payment for the Field Office and Field Laboratory Pay Items is full compensation for providing, equipping, securing, and maintaining the facility; for communications equipment, copier and scanner, field office furniture, installation, and usage and service fees; and for providing bottled water, utilities, fuel, ventilation, and toilet facilities as required, either independently or jointly, for the time specified in 642.3.

(2) Payment for Communication Equipment and copier and scanner is full compensation for providing, installing, paying installation and usage costs, maintenance, removal, and appurtenant costs. Separate payment for Communication Equipment and copier and scanner will only be made for equipment not located in Contractor furnished Field Offices and Field Laboratories. The cost of Communication Equipment and copier and scanner provided for Field Office and Field Laboratories shall be included in the prices bid for those items.

642.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P642.010 to P642.019	Field Office (type) (location)	Each (EA)
P642.020 through P642.029	Field Laboratory	Each (EA)
P642.030 through P642.035	Communication Equipment (location)	Lump Sum (LS)
P642.040 through P642.045	Copier and Scanner (location)	Lump Sum (LS)

END OF SPECIFICATION P642

Specification P643 – Airport Construction Traffic Control

643.1 Description

643.1.1 General

(1) This Specification describes Work required to implement the Construction Safety and Phasing Plan (CSPP). The CSPP and construction scheduling requirements are included in the Project Plans and other portions of the Contract Documents. Contractor shall be responsible for preparing a Safety Plan Compliance Document (SPCD) to implement the CSPP and for providing services and material to construct phasing and traffic control devices required to complete the Project. Contractor shall comply with the requirements of the CSPP and the SPCD, including providing, erecting, maintaining, repositioning, and removing runway and taxiway closing crosses, low profile lighted barricades, temporary signs, temporary pavement markings, drums, barricades, flexible tubular markers, and other traffic control devices shown on the Plans. This item also includes covering lights, covering signs, and temporary jumper cables when required or when shown on the Plans, unless this work is specifically included in other Pay Items.

(2) Work required under this Specification also includes flags, lights, and other requirements for construction vehicles operating on the Airport.

643.1.2 Construction Safety and Phasing Plan

(1) Implement the CSPP and SPCD in accordance with FAA Advisory Circular 150/5370-2 (current version) Operational Safety on Airports During Construction.

(2) The CSPP shall address the following requirements. Refer to the CSPP on the Plans or in the Special Provisions.

a. Coordination.
b. Phasing.
c. Areas and operations affected by the construction activity.
d. Protection of navigation aids (NAVAIDs).
e. Contractor access.
f. Wildlife management.
g. Foreign Object Debris (FOD) management.
h. Hazardous materials (HAZMAT) management
i. Notification of construction activities.
j. Inspection requirements.
k. Underground utilities.
l. Penalties.
m. Special conditions.
n. Runway and taxiway visual aids. Marking, lighting, signs, and visual NAVAIDs.
o. Marking and signs for access routes.
p. Hazard marking and lighting.
q. Protection. Of runway and taxiway safety areas, object free areas, obstacle free zones, and approach/departure surfaces
r. Other limitations on construction.

643.1.3 References

(1) State of Wisconsin Standard Specifications for Highway and Structure Construction (current edition) may be referred to in the Contract Documents as the State Highway Specifications. Provide, erect, maintain, reposition, and remove traffic control devices in accordance with State Highway Specifications.

(2) Federal Highway Administration Manual on Uniform Traffic Control Devices may be referred to in the Contract Documents as the MUTCD. Provide traffic control in accordance with applicable provisions of the MUTCD.

643.1.4 Definitions

(1) **Air Operations Area (AOA) –** Refer to Section 10 for the definition of AOA.

(2) **Movement Area –** Runways, taxiways, and other areas of an airport that are used for taxiing, takeoff, and landing of aircraft, exclusive of loading ramps and parking areas. At those airports with an operating

airport traffic control tower (ATCT), specific approval for entry onto the movement area must be obtained from air traffic control (ATC).

643.2 Materials

643.2.1 General

(1) Runway and Taxiway closing crosses shall be in conformance with the Contract Documents and FAA Advisory Circular 150/5370-2 (current version).

(2) Low profile lighted barricades shall be in accordance with the Contract Documents and FAA Advisory Circular 150/5370-2 (current version).

(3) Temporary traffic signs, pavement markings, drums, barricades, flexible tubular markers, and other traffic control devices shown on the Plans shall be in accordance with State Highway Specifications 643.2.

(4) Pavement markings and signs for construction shall conform to AC 150/5340-18 (current version) Standards for Airport Sign Systems.

643.3 Construction

643.3.1 General

(1) Construct Work shown on the CSPP in accordance with AC 150/5370-2 (current version) and 643.3 of the State Highway Specifications.

643.3.2 Construction Vehicles

(1) Identify and mark construction vehicles in accordance with AC 150/5210-5(current version). Vehicles, other than those that routinely traverse portions of the AOA under the control of ATC, which are not escorted by a vehicle in constant two-way radio communication with ATC and properly equipped and authorized to operate in the AOA, must be provided with a flag on a staff attached to the vehicle so that the flag will be readily visible.

(2) At airports without air traffic control facilities, flags must be provided on all vehicles.

(3) Flags must be at least a three-foot by three-foot square, having a checkered pattern of international orange and white squares at least one foot on each side (see AC 150/5210-5 Appendix A for the fabric color specification).

(4) Construction vehicles may be any color or combination of colors other than solid black or white.

(5) Construction vehicles which are not escorted by a properly lighted vehicle, must be identified during periods of low visibility by a light. Lights shall be yellow flashing light per the chromaticity requirements in Appendix B of AC 1505210-5.

(6) If escort vehicles are required, vehicle drivers shall be trained to ensure compliance with the airport operator's vehicle rules and regulations. Specific training should be provided to those vehicle operators providing escorts in accordance with AC 150/5210-20, Ground Vehicle Operations on Airports.

643.3.3 Maintenance

(1) Contractor shall provide maintenance for traffic control devices. Contractor shall have a person on call 24 hours a day for emergency maintenance of airport hazard lighting and barricades. Contractor must file the contact person's information with the airport operator. Lighting should be checked for proper operation at least once per day, preferably at dusk.

643.4 Measurement

(1) Airport Construction Traffic Control will be measured for payment as a single complete unit of Work per lump sum (LS).

(2) When State Highway Specification Pay Items for traffic control devices are included in the Schedule of Prices, they shall be measured in accordance with 643.4 of the State Highway Specifications.

643.5 Payment

643.5.1 General

(1) Payment will be made at the Contract lump sum price for Airport Construction Traffic Control, which shall be full compensation developing and implementing the SPCD and for keeping it current; and for furnishing materials, labor, transportation, and incidentals necessary to complete the Work as specified. If the Contract does not include separate Pay Items for traffic control devices described in the State Highway Specifications, then the Work under this Specification shall be incidental and the cost included in Contract Pay Item for Airport Construction Traffic Control.

(2) Measurement and payment will be made only for Pay Items included in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

643.5.2 Pay Items

(1) Standard Pay Items for Work covered by the Specification are as follows:

Pay Item	Description	Unit
P643.010	Airport Construction Traffic Control	Lump Sum (LS)

END OF SPECIFICATION P643

Specification P644 – Riprap

644.1 Description

644.1.1 General

(1) This Specification describes furnishing and placing riprap.

644.2 Materials

644.2.1 Riprap Stone

(1) Furnish durable field or quarry stone that is sound, hard, dense, resistant to the action of air and water, and free of seams, cracks, or other structural defects. Use stone pieces with a length and width no more than twice the thickness. Do not place material without Engineer's approval of the stone quality, size, and shape.

(2) The Department will determine the average dimension of stone pieces by averaging measurements of thickness, width, and length. Furnish stones conforming to the size requirements for the riprap grade shown on Plans. Size requirements are expressed as the percent of the gross in-place riprap volume occupied by stones within average dimension size ranges for each riprap grade as follows:

AVERAGE DIMENSION RANGES FOR EACH RIPRAP GRADE				**FRACTION OF GROSS**
Light Riprap	Medium Riprap	Heavy Riprap	Extra-Heavy Riprap	In-Place Riprap Volume Occupied By Stones
Inches	Inches	Inches	Inches	
>16	>20	>25	>30	0 percent
11 - 13	14 - 16	18 - 20	22 - 25	10% - 14%
9 - 11	11 - 14	14 - 18	18 - 22	15% - 21%
4 - 9	5 - 11	6.5 - 14	8 - 18	20% - 28%
<4	<5	<6.5	<8	5% - 7%
<1	<1	<1	<1	2% or less

(3) Contractor may substitute waste concrete slabs for stone. Furnish sound concrete, free of protruding reinforcement, and conforming to the size requirements specified for stone.

644.2.2 Riprap Grout

(1) Furnish an air-entrained mortar or concrete to fill the voids between riprap stones in grouted riprap. Conform to the physical requirements for component materials as specified in subsection 501.2 of the State Highway Specifications, except furnish fine aggregate or a combination of fine and coarse aggregate with a gradation that results in a grout with a consistency that allows complete filling of the riprap voids.

(2) Certify that the grout conforms to the following mixture requirements:

a. Contains 470 pounds or more of Portland cement per cubic yard of grout. Contractor may substitute class C fly ash for up to 30 percent of the required Portland cement.

b. Contains only enough water to achieve a 3-inch slump. Additional workability required to completely fill the riprap voids must be achieved with admixture without increasing the water to cement ratio.

c. Contains nine percent or more air for mixes with a nominal top size aggregate less than 3/8 inch or seven percent or more air for a mix with 3/8 inch or larger aggregate.

644.3 Construction

644.3.1 General

(1) Prepare the bed for the riprap by excavating, shaping the slopes, and constructing the toe for riprap installation. After placing the riprap, restore the surface of adjacent work and dispose of surplus material.

644.3.2 Placing Light Riprap

(1) If laying stone above the waterline, place it by hand. Lay it with close, broken joints and firmly bed it in the slope and against the adjoining stones. Lay the stones perpendicular to the slope with ends in contact. Compact the riprap thoroughly as construction progresses. Make the finished surface even and tight. Place larger stone in lower courses. Chink spaces between stones by firmly ramming spalls into

place. If placing riprap over geotextile fabric, use type R fabric and conform to 645.3.6 of the State Highway Specifications.

(2) Unless specified otherwise, make riprap at least one foot thick, measured perpendicular to the slope.

(3) Do not place riprap against, or in contact with, concrete surface before the end of the concrete's curing and protection period.

644.3.3 Placing Medium, Heavy, and Extra-Heavy Riprap

(1) Contractor may place medium, heavy, and extra-heavy riprap by mechanical means that produce a completed job within reasonable tolerances of the typical section the Plans show. Limit handwork to the amount necessary to fill large voids or to correct segregated areas. If placing riprap over geotextile fabric, use type HR fabric and conform to 645.3.7 the State Highway Specifications.

(2) Unless specified otherwise, make medium riprap at least 18 inches thick, heavy riprap at least 24 inches thick, and extra-heavy riprap at least 30 inches thick.

644.3.4 Placing Grouted Riprap

(1) If the Plans specify using grouted riprap, lay the stone as specified above under 644.3.2 or 644.3.3. Fill the spaces between the stones with cement mortar. Use sufficient mortar or concrete to completely fill all voids, except leave the face surface of the stone exposed.

(2) Place grout from the bottom to the top and then sweep the surface with a stiff broom. After completing the grouting, cure the surface as specified in 415.3.12 of the State Highway Specifications except substitute type 1-D curing compound as specified for structures in 502.2.6 of the State Highway Specifications. During cold weather, protect the concrete as specified in 415.3.13 of the State Highway Specifications for concrete pavement.

644.4 Measurement

(1) The Department will measure all the Pay Items under this Specification by the cubic yard acceptably completed, measured as the volume within the limiting dimensions the Contract designates or the Engineer establishes in the field.

644.5 Payment

644.5.1 General

(1) Payment shall be made at Contract unit price for the unit of measurement as previously specified. This price shall be full compensation for preparing the bed, providing and placing riprap, restoring adjacent work, and disposing of surplus material.

(2) Payment for the Grouted Riprap Pay Item also includes placing and curing mortar.

(3) Measurement and payment will only be made for Pay Items included in the Schedule of Prices. The cost for all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

644.5.2 Pay Items

(1) Standard Pay Items for Work covered by this Specification are as follows:

Pay Item	Description	Unit
P644.010	Riprap Light	Cubic Yard (CY)
P644.012	Riprap Medium	Cubic Yard (CY)
P644.014	Riprap Heavy	Cubic Yard (CY)
P644.016	Riprap Extra-Heavy	Cubic Yard (CY)
P644.020	Grouted Riprap Light	Cubic Yard (CY)
P644.022	Grouted Riprap Medium	Cubic Yard (CY)
P644.024	Grouted Riprap Heavy	Cubic Yard (CY)
P644.026	Grouted Riprap Extra-Heavy	Cubic Yard (CY)

END OF SPECIFICATION P644

Specification P645 - Geosynthetics

645.1 Description

(1) This Specification describes providing geotextile fabrics for subgrade separation and stabilization, drainage filtration, subgrade reinforcement, and under culverts and riprap.

(2) This section also describes providing geogrid for subgrade, marsh, and slope stability reinforcement.

645.2 Materials

645.2.1 General

(1) Furnish geotextile fabric of either woven or nonwoven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. All fabric shall have the minimum strength values in the weakest primary direction. Contractor may use nonwoven fabric that is one or a combination of the following: needle punched, heat bonded, or resin bonded.

(2) Furnish geotextile fabric that is insect, rodent, mildew, and rot resistant.

(3) Furnish the geotextile fabric in a wrapping that protects the fabric from ultraviolet radiation and from abrasion due to shipping and hauling. Keep the geotextile dry until installed.

(4) Clearly mark the geotextile fabric rolls to show the type of fabric.

(5) Engineer may obtain samples of fabric for testing from the job site as specified below, or as the Engineer determines.

(6) Furnish a manufacturer's certified report of test or analysis that shows the geotextile delivered meets the requirements of this specification to the engineer at least 15 days before use in the work. Mark the delivered geotextile to clearly identify it with the applicable test report furnished to the engineer.

(7) If using sewn seams, furnish a field sewn seam sample produced from the geotextile fabric and thread and with the equipment proposing to use on the project, before incorporating into the Work.

(8) If no minimum values are specified below, use those specified in the special provisions.

645.2.2 Geotextile Fabric, Type SAS (Subgrade Aggregate Separation)

(1) Furnish fabric conforming to the following physical properties:

TEST	METHOD	VALUE[1]
Minimum grab tensile strength	ASTM D4632	170 lb.
Minimum puncture strength	ASTM D6241	350 lb.
Maximum apparent opening size	ASTM D4751	No. 70
Minimum permittivity	ASTM D4491	0.35 s^{-1}

[1] All numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

(2) For quantities over 10,000 square yards, the engineer will obtain a sample of geotextile for testing from the job site. The engineer will obtain additional samples for each additional 10,000 square yards or lesser portion used in the work.

645.2.3 Geotextile Fabric, Type MS (Marsh Stabilization)

(1) Furnish fabric conforming to the physical properties required in the Special Provisions.

(2) Deliver to the Engineer a sample of the geotextile material at least 15 days before incorporating into the Work. At the same time, furnish a sewn seam sample using the same geotextile fabric, thread, seam spacing, and number, and overlap distance as are intended or required for use.

(3) Furnish to the Engineer, at least 15 days before use in the Work, a manufacturer's certified report of test or analysis that shows that the geotextile fabric delivered conforms to the above requirements. Mark the delivered geotextile fabric to clearly identify it with the applicable test report furnished to the Engineer. Engineer will obtain samples of fabric for testing from the job site for each 10,000 square yards or lesser portion used on the Contract.

645.2.4 Geotextile Fabric, Type DF (Drainage Filtration)

(1) Furnish fabric conforming with the physical requirements of either Schedule A, Schedule B, or Schedule C. Provide Schedule A, unless Schedule B or Schedule C is required on the Plans or in the Special Provisions.

SCHEDULE A TEST	METHOD	VALUE[1]
Minimum grab tensile strength	ASTM D4632	110 lb.
Minimum puncture strength	ASTM D6241	200 lb.
Minimum apparent breaking elongation	ASTM D4632	30%
Maximum apparent opening size	ASTM D4751	300 µm
Minimum permittivity	ASTM D4491	0.70 s^{-1}

SCHEDULE B TEST	METHOD	VALUE[1]
Minimum grab tensile strength	ASTM D4632	180 lb.
Minimum puncture strength	ASTM D6241	300 lb.
Minimum apparent breaking elongation	ASTM D4632	30%
Maximum apparent opening size	ASTM D4751	300 µm
Minimum permittivity	ASTM D4491	1.35 s^{-1}

SCHEDULE C TEST	METHOD	VALUE[1]
Minimum grab tensile strength	ASTM D4632	180 lb.
Minimum puncture strength	ASTM D6241	350 lb.
Minimum apparent breaking elongation	ASTM D4632	15%
Maximum apparent opening size	ASTM D4751	600 µm
Minimum permittivity	ASTM D4491	1.00 s^{-1}

[1] All numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

(2) Do not use slit film woven fabric for this Work.

(3) For quantities over 1,500 square yards, the engineer will obtain a sample of geotextile for testing from the job site. The engineer will obtain additional samples for each additional 1,500 square yards or lesser portion used in the work.

645.2.5 Geotextile Fabric, Type SR (Subgrade Reinforcement)

(1) Furnish fabric conforming to the physical properties the special provisions specify.

(2) For quantities over 10,000 square yards, furnish to the Engineer, at least 10 days before use in the Work, a manufacturer's certified report of test or analysis that shows the geotextile fabric delivered conforms to the above requirements. Mark the delivered geotextile fabric to clearly identify it with the applicable test report furnished to the Engineer. Engineer will obtain samples of fabric for testing from the job site for each 10,000 square yards or lesser portion thereof used on this Contract.

645.2.6 Geotextile Fabric, Type R (Riprap)

(1) Use fabric conforming to the following physical properties:

TEST	METHOD	VALUE[1]
Minimum grab tensile strength	ASTM D4632	205 lb.
Minimum puncture strength	ASTM D6241	400 lb.
Minimum apparent breaking elongation	ASTM D4632	15%
Maximum apparent opening size	ASTM D4751	No. 30
Minimum permittivity	ASTM D4491	0.12 s^{-1}

[1] All numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

(2) For quantities over 1,500 square yards, the engineer will obtain a sample of geotextile for testing from the job site. The engineer will obtain additional samples for each additional 5,000 square yards used in the work.

645.2.7 Geotextile Fabric, Type HR (Heavy Riprap)

(1) Use fabric conforming to the following physical properties:

TEST	METHOD	VALUE[1]
Minimum grab tensile strength, lb	ASTM D4632	305 lb.
Minimum puncture strength, lb	ASTM D6241	500 lb.
Minimum apparent breaking elongation, %	ASTM D4632	15%
Maximum apparent opening size	ASTM D4751	No. 30

Minimum permittivity	ASTM D4491	0.40, s^{-1}

[1] All numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

(2) For quantities over 1,500 square yards, the engineer will obtain a sample of geotextile for testing from the job site. The engineer will obtain additional samples for each additional 5,000 square yards used in the work.

645.2.8 Geotextile Fabric, Type C (Modified SAS)

(1) Use fabric conforming to the following physical properties:

TEST	METHOD	VALUE[1]
Grab tensile strength, lb	ASTM D4632	205 lb.
Puncture strength, lb	ASTM D6241	350 lb.
Maximum apparent opening size	ASTM D4751	No. 50
Minimum permittivity	ASTM D4491	0.12 s^{-1}

[1] All numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

(2) For quantities over 1,500 square yards, the engineer will obtain a sample of geotextile for testing from the job site. The engineer will obtain additional samples for each additional 5,000 square yards used in the work.

645.2.9 Geotextile Fabric, Type ES (Embankment Stabilization)

(1) Furnish fabric conforming to the physical properties required in the Special Provisions.

(2) Deliver to the Engineer a sample of the geotextile material at least 15 days before incorporating it into the Work. At the same time, furnish a sewn seam sample using the same geotextile fabric, thread, seam spacing and number, and overlap distance as are intended or required for use in the Work.

(3) Furnish to the Engineer, at least 15 days before use in the Work, a manufacturer's certified report of test or analysis that shows that the geotextile fabric delivered conforms to the above requirements. Mark the delivered geotextile fabric to clearly identify it with the applicable test report furnished to the Engineer. The Engineer will obtain samples of fabric for testing from the job site for each 10,000 square yard or lesser portion used on the Contract.

645.2.10 Geogrid

645.2.10.1 General

(1) Furnish geogrid that consists of either single or joined multiple layers of a uniform square or rectangular grid of bonded, formed, or fused polymer tensile strands. Furnish polyester, polypropylene, polyamide, or polyethylene material that maintains dimensional stability during handling, placing, and installation. Use geogrid that is at least 6.0 feet wide.

(2) Furnish a manufacturer's certified report of test or analysis that shows that the geogrid delivered meets the requirements of this specification to the engineer at least 15 business days before use in the work. Mark the delivered geogrid to clearly identify it with the applicable test report furnished to the engineer. The engineer will obtain samples of geogrid for testing from the job site for each 10,000 square yards or lesser portion used in the work.

645.2.10.2 Geogrid, Type SR (Subgrade Reinforcement)

(1) Provide geogrid for subgrade reinforcement that complies with the following physical properties:

TEST	METHOD	VALUE[1]
Tensile Strength at 5% Strain (both principal directions in lb/ft)	ASTM D6637	500 min
Overall Flexural Rigidity (mg-cm)	ASTM D7748	250,000 min.
Aperture Area (in^2)	Inside Measurement	5.0 max
Aperture Dimension (in)	Inside Measurement	0.5 min

[1] Numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

645.2.10.3 Geogrid, Type MR (Marsh Reinforcement)

(1) Provide geogrid for marsh reinforcement that complies with the physical properties specified in the contract special provisions.

645.2.10.4 Geogrid, Type SSR (Slope Stability Reinforcement)

(1) Provide geogrid for slope stability reinforcement that complies with the physical properties specified in the contract special provisions.

645.3 Construction

645.3.1 General

(1) Sew all factory and field seams with a thread having the same or greater durability as the fabric material. Use a 401 stitch conforming to Federal Standard No. 751a for all seams. Ensure that all seams develop a tensile strength equal to or greater than 60 percent of the specified grab tensile strength of the fabric, unless specified otherwise.

(2) Place, spread, and compact fill material above the geotextile as the contract specifies for that particular type of cover material.

645.3.2 Geotextile Fabric, Type SAS

(1) Before placing the geotextile fabric, smooth, shape, and compact the subgrade to the required grade, section, and density. After placing the fabric on the subgrade area, the Engineer will not allow traffic or construction equipment to travel directly on the fabric.

(2) Roll the fabric out on the roadway and pull taut manually to remove wrinkles. Join separate pieces of fabric by overlapping or sewing. Place the fabric in the overlapped joints so it overlaps at least 18 inches.

(3) Engineer may require the use of weights or pins to prevent the wind from lifting the fabric.

(4) After placing, do not expose the fabric longer than 48 hours before covering.

(5) Place backfill material over the geotextile by back dumping with trucks and leveling with a crawler dozer. Contractor shall not use construction equipment that causes ruts deeper than 3 inches. Fill all ruts with additional material. Engineer will not allow the Contractor to smooth ruts without adding additional material. Cover damaged areas with a patch of fabric using a three-foot overlap in all directions.

645.3.3 Geotextile Fabric, Type MS

(1) Complete clearing operations before placing the fabric. Within the area being covered by fabric, cut stumps and sharp objects level with the ground surface. Do not remove sod, grass, and roots that extend beneath the ground surface. Carefully place the geotextile fabric on the ground using hand methods to avoid disturbing the existing root mat and vegetation. Roll the fabric out as smoothly as possible and pull taut manually to remove wrinkles. Engineer may require the use of weights or pins to prevent the wind from lifting the fabric. After placement, do not expose the fabric longer than 48 hours before covering. If visible defects exist, replace the defective section of fabric with a new defect-free section of fabric.

(2) Place the geotextile fabric with the machine direction perpendicular to the roadway alignment. Sew all seams with two parallel stitch lines according to Plan details. Space the parallel stitching no more than one inch apart. Place all seams perpendicular to the roadway alignment and facing upward. Ensure that all seams develop at least 80 percent of the specified cross direction tensile strength of the fabric, as determined by the same testing methods. Do not make butt splices between individual roll ends. One stitch line may not cross another stitch line. Repair all breaks or faults in any seam as the Engineer directs.

(3) Place the initial fill layer over the fabric to a depth not less than one-foot but not more than 2 feet by carefully end dumping and pushing on to the fabric. Contractor shall not use construction equipment that causes ruts deeper than three inches and does not excessively deform the marsh surface. The Contractor shall not drive vehicles on the fabric. Complete the initial lift and install all instrumentation before placing any additional material. After placing the initial lift, place all subsequent lifts no deeper than one foot. Do not begin any lift until completing the preceding lift and obtaining the Engineer's approval. Conduct spreading operations so that no damage occurs to the fabric. Unless the Engineer directs otherwise, place and spread lifts by expanding outward from the centerline of the fill. If fill placement damages the fabric, remove the fill material around the damaged area and the Engineer will examine the damaged area to determine if the material requires replacement.

645.3.4 Geotextile Fabric, Type DF

(1) Before placing the geotextile fabric in trench drains, construct the trench to the grades and dimensions the Plans show or as the Engineer directs. Remove protruding stones and other matter that might damage the geotextile fabric from the trench walls and base before placing the fabric. Place the geotextile fabric in the trench so it conforms to the trench walls and remains in proper position during drain construction and backfilling. Contractor may join separate pieces of fabric by overlapping or sewing. If overlapping, place the fabric in overlap joints of at least 18 inches in the direction of drain flow.

Correct misaligned fabric as the Engineer directs. Engineer will direct treatment of damaged fabric areas by one of the following methods:

a. Place an additional section of fabric extending at least 24 inches beyond any point of the damaged area and position between the trench walls and the damaged fabric.

b. Remove the section of fabric containing the damaged area and replace it with a new section of fabric.

(2) After placing, do not expose the fabric longer than 48 hours before covering.

(3) For applications other than trench drains, construct the surface on which placing the fabric to the grades and dimensions the Plans show. Prepare the surface by removing or covering all objects that might damage the fabric. Carefully place the fabric to prevent damage and secure in position. Conduct backfilling or covering operations so that no damage or misalignment occurs to the fabric. Treat all fabric damage or misalignment as specified in the previous paragraph. After placement, do not expose the fabric longer than 48 hours before covering or backfilling.

645.3.5 Geotextile Fabric, Type SR

(1) Before placing the fabric, smooth and shape the roadway to the required grade and section, and if the Engineer requires, compact to the specified density. After placing the fabric on the earth grade, the Contractor shall not allow traffic or construction equipment to travel on the fabric.

(2) Roll out the fabric on the roadway and pull taut manually to remove wrinkles. Join parallel strips of fabric by overlapping or sewing. Sew seams as specified in 645.3.1, except ensure a tensile strength equal to or greater than 60 percent of the specified directional tensile strength of the fabric develops. Overlap the fabric in joints at least 24 inches. Overlap butt splices between fabric rolls at least 36 inches. Engineer may require the use of weights or pins to prevent the wind from lifting the fabric.

(3) Cover all tears, holes, or rips in the fabric with a patch of fabric overlapping the defect 36 inches in all directions.

(4) Cover geotextile within 48 hours of placement.

(5) Place the backfill material in an initial lift of 12 inches. Do not place subsequent lifts, in layers exceeding 12 inches thick. Spread each lift with a crawler type tractor and compact with suitable compaction equipment. Contractor shall not use construction equipment that causes ruts deeper than four inches. The Engineer will not allow turning movements for hauling or spreading equipment on the fabric until at least two lifts of backfill, at least 18 inches deep, are placed and compacted. Do not begin subsequent lifts until spreading and compacting a distance of at least 1000 feet of the previous lift. Maintain a 1000-foot interval between subsequent lifts until completing each lift. If ruts greater than four inches develop during construction operations, Engineer may require the Contractor to use lighter equipment, equipment with lower contact pressure, or smaller loads on existing equipment.

(6) Fill all ruts in the surface of each lift of backfill with additional material. Do not smooth ruts without adding additional backfill.

645.3.6 Geotextile Fabric, Type R

(1) Before placing the fabric, grade the area smooth and remove all stones, roots, sticks, or other matter that might prevent the fabric from completely contacting the soil.

(2) Place the fabric loosely and lay it parallel to the direction of water movement. Engineer may require pinning or stapling to hold the geotextile in place. Join separate pieces of fabric by overlapping or sewing. Overlap the fabric in the joints at least 24 inches in the direction of flow. After placing, do not expose the fabric longer than 48 hours before covering.

(3) Cover damaged areas with a patch of fabric that overlaps 3 feet in all directions.

(4) Place riprap from the base of the slope upward. Engineer will determine the freefall height of riprap, but in no case should this height exceed one foot.

645.3.7 Geotextile Fabric, Type HR

(1) Place as specified in 645.3.6, except that the freefall height of riprap must not exceed 6 inches.

645.3.8 Geotextile Fabric, Type C

(1) Before placing geotextile fabric, construct and shape the grade to the required grade and section. After placing the fabric, Engineer will not allow traffic or construction equipment to travel on the fabric.

(2) Roll out the fabric on the excavation and pull taut manually to remove wrinkles. Join separate pieces of fabric by overlapping or sewing. Overlap the fabric in joints at least 18 inches. Engineer may require the use of weights or pins to prevent the wind lifting the fabric.

(3) After placing, do not expose the fabric longer than 48 hours before covering.

(4) Then place the specified backfill material over the fabric. The Contractor shall not use construction equipment that causes ruts over three inches deep. Fill all ruts with additional material and level to required grade. Do not smooth ruts without adding additional material.

645.3.9 Geotextile Fabric, Type ES

(1) Before placing the geotextile fabric, construct the embankment to the required elevation and make the surface smooth and level. Place the fabric on the prepared surface to the limits the Plans show with the machine direction of the fabric oriented in the direction the Plans show. Roll out the fabric as smoothly as possible and pull taut manually to remove wrinkles. Engineer may require the use of weights or pins to prevent the wind lifting the fabric. After placing, do not expose the fabric longer than 48 hours before covering. If visible defects or damage to the fabric exists, remove the section containing the defect or damage and replace with a new section of defect-free fabric.

(2) Sew all seams between fabric strips with two parallel stitch lines spaced no more than one inch apart according to the details shown on the Plans. Orient all seams parallel to the roadway alignment and face upward. Sew all seams with a thread having the same or greater durability as the fabric material. Use a 401 stitch conforming to Federal Standard No. 751a for all seams. Ensure that all seams develop a tensile strength equal to or greater than 50 percent of the specified cross direction tensile strength of the fabric. Repair all sewing defects in seams. Do not use butt splices between individual roll ends.

(3) Place the initial fill layer over any fabric layer to a depth not less than 8 inches or more than one foot. Carefully end dump and push this lift on to the fabric. Perform spreading operations and use equipment in a way that does not displace or damage the fabric. Do not make sharp turning movements while placing the initial lift over any individual fabric layer. Contractor shall not drive vehicles on the fabric. Complete the preceding lift before beginning the next lift. Place and compact additional lifts as specified for backfilling.

(4) Unless specified otherwise, use the granular fill material, specified in the Plans and special provisions, from at least eight inches below to at least eight inches above single or multiple layer geotextile installation.

645.3.10 Geogrid

645.3.10.1 General

(1) Place geogrid as the plans show or engineer directs. Pull flat and secure using pins, staples, or other devices to prevent movement or displacement. Lap butt joints between roll ends at least 12 inches unless the plans or special provisions specify otherwise. Secure lapped sections together using engineer-approved ties, straps, clips, or other devices. Do not operate vehicles or construction equipment directly on geogrid.

(2) Cover small rips, tears, or defects in the geogrid with an additional section of geogrid secured in place overlapping the damaged area by at least 3 feet in all directions. Remove and replace geogrid sections with large rips, tears, defects, or other damage as the engineer directs before backfilling.

(3) After placement, backfill the geogrid to the depth and with the type of material the plans or special provisions specify. Place, spread, and compact backfill conforming to the standard spec or special provision requirements for that backfill material, except ensure that the initial lift over the geogrid is at least 4 inches deep.

(4) Place, spread, and compact fill material above the geogrid as the contract specifies for that particular type of cover material.

(5) Do not displace or damage the geogrid during backfill operations. The engineer may direct the contractor to repair or replace damaged, displaced, or otherwise defective geogrid and may require equipment and operations changes to prevent further damage or displacement.

645.3.10.2 Geogrid, Type SR

(1) Before placing geogrid, establish the placement surface to the required lines, grades, and dimensions the plans show or as the engineer directs. Smooth and shape the surface to eliminate rocks, clods, roots, or other debris that may damage the geogrid during placement or backfilling.

(2) Overlap parallel strips at least 6 inches.

645.3.10.3 Geogrid, Type MR

645.3.10.3.1 General

(1) Complete clearing operations before placing geogrid. Cut stumps and sharp objects level with the ground surface where placing geogrid. Do not remove sod, grass, or roots that extend beneath the ground surface unless the engineer directs. Avoid disturbing the existing root mat and vegetation

during geogrid placement. Unroll the geogrid and pull tight manually to remove wrinkles. If the geogrid has different strengths in the machine and cross directions, orientate as the plans or special provisions specify.

(2) Overlap parallel strips at least 12 inches unless the plans or special provisions specify otherwise.

645.3.10.4 Geogrid, Type SSR

645.3.10.4.1 General

(1) Before placing the geogrid, smooth and shape the roadway to the required lines, grades and dimensions the plans show or as the engineer directs. Smooth and shape the surface to eliminate rocks, clods, roots, or other debris that may damage the geogrid during placement or backfilling.

(2) Overlap parallel strips at least 12 inches unless the plans or special provisions specify otherwise.

645.4 Measurement

(1) Geotextile Fabric and Geogrid Pay Items will be measured by the square yard completed and accepted.

645.5 Payment

645.5.1 General

(1) Payment shall be made at contract unit price per square yard Geotextile Fabric Type SAS, Geotextile Fabric Type MS, Geotextile Fabric Type DF, Geotextile Fabric Type SR, Geotextile Fabric Type R, and Geotextile Fabric Type HR, Geotextile Fabric Type C, and Geotextile Fabric Type ES This price shall be full compensation for furnishing all materials and for all foundation preparation, installation, samples and testing and for all labor, equipment, tools, and incidentals necessary to complete this Work.

(2) Payment for the Geogrid bid items is full compensation for providing geogrid. Payment for Geogrid Type MR also includes preparing the marsh area before installation.

(3) Measurement and payment will only be made for Pay Items included in the Schedule of Prices. The cost for all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

645.5.2 Pay Items

(1) Standard Pay Items for Work covered by this Specification are as follows:

Pay Item	Description	Unit
P645.010 through P645.049	Geotextile Fabric (type)	Square Yard (SY)
P645.100 through P645.149	Geogrid (type)	Square Yard (SY)

END OF SPECIFICATION P645

Specification P646 - Maintenance and Repair of Haul Roads

646.1 Description

(1) This Specification describes maintaining, repairing, and restoring all public roads, streets, drainage facilities, appurtenant facilities, Airport roads, and other routes used to access the Work (referred to as haul roads) for hauling by Contractor, subcontractor, and suppliers. Haul roads shall be maintained during construction, and at the completion of construction restored to a condition equivalent to that which existed prior to construction.

(2) Maintenance and Repair of Haul Roads does not apply to routes on the State Trunk Highway System.

(3) Contractor's obligation under this Pay Item does not authorize the use of haul roads for transporting loads exceeding statutory size and weight limitations.

646.2 Materials

(1) Furnish and use materials in the Work at least equal in quality and serviceability to those existing in the road before its use as a haul road. The amount and quality of all materials to be used shall be submitted for review and approval by Engineer prior to being incorporated into the Work.

646.3 Construction

646.3.1 General

(1) Engineer will determine the type and quality of maintenance and repair required, including the quality of materials to be used, based upon review and logging of the haul road condition prior to construction. Contractor shall provide seven days' notice to Engineer prior to use of haul road for construction operations. Contractor shall accompany Engineer during logging of the haul road condition, or shall accept Engineer's determination of the prior condition of the haul road. If two or more contractors having contracts with the Department transporting materials over the same haul road at the same time, or at about the same time, Engineer will determine the repair and restoration obligations of the respective contractors.

646.3.2 Maintenance

(1) Engineer has the authority to order maintenance and repair work on haul roads, including dust abatement, at any time during hauling operations.

(2) To prevent or minimize damage to haul roads the Contractor may stabilize, reinforce, or strengthen existing facilities before hauling starts; and may condition the surface and perform repairs during hauling operations.

646.3.3 Restoration

(1) Upon termination of hauling operations and before conditional final acceptance, restore all haul roads, including drainage facilities and other components, to the equivalent of pre-hauling conditions.

(2) The final repair of a haul road is subject to the Engineer's approval.

646.4 Measurement

(1) Maintenance and Repair of Haul Roads will be measured for payment as a single complete unit of Work per lump sum for all haul roads maintained and repaired that are located off the Airport Site. Maintenance and Repair of Airport Haul Roads will be measured as a single complete unit of Work per lump sum for all haul roads maintained and repaired on the Airport. Measure and payment for the Pay Item will be made even if no hauling was done on the haul roads and even if no maintenance or repair work was required.

646.5 Payment

646.5.1 General

(1) Payment for the Maintenance and Repair of Haul Roads Pay Items is full compensation for providing, hauling, and placing required materials; and for other costs incurred by Contractor to prevent or minimize damage to the haul roads.

(3) Work shall be measured and paid upon completion of all work under the Contract, except Engineer may make partial payment for work performed.

646.5.2 Pay Items

(1) Payment will be made for measured quantities base on Contract prices for the following Pay Items.

Pay Item	Description	Unit
P646.010	Maintenance and Repair of Haul Roads	Lump Sum (LS)
P646.020	Maintenance and Repair of Airport Haul Roads	Lump Sum (LS)

END OF SPECIFICATION P646

Specification P648 – Aircraft Tie-Downs

648.1 Description

648.1.1 General

(1) This Work includes construction of tie-downs for aircraft at the locations and in accordance with the details shown on the Plans.

648.2 Construction

648.2.1 General

(1) Materials and installation shall conform to location and details shown on the Plans

(2) When the Plans show installation of anchors that are required to be augured into place, the anchor shall be augured in a manner that will not loosen or displace the soil in contact with the anchor.

(3) Type A tie down will measure 24’ x 17’, with the longer dimension parallel to the wings.

(4) Type B tie down will measure 34’ x 24’, with the longer dimension parallel to the wings.

648.3 Measurement

(1) Aircraft Tie-downs shall be measured for payment on a unit price basis per set. A set includes three or six anchors constructed as shown on the Plans and accepted.

(2) Aircraft Tie-Down Anchors shall be measured on a unit basis per each. When a tie-down anchor is included in a set, it shall not be measured under the Pay Item for Aircraft Tie-Down Anchors.

648.4 Payment

648.4.1 General

(1) Payment will be made at the Contract unit price per set for the various types of Aircraft Tie-downs or Aircraft Tie-Down Anchors constructed in accordance with the Contract Documents. This price shall be full compensation for furnishing all materials and for preparation and installation of tie-downs, including restoration of existing surfaces, and all labor, equipment, tools and incidentals necessary to complete the Work. Pavement marking shall be measured and paid under the Pay Item for Painting (Specification P620) when Pay Items for Painting are included in the Schedule of Prices; otherwise, pavement marking shall be incidental and the cost included in the Pay Item for Aircraft Tie-downs.

(2) Measurement and Payment will only be made for Pay Items included in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in Pay Items contained in the Schedule of Prices.

648.4.2 Pay Items

(1) Payment will be made for measured quantities based on Contract unit prices for the following Pay Items.

Pay Item	Description	Unit
P648.010 through P648.019	Aircraft Tie-Down (type)	SET
P648.020	Aircraft Tie-Down Anchor (type)	Each (EA)

END OF SPECIFICATION P648

Specification P652 – Micro-Surfacing

652.1 Description

652.1.1 General

(1) Contractor must furnish all labor, equipment, material, supplies, signage, traffic control, and other incidentals necessary to provide Micro-Surfacing. Micro-Surfacing shall consist of a TYPE II mixture (modified according to the gradation table) containing a polymer-modified emulsified asphalt, mineral aggregate, water, and specified additives, proportioned, mixed and uniformly applied and spread over a properly prepared asphalt surface. The completed Micro-Surfacing shall leave a homogeneous mat, adhere firmly to the prepared surface, & have a skid-resistant surface texture throughout its service life.

(2) The work will be completed according to the areas shown on the Plans and with these specifications, or as directed by the Engineer.

652.2 Materials

652.2.1 Aggregate

(1) The aggregate shall consist of sound and durable natural or manufactured sand, slag, crusher fines, crushed stone, or crushed stone and rock dust, or a combination thereof. Aggregate shall consist of 90 percent of the particles having at least one crushed face. Smooth-textured sand of less than 1.25 percent water absorption, as tested by ASTM C128, shall not exceed 50 percent of the total combined aggregate. The aggregate shall be clean and free from vegetable matter, dirt, dust, and other deleterious substances. The aggregate blend shall have a sand equivalent of not less than 65 when tested in accordance with ASTM D2419. The aggregate shall have a percentage of wear of not more than 35 percent at 500 revolutions when tested in accordance with ASTM C 131. The sodium sulfate soundness loss shall not exceed nine percent, or the magnesium soundness loss shall not exceed 12 percent after five cycles when tested in accordance with ASTM C88. Aggregate retained on the No. 50 sieve shall be 100 percent crushed.

(2) The combined aggregate shall conform to the gradation shown in Table 652.2.1 when tested in accordance with ASTM C136.

(3) If crushed slag is used, it shall be air-cooled blast furnace slag and have a unit weight of not less than 70 pounds/cubic foot, when in accordance with ASTM C29.

(4) Samples of aggregate shall be furnished by the Contractor, not less than 15 days prior to the start, to the Engineer for aggregate approval.

TABLE 652.2.1
GRADATION OF AGGREGATES

Sieve Size	Percentage by Weight Passing Sieves	Stock Pile Tolerances
3/8 inch (9.5 mm)	100	--
No. 4 (4.75 mm)	99-100	± 5 percent
No. 8 (2.36 mm)	85-96	± 3 percent
No. 16 (1.18 mm)	55-80	± 3 percent
No. 30 (600 micro m)	35-55	± 3 percent
No. 50 (300 micro m)	18-35	± 3 percent
No. 100 (150 micro m)	10-21	± 2 percent
No. 200 (75 micro m)	5-15	± 2 percent

(5) The aggregate, as finally selected, shall have a gradation within the limits designated in Table 652.2.1, and should not vary from the low limit on one sieve to the high-limit on the adjacent sieve and vice versa.

(6) Precautions shall be taken to prevent segregation of the aggregate in storing and handling. The stockpile shall be kept in areas that drain readily.

652.2.2 Filler

(1) If filler, in addition to that naturally present in the aggregate, is necessary, it shall meet the requirements of ASTM D242 and shall be used in the minimum amounts required. Mineral filler shall only be used if

needed to improve the workability of the mix or to improve the gradation of the aggregate. The filler shall be considered as part of the blended aggregate.

652.2.3 Emulsified Asphalt

(1) The emulsified asphalt shall be quick-set polymer modified cationic Type CSS-1H emulsion and shall conform to the requirements of ASTM D2397 for type CSS-1H emulsion or as approved by the Engineer.

(2) The residue of the emulsion, distilled at a maximum temperature of 350 degrees Fahrenheit for 20 minutes, shall have a minimum ring and ball softening point of 135 degrees Fahrenheit when tested in accordance with ASTM D36 and an absolute viscosity of 7500 poise per ASTM D2171. Residue after distillation shall be 62 percent minimum per ASTM D244. Softening point shall be 135 degrees Fahrenheit minimum per ASTM D36. Penetration at 77 degrees Fahrenheit shall be 40 to 90 per ASTM 2397.

(3) The five day settlement test may be waived, provided job stored emulsion is used within thirty-six hours from the time of the shipment, or the stored material has had additional emulsion blended into it prior to use.

(4) Contractor shall furnish a vendor's certified test report for each finished product storage tank, car load or tank of emulsion shipped for use on the project. Also, a two quart sample of emulsion of each load shall be given to the Engineer.

652.2.4 Polymer Modifier

(1) The minimum amount of polymer modifier shall be three percent polymer solid, based on asphalt weight, unless approved by the Engineer. The type of polymer modifier shall be a Natural Rubber or Approved Equal, and be certified by the emulsion supplier.

(2) The cement mixing test shall be waived for this emulsion.

(3) The polymer material shall be milled or blended into the asphalt or emulsifier solution prior to the emulsification process.

652.2.5 Water

(1) All water used in making the slurry shall be potable and free from-harmful soluble salts.

652.2.6 Tack Coat

(1) The tack coat shall be a diluted asphalt emulsion of the same type specified for the slurry mix. The ratio of asphalt emulsion to water shall be 1 to 3 and apply at a rate of 0.05 to 0.15 gallons per square yard, a minimum 2 hours before surface placement.

652.2.7 Quality Tests

(1) When tested according to the following tests, the emulsion shall meet the requirements of AASHTO M208 or ASTM D2397 for CSS-1h, plus the following:

Test	Quality	Spec
AASHTO T59 ASTM D244	Residue after Distillation	62 percent min

Viscosity saybolt furol at 25°C, seconds 15-100

(2) The temperature for this test should be held below 280°F (138°C). Higher temperatures may cause the polymers to break down.

Test	Quality	Spec
AASHTO T53 ASTM D36	Softening Point	135°F (57°C) min
AASHTO T49 ASTM 2397	Penetration at 77°F (25°C) Ductility (77°F) 25°C, 5 cm/min	40-90 50

(3) Climate conditions should be considered when establishing this band.

(4) Each load of emulsified asphalt shall be accompanied with a certificate of analysis/compliance to assure that it is the same as that used in the mix design.

652.2.8 Mix Design

(1) No slurry seal for payment shall be placed until a mix design has been approved by the Engineer. The mix design shall be developed by a laboratory with experience in designing slurry seal mixes and a signed copy submitted in writing by the Contractor to the Engineer at least 10 days prior to the start of operations.

(2) The laboratory report must indicate the proportions of aggregates, mineral filler (min. and max.), water (min. and max.) emulsion, other additives and asphalt based on the dry aggregate weight. It shall also report the quantitative effects of moisture content on the unit weight of the aggregate (bulking effects). The mix design shall be in effect until modified in writing by the Engineer. Should a change in sources of materials be made, a new design mix shall be established before the new material is used.

(3) The percent of aggregate passing each sieve shall not vary more than that stated in aggregate section from the mix design formula. The residual asphalt content shall not vary more than plus or minus 0.5 percent from the mix design quantity.

Residual Asphalt	6.0% to 13.5% by dry weight of aggregate.
Mineral Filler	0.5% to 3.0% by dry weight
Polymer Based Modifier	Minimum of 3.0% solids based on asphalt weight content.
Additive	As needed
Water	As required to produce proper mix consistency
Pounds of Micro-surfacing Material per S.Y.	17 ± 3

(4) The mix design shall be made with the same aggregate gradation that the Contractor will provide on the project. Recommended tests and values are as follows:

Test	Description	Spec
ISSA TB-139	Wet Cohesion @ 30 minutes min (set) @ 60 minutes min (traffic)	 12 kg-cm min 20 kg-cm min or near spin
ISSA TB-109	Excess Asphalt by LWT Sand Adhesion	50 g/ft^2 max (538 g/m^2 max)
ISSA TB-114	Wet Stripping	Pass (90% min)
ISSA TB-100	Wet Track Abrasion Loss One Hour Soak Six Day Soak	 50 g/ft^2 max (538 g/m^2) 75 g/ft^2 max (807 g/m^2)

(5) The wet track abrasion test (ASTM D3910) is used to determine the minimum asphalt content and resistance to stripping. Some systems require longer times for the asphalt to adhere to the stone. In these systems, a modified Marshall Stability Test (ISSA TB-140) or Hveem Cohesiometer Test (ASTM D 1560) has been used to confirm asphalt content.

ISSA TB-147	Lateral Displacement Specific Gravity after 1000 cycles of 125 lbs. (57kg)	5% MAX 2.10 max
ISSA TB-144	Classification Compatibility	(AAA, BAA) 11 grade points min
ISSA TB-113	Mix Time @ 77°F (25°C)	Controllable to 120 sec. min

652.3 Construction

652.3.1 Weather Limitations

(1) The slurry seal shall not be applied if either the pavement or the air temperature is 55 degrees Fahrenheit (13 C) or below or when rain is imminent, unless approved by the Engineer.

652.3.2 Equipment and Tools

(1) All equipment, tools, and machines used in the performance of this work shall be maintained in satisfactory working order at all times. Descriptive information on the slurry mixing and applying equipment to be used shall be submitted to the Engineer for approval not less than 10 days before work starts.

652.3.3 Pressure Distributors

(1) Pressure distributors used for application of the diluted asphalt emulsion tack coat shall be self-propelled, equipped with pneumatic tires, and capable of uniformly applying 0.05 to 0.15 gallon per square yard of the diluted emulsion over the required width of application. Distributors shall be equipped with tachometers, pressure gages, and volume-measuring devices.

652.3.4 Slurry Mixing Equipment

(1) The slurry mixing machine shall be a continuous flow mixing unit capable of accurately delivering a predetermined proportion of aggregate, water, and asphalt emulsion to the mixing chamber and of discharging the thoroughly mixed product on a continuous basis. The aggregate shall be pre-wetted immediately prior to mixing with the emulsion. The mixing unit of the mixing chamber shall be capable of thoroughly blending all ingredients together. No excessive mixing shall be permitted. The mixing machine shall be equipped with an approved fines feeder that provides an accurate metering device or method to introduce a predetermined proportion of mineral filler into the mixer at the same time and location that the aggregate is fed into the mixer. The fines feeder shall be used whenever added mineral filler is part of the aggregate blend.

(2) The mixing machine shall be equipped with a water pressure system and fog-type spray bar adequate for complete fogging of the surface with an application of 0.05 to 0.10 gallon per square yard preceding the spreading equipment.

(3) Sufficient machine storage capacity to mix properly and apply a minimum of 5 tons of the slurry shall be provided. Proportioning devices shall be calibrated prior to placing the slurry seal.

652.3.5 Slurry Spreading Equipment

(1) Attached to the mixing machine shall be a mechanical-type spreader box attached to the mixer, equipped with paddles to agitate and spread the materials throughout the box. It shall be maintained to prevent loss of slurry on varying grades and crown by adjustments to assure uniform spread. There shall be a lateral control device and a flexible strike-off capable of being adjusted to lay the slurry at the specified rate of application. The spreader box shall have an adjustable width. The box shall be kept clean, and built-up asphalt and aggregate on the box shall not be permitted. The use of burlap drags or other drags shall be approved by the Engineer.

652.3.6 Auxiliary Equipment

(1) Other tools or equipment such as brushes, hand squeegees, hose equipment, tank trucks, water distributors and flushers, power blowers, barricades, etc., shall be provided as required.

652.3.7 Equipment Calibration

(1) Each slurry mixing unit to be used on the project shall be calibrated in the presence of the Engineer prior to construction. Previous calibration documentation covering the exact materials to be used may be accepted by the Engineer provided they were made during the calendar year. The documentation shall include an individual calibration of each material at various settings, which can be related to the machines metering devices. No machine will be allowed to work on the project until the calibration has been completed and/or accepted.

652.3.8 Cleaning Existing Surface

(1) Prior to placing the tack coat and slurry seal coat, unsatisfactory areas shall be repaired and the surface shall be cleaned of dust, dirt, or other loose foreign matter, grease, oil, or any type of objectionable surface film. Standard cleaning methods will be acceptable except that water flushing will not be permitted in areas where considerable cracks are present in the pavement surface.

652.3.9 Bituminous Tack Coat Application

(1) Following the preparation for sealing, application of the diluted emulsion tack coat shall be made by means of a pressure distributor in amounts between 0.05 and 0.15 gallon per square yard as directed by the Engineer. The tack coat shall be applied, at least, 2 hours before the slurry seal, but within the same day.

652.3.10 Test Sections

(1) Test sections shall be placed prior to the start of the slurry seal work in the presence of the Engineer. The test area will be designated by the Engineer and will be located on the existing pavement.

(2) Test strips shall be made by each machine after calibration. Samples of the slurry seal shall be taken and the mix consistency and proportions verified. The rate of application will also be verified. If any test does not meet specification requirements, additional tests shall be made at the Contractor's cost until an acceptable test strip is placed. If material is accepted, it will be paid for at the Contract unit price.

652.3.11 Micro-Surface Coat Application

(1) The surface shall be pre-wet by fogging ahead of the slurry spreader box. Water used in pre-wetting the surface shall be applied at such a rate that the entire surface is damp with no apparent flowing water in front of the slurry spreader box. The slurry mixture shall be of the desired consistency when deposited on the surface, and no additional elements shall be added. Total time of mixing shall not exceed five minutes. A sufficient amount of slurry shall be carried in all parts of the spreader box at all times so that complete coverage of all surface voids and cracks is obtained. Care shall be taken not to overload the spreader box which shall be towed at a slow and uniform rate not to exceed five miles per hour. No lumping, balling, or unmixed aggregate shall be permitted. No segregation of the emulsion and aggregate fines from the coarse aggregate will be permitted. If the coarse aggregate settles to the bottom of the mix, the slurry will be removed from the pavement surface. A sufficient amount of slurry shall be fed in the box to keep a full supply against the full width of the squeegee. The mixture shall not be permitted to overflow the front sides of the spreader box.

(2) No excessive breaking of the emulsion will be allowed in the spreader box.

(3) No streaks such as caused by oversized aggregate will be left in the finished pavement. If streaks develop, the job shall be stopped until necessary corrections have been made.

(4) Adjacent lanes shall be lapped at the edges a minimum of four inches to provide complete sealing at the overlap. All edges shall be feathered with hand squeegees.

(5) The fresh slurry seal application shall be protected by barricades and markers and permitted to dry for four to 24 hours, depending on weather conditions. Damage to uncured slurry will be repaired at the Contractor's expense.

(6) In areas where the spreader box cannot be used, the slurry shall be applied by means of a hand squeegee. Joints and cracks that are not filled by the slurry mixture shall be filled by using hand squeegees. No excessive buildup or unsightly appearance shall be permitted on longitudinal or transverse joints. Upon completion of the work, the seal coat shall have no holes, bare spots, or cracks through which liquids or foreign matter could penetrate to the underlying pavement. The finished surface shall present a uniform and skid resistant texture satisfactory to the Engineer. All wasted and unused material and all debris shall be removed from the site prior to final acceptance.

(7) Upon completion of the micro-surfacing, including rolling, all treated surfaces shall be thoroughly swept.

652.3.12 Emulsion Material (Contractor’s Responsibility)

(1) Samples of the emulsion that the Contractor proposes to use, together with a statement as to its source, must be submitted, and approval must be obtained before using such material. Contractor shall furnish Engineer a manufacturer's certified report for each consignment of the emulsion. The manufacturer's certified report shall not be interpreted as a basis for final acceptance. All such reports shall be subject to verification by testing samples of the emulsion as received for use on the project.

(2) Samples of the micro-surfacing mixture shall be taken on a daily basis as a minimum. Samples shall be taken directly from the mixing unit(s) for testing for consistency and residual asphalt content.

652.3.13 Rut Filling

(1) Where shown on the Plans, prior to the final surface course, preliminary micro-surfacing material is required to fill ruts or depressions. Ruts of 1/2-inch or greater in depth shall be filled independently with a rut filling spreader box, either five-foot or six-foot in width. For irregular or shallow rutting less than 1/2-inch in depth, a full width scratch coat pass may be used as directed by the Engineer.

(2) Ruts that are in excess of 1-1/2 inches in depth may require multiple placements in order to restore the cross section.

(3) Cracks shall be filled by either hand tools or spreader box. Rate of material application shall be at a rate to allow material to fill full depth of crack.

(4) Prior to material placement, loose pieces of bituminous pavement shall be removed along with vegetation and other objectionable materials. If water is used to clean cracks, cracks shall be allowed to dry thoroughly before applying material.

(5) In filling ruts or cracks, Contractor shall achieve a surface tolerance of not more than 1/4-inch deviation when tested with a 12-foot straight edge.

(6) All rut/crack filling material should cure for a period of 24 hours before surface application is applied.

652.4 Measurement

652.4.1 Method of Measurement

(1) Micro-Surfacing will be measured by the square yard of pavement micro surfaced.

652.5 Payment

652.5.1 Method of Payment

(1) Micro-Surfacing, as measured above, will be paid at the Contract unit price per square yard, which price shall be full compensation for all labor, tools, equipment and incidentals necessary to complete the work in accordance with the Contract.

652.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
P665.010	Micro-Surfacing	Square Yard (SY)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications 14369 are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C 88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 128	Specific Gravity and Absorption of Fine Aggregates
ASTM C 131	Resistance to Abrasion of Small Size Course Aggregate by Use of Los Angeles Machine
ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM D 242	Mineral Filler for Bituminous Paving Mixtures
ASTM D 977	Emulsified Asphalt
ASTM D 2397	Cationic Emulsified Asphalt
ASTM D 2419	Sand Equivalent Value of Soils and Fine Aggregate

The asphalt Table IV-3 Temperature-Volume Corrections for Institute Emulsified Asphalts Manual MS-6.

END OF SPECIFICATION P652

Part 10 – Fencing

Specification F161 - Wire Fence With Steel Posts

161.1 Description

161.1.1 General

(1) This Work includes furnishing materials and constructing new wire fences and gates with steel posts in accordance with the details included herein and as shown on the Plans.

(2) Woven Wire Fence Type 1 shall be fence with steel posts and woven wire fabric with no barbed wire in accordance with details shown on the Plans.

(3) Woven Wire Fence Type 2 shall be fence with steel posts, woven wire fabric and barbed wire in accordance with details shown on the Plans. Provide a minimum of three strands of barbed wire constructed with one of the material options listed in this specification, unless additional wires or a particular material is required on the detail on the Plans or specified in the Special Provisions.

161.2 Materials

161.2.1 Wire.

161.2.1.1 Woven Wire (Zinc-Coated)

(1) Woven wire fencing shall be 7-bar, 26 inch field fence with top and bottom wires No. 10 gauge, and filler and stay wires No. 12-1/2 gauge. Stay wires shall be spaced six inches apart. All wire shall be smooth galvanized steel wire conforming to ASTM A116. All wires shall be twice-dipped and spaced as shown on the Plans.

161.2.1.2 Barbed Wire (Zinc-Coated)

(1) Zinc-coated barbed wire shall be 2-strand twisted No. 12-1/2 gauge galvanized steel wire with 4-point barbs of No. 14 gauge galvanized steel wire. All wire shall conform to ASTM A121, Type A. The barbs shall be spaced approximately 5 inches apart or as shown on Plans.

161.2.1.3 Barbed Wire (Copper-Covered)

(1) Copper-covered steel barbed wire shall conform to ASTM A121, Type A.

161.2.1.4 Barbed Wire (Aluminum-Coated)

(1) Aluminum-coated steel barbed wire shall be 2-strand twisted No. 12-1/2 gauge. The 4-point barbs of No. 14 gauge aluminum-coated steel wire shall be spaced approximately five inches apart. The steel wire shall have a tensile strength of between 60,000 and 80,000 pounds per square inch and the aluminum coating shall have a minimum weight of 0.30 ounces per square foot of wire surface on the No. 12-1/2 gauge line wire and 0.25 ounces per square foot of wire surface on the No. 14 gauge barbs.

161.2.1.5 Bracing Wire (Zinc-Coated)

(1) Wire used for cable bracing shall be No. 9 smooth galvanized soft wire.

161.2.2 Fence Posts, Gates, Rails, Braces, and Accessories

(1) Fence posts, gates, rails, braces, and accessories, when specified, shall conform to the requirements of Federal Specification RR-F-191 and shall be zinc-coated.

161.2.3 Concrete

(1) Concrete shall conform to SHS 501 with a minimum 28-day compressive strength of 3,000 psi.

161.3 Construction

161.3.1 General

(1) The fence shall be constructed in accordance with the details on the Plans and as specified here using new materials. All work shall be performed in a workmanlike manner. Prior to beginning fence construction, Contractor shall give Engineer one week notice to establish and mark the property line or fence line, unless the Plans or Special Provision require layout by Contractor. Contractor shall span the opening below the fence with barbed wire at all locations where it is not practical to conform the fence to the general contour of the ground surface because of natural or manmade features such as drainage ditches. The new fence shall be permanently tied to the terminals of existing fences. The finished fence shall be plumb, taut, true to line and ground contour, and complete in every detail. When directed, the Contractor shall stake down the woven wire fence at several points between posts.

(2) Contractor shall arrange the work so that construction of the new fence will immediately follow the removal of existing fences. The length of unfenced section shall not exceed 300 feet. For projects where new fence will replace existing fence, the work shall progress in this manner and at the close of the working day the newly constructed fence shall be tied to the existing fence.

161.3.2 Clearing Fence Line

(1) The site of the fence shall be sufficiently cleared of obstructions, and surface irregularities. The fence line shall be graded so that the fence will conform to the general contour of the ground. The fence line shall be cleared to a minimum width of ten feet on each side of the centerline of the fence. This clearing shall consist of the removal of all stumps, brush, rocks, trees, or other obstructions that will interfere with proper construction of the fence. Stumps within the cleared area of the fence shall be grubbed or excavated. The bottom of the fence shall be placed a uniform distance above ground, as specified in the Plans. When shown on the Plans or as directed by the Engineer, the existing fences which interfere with the new fence location shall be incidental work and shall be removed by the Contractor as a part of the construction work unless such removal is listed as a separate Pay Item in the bid schedule. All holes remaining after post and stump removal shall be refilled with suitable soil, gravel, or other suitable material and compacted with tampers.

(2) The work shall include the handling and disposal of all material cleared, excavated or removed, regardless of the type, character, composition, or condition of such material encountered.

161.3.3 Installing Posts

(1) All posts shall be spaced as shown on the Plans. Corner, brace, anchor, end, and gate posts shall be set in concrete as shown on the Plans. The top of the concrete shall be slightly above the ground surface, trowel finished, and sloped to drain. Post holes of full depth and size for the concrete shall be provided. All line posts may be either driven or set in dug holes to a depth of three feet. All post setting shall be done carefully and to true alignment. Dirt removed for placing posts, anchor bars, flanges, and other Work, shall be replaced, tamped, and leveled. When posts are driven, care shall be exercised to prevent marring or buckling of the posts. Damaged posts shall be replaced at the Contractor's expense. No extra compensation will be made for rock excavation.

161.3.4 Bracing

(1) All corner, anchor, end, and gate posts shall be braced as shown on the Plans. Anchor posts shall be set at approximately 500 feet intervals and braced to the adjacent posts.

161.3.5 Installing Wire

(1) All barbed wire and woven wire shall be placed on the side of the post away from the airport, or as directed by the Engineer, at the height indicated on the Plans. The woven wire shall be carefully stretched and hung without sag and with true alignment. Care shall be taken not to stretch the wire so tightly that it will break in cold weather or pull up corner and brace posts. All horizontal wires shall be fastened securely to each post by fasteners or clips designed for use with the posts furnished. The woven wire shall be wrapped around end, corner, and gate posts, and the ends of all horizontal wires shall be tied with snug, tight twists. The wire shall be secured to prevent slipping up and down the post. Barbed wire strands shall be stretched and each strand secured to each post to prevent slipping out of line or becoming loose. At end, corner, and gate posts the barbed wire shall be securely wrapped and anchored once about the post from outside and secured against slipping by tying the ends with snug, tight twists. However, on spans of less than 100 feet both ends of the span need not be wrapped around the posts. The bottom wire of the woven wire fencing shall clear the ground by not more than four inches or less than one inch along the entire length of fence.

161.3.6 Splicing Wire

(1) Splices in barbed and woven wire will be permitted if made with an approved galvanized bolt-clamp splice or a wire splice made as follows: Construct the splice so that the ends of each wire shall be carried three inches past the splice tool and wrapped around the other wire for at least six turns in opposite directions. After the tool is removed, the space occupied by it shall be closed by pulling the ends together. The unused ends of the wire shall be cut close to make a neat, workmanlike job.

161.3.7 Installing Gates

(1) Gates shall be hung on gate fittings as shown on the Plans. They shall be attached in such a manner that the gate cannot be lifted off the hinges. Gates shall be erected to swing in the direction indicated and shall be provided with gate stops, as specified or as shown on the Plans. Gates shall be erected at locations shown on the Plans.

161.3.8 Existing Fence Connections

(1) Wherever the new fence joins an existing fence, either at a corner or at the intersection of straight fence lines, a corner or anchor post shall be set at the junction and braced and anchored the same as herein described for corner posts.

(2) If the connection is made at other than the corner of the new fence, the last span of the old fence shall contain a brace span.

161.3.9 Electrical Grounds

(1) Electrical grounds shall be constructed where a power line passes over the fence and at intervals not to exceed 500 feet along the fence line. The ground shall be installed directly below the point of the power line crossing. The ground shall be constructed with a copper clad rod ten feet long and a minimum of 3/4 inches in diameter driven vertically until the top is six inches below the ground surface. A No. 6 solid copper conductor shall be clamped to the rod and to the fence in such a manner that each element of the fence is grounded. Installation of ground rods shall not constitute a Pay Item and shall be considered incidental to fence construction. Contractor shall comply with FAA-STD-019, Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment, paragraph 4.2.3.8, Lightning Protection for Fences and Gates, when fencing is adjacent to FAA facilities.

161.3.10 Cleaning Up

(1) Contractor shall remove from the vicinity of the completed work all debris and tools, buildings, equipment, and other Contractor items, used during construction. All disturbed areas shall be graded and seeded per T901.

161.4 Measurement

161.4.1 Fence

(1) Woven Wire Fence Type 1 or Type 2 shall be measured in place from outside to outside of end posts or corner posts and shall be the length of fence actually constructed, except for the space occupied by the gates. Measurement shall be made by the linear foot and shall be rounded off to the nearest even foot.

161.4.2 Gates

(1) Vehicle gates and pedestrian gates shall be measured in units for each type of gate installed and accepted.

(2) Vehicle and pedestrian gates shall be measured per lump sum for gates installed and accepted at a particular location.

161.5 Payment

161.5.1 General

(1) Payment shall be made at the Contract unit price per linear foot for Woven Wire Fence Type 1 or Type 2 of the height specified. This price shall be full compensation for furnishing all materials and for all preparation, erection, cleaning up, grading, seeding, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the Work.

(2) Payment will be made at the Contract unit price per each for vehicle or for pedestrian gates or at the Contract price per lump sum. This price shall be full compensation for furnishing all materials and for all preparation, erection, cleaning up, grading, seeding, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the Work.

(3) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

161.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
F161.010 through F161.019	Woven Wire Fence Type 1 (height)	Linear Foot (LF)
F161.020 through F161.029	Woven Wire Fence Type 2 (height)	Linear Foot (LF)
F161.030 through F161.049	Fence Gate Type (type)	Each (EA)
F161.050 through F161.059	Fence Gate (location)	Lump Sum (LS)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM A116	Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
ASTM A121	Standard Specification for Metallic-Coated Carbon Steel Barbed Wire

FAA Standard

FAA-STD-019	Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment

Federal Specification (FED SPEC)

FED SPEC RR-F-191/Gen	Fencing, Wire, and Post Metal (and Gates, Chain-link Fence Fabric, and Accessories) (General Specification)

FAA Orders

5100.38	AIP Handbook

END OF SPECIFICATION F161

Specification F162 - Chain-Link Fence

162.1 Description

162.1.1 General

(1) This Work shall consist of furnishing and erecting a chain link fence in accordance with these Specifications and the details shown on the Plans and in conformity with the lines and grades shown on the Plans or established by Engineer.

(2) Chain Link Fence, of the type and height specified, shall consist of fencing fabric, attached to metal posts, including bracing, terminal posts, corner posts and bracing, tension wire or rails, electrical grounding, concrete, hardware, barbed wire (when specified), clearing, site preparation, and appurtenances. Types of Chain Link Fence shall be defined as follows:

a. Type 1: Chain Link Fence with tension wire top and bottom, driven line posts, and barbed wire.
b. Type 2: Chain Link Fence with tension wire top and bottom, and driven line posts.
c. Type 3: Chain Link Fence with tension wire top and bottom, concrete anchored line posts and barbed wire.
d. Type 4: Chain Link Fence with tension wire top and bottom, and concrete anchored line posts.
e. Type 5: Chain Link Fence with top and bottom rails, concrete anchored line posts, and barbed wire.
f. Type 6: Chain Link Fence with top and bottom rails, and concrete anchored line posts.

(3) Corner posts, anchor posts, terminal posts, gate posts, and other brace posts indicated on the Plans shall be anchored in concrete for all types of Chain Link Fence.

162.2 Materials

162.2.1 Fabric

(1) The fabric shall be woven from a nine gauge aluminum-coated steel wire in a two-inch diamond pattern mesh and shall conform to the requirements of ASTM A491. Top and bottom selvages shall be knuckled. Fence fabric shall be same nominal height as the designated fence height.

162.2.2 Barbed Wire

(1) Barbed wire shall be 2-strand twisted 12-1/2 gauge zinc-coated or aluminum-coated wire with 4-point barbs Zinc-coated barbed wire shall conform to the requirements of ASTM A121, Class 3, Chain Link Fence Grade. Aluminum-coated barbed wire shall conform to the requirements of ASTM A121, Class II.

162.2.3 Posts, Rails, and Braces

(1) Line posts, rails, and braces shall conform to the requirements of ASTM F1043 or ASTM F1083 as follows:

a. Galvanized tubular steel pipe: Group IA, (Schedule 40) coatings conforming to Type A, or Group IC (High Strength Pipe), External coating Type B, and internal coating Type B or D.
b. Roll Formed Steel Shapes (C-Sections): Group IIA, and be galvanized in accordance with the requirements of ASTM F1043, Type A.
c. Hot-Rolled Shapes (H Beams): shall meet the requirements of Group III, and be galvanized in accordance with the requirements of ASTM F1043, Type A.
d. Aluminum Pipe: Group IB.
e. Aluminum Shapes: Group IIB.
f. Vinyl or polyester coated steel: ASTM F1043, Paragraph 7.3, Optional Supplemental Color Coating.
g. Composite posts: Strength requirements ASTM F1043 or ASTM F1083. The strength loss of composite posts shall not exceed 10% when subjected to 3,600 hours of exposure to light and water in accordance with ASTM G152, ASTM G153, ASTM G154, and ASTM G155.
h. Posts, rails, and braces: furnished for use in conjunction with aluminum alloy fabric shall be aluminum alloy or composite.

(2) Posts, rails, and braces: with the exception of galvanized steel conforming to ASTM F1043 or ASTM F1083, Group 1A, Type A, or aluminum alloy, shall demonstrate the ability to withstand testing in salt spray in accordance with ASTM B117 as follows:

a. External: 1,000 hours with a maximum of 5% red rust.
b. Internal: 650 hours with a maximum of 5% red rust.

(3) The dimensions of the posts, rails, and braces shall be in accordance with Tables I through VI of Federal Specification RR-F-191/3.

162.2.4 Gates

(1) Gate frames shall consist of galvanized steel pipe, polymer-coated steel pipe, aluminum alloy pipe, or composite posts and shall conform to the specifications for the same material under 162.2.3. The fabric shall be of the same type material as used in the fence.

162.2.5 Wire Ties and Tension Wires

(1) Wire ties for use in conjunction with a given type of fabric shall be of the same material and coating weight identified with the fabric type. Tension wire shall be 7-gauge marcelled steel wire with the same coating as the fabric type and shall conform to ASTM A824.

(2) All material shall conform to Federal Specification RR-F-191/4.

162.2.6 Miscellaneous Fittings and Hardware

(1) Miscellaneous steel fittings and hardware, for use with zinc-coated, aluminum-coated, or zinc-five percent aluminum-mischmetal alloy-coated steel fabric, shall be of commercial grade steel or better quality, wrought or cast as appropriate to the article, and sufficient in strength to provide a balanced design when used in conjunction with fabric posts, and wires of the quality specified herein. All steel fittings and hardware shall be protected with a zinc coating applied in conformance with ASTM A153. Miscellaneous aluminum fittings for use with aluminum alloy fabric shall be wrought or cast aluminum alloy. Barbed wire support arms shall withstand a load of 250 pounds applied vertically to the outermost end of the arm.

162.2.7 Concrete

(1) Concrete shall conform to SHS 501 with a minimum 28-day compressive strength of 3,000 psi.

162.2.8 Marking

(1) Each roll of fabric shall carry a tag showing the kind of base metal (steel, aluminum, or aluminum alloy number), kind of coating, the gauge of the wire, the length of fencing in the roll, and the name of the manufacturer. Posts, wire, and other fittings shall be identified as to manufacturer, kind of base metal (steel, aluminum, or aluminum alloy number), and kind of coating.

162.3 Construction

162.3.1 General

(1) The fence shall be constructed in accordance with the details on the plans and as specified here using new materials. All work shall be performed in a workmanlike manner satisfactory to Engineer. Engineer shall establish and mark the property line or fence line for the work, unless Plans or Special Provisions require Contractor to layout the fence line. Contractor shall span the opening below the fence with barbed wire at all locations where it is not practical to conform the fence to the general contour of the ground surface because of natural or manmade features such as drainage ditches. The new fence shall be permanently tied to the terminals of existing fences as shown on the plans. Contractor shall stake down the woven wire fence at several points between posts as shown on the plans.

(2) Contractor shall arrange the work so that construction of the new fence will immediately follow the removal of existing fences. The length of unfenced section at any time shall not exceed 300 feet. The work shall progress in this manner and at the close of the working day the newly constructed fence shall be tied to the existing fence.

162.3.2 Clearing Fence Line

(1) All trees, brush, stumps, logs, rocks, and other debris which would interfere with the proper construction of the fence, including over-hanging branches shall be removed a minimum width of 10 feet on each side of the fence centerline before starting fencing operations. When the Pay Item includes grubbing, stumps within the cleared area of the fence shall be grubbed or excavated. The bottom of the fence shall be placed a uniform distance above ground, as specified in the Plans. When shown on the Plans or as directed by the Engineer, the existing fences which interfere with the new fence location shall be removed by the Contractor as an incidental part of the construction work unless such removal is listed as a separate item in the bid schedule. All holes remaining after post and stump removal shall be refilled with suitable soil, gravel, or other suitable material and compacted with tampers.

(2) The cost of removing and disposing of the material shall be considered incidental to fence construction and the cost included in the price for fence, unless other Pay Items for removal are included in the Contract Documents.

162.3.3 Installing Posts

(1) All posts shall be set in concrete, except as shown on the Plans. Posts shall be set at the required dimension and depth and at the spacing shown on the Plans.

(2) Concrete shall be thoroughly compacted around the posts by tamping or vibrating and shall have a smooth finish slightly higher than the ground and sloped to drain away from the posts. All posts shall be set plumb and to the required grade and alignment. No materials shall be installed on the posts, nor shall the posts be disturbed in any manner within seven days after the individual post footing is completed.

(3) Should rock be encountered at a depth less than the planned footing depth, a hole two inches larger than the greatest dimension of the posts shall be drilled to a depth of 12 inches. After the posts are set, the remainder of the drilled hole shall be filled with grout, composed of one part Portland cement and two parts mortar sand. Any remaining space above the rock shall be filled with concrete in the manner described above.

(4) In lieu of drilling, the rock may be excavated to the required footing depth. No extra compensation shall be made for rock excavation.

162.3.4 Installing Top Rails

(1) Top rail shall be continuous and shall pass through the post tops. The coupling used to join the top rail lengths shall allow for expansion.

162.3.5 Installing Braces

(1) Horizontal brace rails, with diagonal truss rods and turnbuckles, shall be installed at all terminal posts.

162.3.6 Installing Fabric

(1) Wire fabric shall be firmly attached to the posts and braced as shown on the Plans. All wire shall be stretched taut and shall be installed to the required elevations. The fence shall generally follow the contour of the ground, with the bottom of the fence fabric no less than one inch or more than four inches from the ground surface. Grading shall be performed where necessary to provide a neat appearance.

(2) At locations of small natural swales or drainage ditches and where it is not practical to have the fence conform to the general contour of the ground surface, longer posts may be used and multiple strands of barbed wire stretched to span the opening below the fence. The vertical clearance between strands of barbed wire shall be six inches or less.

162.3.7 Electrical Grounds

(1) Electrical grounds shall be constructed where a power line passes over the fence and at intervals not to exceed 500 feet along the fence line. The ground shall be installed directly below the point of the powerline crossing. The ground shall be constructed with a copper clad rod ten feet long and a minimum of 3/4 inches in diameter driven vertically until the top is six inches below the ground surface. A No. 6 solid copper conductor shall be clamped to the rod and to the fence in such a manner that each element of the fence is grounded. Installation of ground rods shall not constitute a Pay Item and shall be considered incidental to fence construction. The Contractor shall comply with FAA-STD-019, Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment, Paragraph 4.2.3.8, Lightning Protection for Fences and Gates, when fencing is adjacent to FAA facilities.

162.3.8 Cleaning Up

(1) Contractor shall remove from the vicinity of the completed work all tools, buildings, equipment, etc., used during construction. All disturbed areas shall be seeded per T901.

162.4 Measurement
162.4.1 General

(1) Chain-link fence will be measured for payment by the linear foot. Measurement will be along the top of the fence from center to center of end posts, excluding the length occupied by gate openings.

(2) Gates will be measured as complete units per each.

162.5 Payment
162.5.1 General

(1) Payment shall be made at the Contract unit price per linear foot for the type and height of Chain-Link Fence accepted and measured. This price shall be full compensation for furnishing all materials and for all preparation, erection, and installation of materials, and for all labor, equipment, tools, and incidentals necessary to complete this Work.

(2) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices as specified. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

162.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
F162.010 through F162.069	Chain-Link Fence (type) (height)	Linear Foot (LF)
F162.070 through F162.079	Chain-Link Fence Gate (height) (opening size)	Each (EA)
F162.080 through F162.089	Chain-Link Fence Gate with Barbed Wire (height) (opening size)	Each (EA)
F162.090 through F162.099	Chain-Link Fence (type) (location)	Lump Sum (LS)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM A121	Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
ASTM A123	Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A392	Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A491	Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A572	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A824	Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence
ASTM A1011	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High Strength Low Alloy with Improved Formability, and Ultra High Strength
ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B221	Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles and Tubes
ASTM B429	Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM F668	Standard Specification for Polyvinyl Chloride(PVC), Polyolefin and other Organic Polymer Coated Steel Chain-Link Fence Fabric
ASTM F1043	Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework
ASTM F1083	Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F1183	Standard Specification for Aluminum Alloy Chain Link Fence Fabric
ASTM F1345	Standard Specification for Zinc 5% Aluminum-Mischmetal Alloy Coated Steel Chain-Link Fence Fabric
ASTM G152	Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

ASTM G153	Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials
ASTM G155	Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials

Federal Specifications (FED SPEC)

FED SPEC RR-F-191/3 Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces)

FED SPEC RR-F-191/4 Fencing, Wire and Post, Metal (Chain-Link Fence Accessories)

FAA Standard

FAA-STD-019	Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment

FAA Orders

5100.38	AIP Handbook

END OF SPECIFICATION F162

Specification F163 - Wildlife Deterrent Fence Skirt

163.1 Description

163.1.1 General

(1) This Work shall consist of furnishing and installing chain-link fence fabric underground along an existing chain link fence, constructing concrete pads at existing fence gates in accordance with these specifications and the details shown on the drawings and in conformity with the lines and grades shown on the Plans or established by the Engineer.

163.2 Materials

163.2.1 Chain Link Fence Fabric

(1) The fabric shall be woven with a nine-gauge galvanized steel wire in a two-inch mesh and shall meet the requirements of ASTM A392, Class II. The fabric shall be five-feet wide or as shown on the Plan details.

163.2.2 Barbed Wire

(1) Barbed wire shall be 2-strand 12-1/2 gauge zinc-coated wire with 4-point barbs and shall conform to the requirements of ASTM A121, Class 3.

163.2.3 Wire Ties and Tension Wires

(1) Wire fabric ties, wire ties, and tension wire for a given type of fabric shall be the same material as the fabric type. The tension wire shall be 7-gauge coiled spring wire coated similarly to the respective wire fabric being used.

(2) Wire fabric ties shall be hog rings of galvanized steel wire not less than nine-gauge.

(3) All material shall conform to Federal Specification RR-F-191/4.

163.2.4 Miscellaneous Fittings and Hardware

(1) Miscellaneous steel fittings and hardware for use with zinc-coated steel fabric shall be of commercial grade steel or better quality, wrought or cast as appropriate to the fitting or hardware, and sufficient in strength to provide a balanced design when used with fabric, posts, and wires of the specified quality. All steel fittings and hardware shall be protected with a zinc coating applied in conformance with ASTM A153.

163.2.5 Concrete Pads at Gates

(1) Concrete shall conform to SHS 501 with a minimum 28-day compressive strength of 3,000 psi.

163.2.6 Marking

(1) Each roll of fabric shall carry a tag showing the kind of base metal, kind of coating, the gauge of the wire, the length of fencing in the roll, and the name of the manufacturer. Posts, wire, and other fittings shall be identified as to manufacturer, kind of base metal, and kind of coating.

163.2.7 Weed Control Material

(1) A commercially available weed control material shall be applied according to the manufacturer's recommendation and at the manufacturer's recommended rate.

163.3 Construction

163.3.1 General

(1) The fence shall be constructed in accordance with the details on the Plans and as specified here using new materials. All work shall be performed in a workmanlike manner satisfactory to Engineer. Engineer shall establish and mark the property line or fence line for the work, unless Plans or Special Provisions require Contractor to layout the fence line. The work shall progress in this manner and at the close of the working day the newly constructed fence shall be tied to the existing fence.

163.3.2 Clearing Fence Line

(1) All brush, stumps, logs, and other debris which would interfere with the construction of the fence shall be removed a minimum width of 10 feet on either side of the fence centerline before starting fencing operations. The material removed and disposed of shall not constitute a Pay Item and shall be considered incidental to fence construction.

163.3.3 Installing Fabric

(1) Excavate ground to the depth required for proper installation of the fabric. Obtain Engineer's approval of depth of excavation before placing the wire fabric. Place the fabric and lap splice it to existing fence fabric and tie with wire ties at two-foot spacing. Cut wire fabric around fence post footing to allow proper

placement. Backfill with native soil to original grade and compact. Gate concrete pads shall be installed at each gate or as shown on the Plans.

163.3.4 Weed Control Application

(1) Weed control material shall be applied over an area five feet wide, measured from the fence centerline, and over the wildlife fence. Apply weed control material as recommended by the manufacturer's instructions and in compliance with state and local regulations.

163.3.5 Electrical Grounds

(1) Electrical grounds shall be constructed where a power line passes over the fence and at intervals not to exceed 500 feet along the fence line. The ground shall be installed directly below the point of the power line crossing. The ground shall be constructed with a copper clad rod ten feet long and a minimum of 3/4 inches in diameter driven vertically until the top is six inches below the ground surface. A No. 6 solid copper conductor shall be clamped to the rod and to the fence in such a manner that each element of the fence is grounded. Installation of ground rods shall not constitute a Pay Item and shall be considered incidental to fence construction. Contractor shall comply with FAA-STD-019, Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment, paragraph 4.2.3.8, Lightning Protection for Fences and Gates, when fencing is adjacent to FAA facilities.

163.3.6 Cleaning Up

(1) Contractor shall remove from the vicinity of the completed work all debris and tools, buildings, equipment, and other Contractor items, used during construction. All disturbed areas shall be seeded in accordance with T901.

163.4 Measurement

163.4.1 Chain Link Fence Fabric

(1) Chain-link fence fabric for Fence Skirt shall be measured for payment by the linear foot to the nearest foot. Measurement shall be along the fence from center to center of end or corner posts, excluding the length occupied by gate openings.

(2) Concrete pads at gates shall be measured by the unit per each.

(3) Borrow material for fill for fence construction shall be furnished by the Contractor. This shall be measured by the cubic yard in place.

(4) Weed control application shall be measured by the linear foot of fence line acceptably treated.

163.5 Payment

163.5.1 General

(1) Payment for Chain-Link Fence Fabric for Fence Skirt shall be made at the Contract unit price per linear foot. This price shall be full compensation for furnishing materials, all labor, installation (including preparation, excavation, backfill, fill, and installation), cleaning up and seeding, equipment, tools, and incidentals necessary to complete this item. Utility locates shall be included in this Pay Item.

(2) Payment for Concrete Pads at Gates shall be made at the contract unit price for each pad. This price shall be full compensation for furnishing materials, all labor, installation (including preparation, excavation, backfill, placement of concrete, reinforcing steel, and forms), cleaning up and seeding, equipment, tools, and incidentals necessary to complete this item.

(3) Borrow Fill Material for Fence Construction including supplying, loading, transporting, and placing of borrow material shall be made at the Contract unit price per cubic yard. This price shall be full compensation for furnishing all labor (including placement, compaction, and grading), equipment, tools, and incidentals necessary to complete this work.

(4) Payment for Weed Control Application shall be made at the contract unit price per linear foot. This price shall be full compensation for furnishing materials, all labor, equipment, tools, and incidentals necessary to complete this Work.

(5) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

163.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
F163.010	Chain-Link Fence Fabric for Fence Skirt	Linear Foot (LF)
F163.020	Concrete Pads at Gates	Each (EA)
F163.030	Borrow Fill Material for Fence Construction	Cubic Yard (CY)
F163.040	Weed Control Application	Linear Foot (LF)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM A121 Standard Specification for Metallic-Coated Carbon Steel Barbed Wire

ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A392 Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric

Federal Specification (FED SPEC)

FED SPEC RR-F-191/3 Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces)

FED SPEC RR-F-191/4 Fencing, Wire and Post, Metal (Chain-Link Fence Accessories)

FAA Standard

FAA-STD-019 Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment

FAA Orders

5100.38 AIP Handbook

END OF SPECIFICATION F163

Specification F164 - Wildlife Exclusion Fence

164.1 Description

164.1.1 General

(1) This work includes furnishing materials and constructing new wire wildlife exclusion fences and gates with wood or steel posts; furnishing and installing chain-link fence fabric underground along the wire fence line; and constructing concrete pads at fence gates in accordance with the details included here and as shown on the Plans. The fence to be erected shall be woven wire or chain-link fencing topped by three strands of barbed wire, as indicated on the Plans or Special Provisions.

(2) This work includes furnishing materials and constructing new swale crossings intended to prevent wildlife from crossing under the fence in areas where there are ditches, small streams, and depressions in the ground beneath the fence line in accordance with the specifications included here and as shown on the Plans.

164.2 Materials

164.2.1 Wire

164.2.1.1 Woven Wire (Zinc-Coated)

(1) The woven wire fence shall be 23-bar, 120 inch field fence with top and bottom wires No. 12-1/2 gauge, and filler and stay wires No. 12-1/2 gauge. Stay wires shall be spaced six inches apart. All wires shall be smooth galvanized steel wire, conforming to ASTM A116. All wires shall be twice-dipped and shall be spaced as shown on the Plans.

164.2.1.2 Chain-Link Fence Fabric

(1) The fabric shall be woven with a 9-gauge zinc-5 percent aluminum mischmetal wire in a 2-inch mesh and shall meet the requirements of ASTM F1345, Class 2 or; the fabric shall be woven from a 9 gauge aluminum-coated steel wire in a 2-inch mesh and shall conform to the requirements of ASTM A491.

164.2.1.3 Chain Link Skirt Fabric

(1) The fabric shall be woven with a 9-gauge galvanized steel wire in a two-inch mesh and shall meet the requirements of ASTM A392, Class II. The fabric shall be five feet wide.

164.2.1.4 Barbed Wire (zinc-coated)

(1) Zinc-coated barbed wire shall be 2-strand twisted No. 12-1/2 gauge galvanized steel wire with 4-point barbs of No. 14 gauge galvanized steel wire. All wire shall conform to ASTM A121, Type A. The barbs shall be spaced approximately 5 inches apart.

164.2.1.5 Wire Ties and Tension Wires

(1) Wire fabric ties, wire ties, and tension wire for a given type of fabric shall be the same material as the fabric type. The tension wire shall be 7-gauge coiled spring wire coated similarly to the respective wire fabric being used. The fabric shall be attached to the tension wire as shown on the plans, but not greater than every four feet. Wire fabric ties shall be hog rings of galvanized steel wire not less than 9-gauge. All material shall conform to Federal Specification RR-F-191/4.

164.2.1.6 Bracing Wire (Zinc-Coated)

(1) Wire used for cable for bracing shall be No. 9 smooth galvanized soft wire.

164.2.2 Gates and Hardware

(1) Gates shall be constructed of galvanized steel tubing conforming to Federal Specification RR-F-191 and shall be the size shown on the Plans. Heavily galvanized hinges and latches for wood posts shall be furnished with each gate. Either a bolt or lag screw hinge shall be used, or either a wing or butterfly latch shall be furnished. The fabric shall be the same as required for the fence.

164.2.3 Miscellaneous Fittings and Hardware

(1) Miscellaneous steel fittings and hardware for use with zinc-coated steel fabric shall be of commercial grade steel or better quality, wrought or cast as appropriate to the fitting or hardware, and sufficient in strength to provide a balanced design when used with fabric, posts, and wires of the specified quality. All steel fittings and hardware shall be protected with a zinc coating applied in conformance with ASTM A153.

164.2.4 Wood Posts

164.2.4.1 Species

(1) All posts shall be one of the following species of wood, unless otherwise noted in the proposal.

Wood Species

Group I	Group II
Cedar	Douglas-fir
Chestnut	Gum, Red
Cypress, Southern	Larch, Western
Locust, Black	Pine, Southern Yellow
Osage-orange	Pine, Lodgepole
Redwood	Tamarack
Yew, Pacific	Ash
Honey locust	Maple, Sugar
Oak, White	Oak, Red
Mulberry	Spruce
Live Oak	

(2) Posts of Group I may be used untreated, provided at least 75 percent of the wood is heartwood. Posts of less than 75 percent heartwood of Group I shall be given a preservative treatment for the part of the post that will have contact with the ground line in accordance with the method specified under 164.2.4.5 butt treatment below. Posts of Group II shall be given a preservative treatment in accordance with the method specified under 164.2.4.5 full length treatment below.

164.2.4.2 Quality

(1) Posts shall be peeled, sound, straight-grained, free from decay, cracks, and splits. Shakes shall not be in excess of 1/4 inch wide and 3 feet long. Checks (lengthwise separations of the wood in a generally radial direction) are permitted, provided they are not harmful.

164.2.4.3 Dimensions

(1) Posts shall be the length shown on the Plans. Posts shall have the minimum top diameters shown on the Plans or as specified. Sawn and split posts are acceptable instead of round posts if the required diameter round posts could be turned from the sawn/split posts.

164.2.4.4 Manufacture

(1) Outer bark shall be completely removed from all posts including depressions. Inner bark shall be removed from all post surfaces to be treated, except inner bark may remain in depressions. The amount of wood shaved off in the removal of inner bark shall be held to a minimum.

164.2.4.5 Treatment

(1) Posts shall be conditioned by air seasoning, steaming, or heating in oil in a manner that prevents injurious checking, splitting, or warping before treating. All timber shall be thoroughly seasoned and dry (22 percent maximum moisture content) before applying preservative treatment. The treatment, care and preservative shall be with waterborne preservatives in accordance with American Wood Preservers Association (AWPA) Standard U1, Use Category 4 (UC4).

164.2.5 Braces

(1) Cleats, gate stops, and braces shall be of the size shown on the plans. They shall be of the same species and quality specified for the posts or approved by the Engineer, and they shall be free from knots larger than one-third the width of the piece. Gate stops shall be made of posts of suitable length. Braces may be made of posts of suitable length or of sawed lumber. All cleats, gate stops, and any braces in contact with the ground and for a distance of at least 6 inches above the ground shall be treated by the hot and cold bath process, specified herein for posts. The wire used in cable for bracing shall conform to 164.2.1.6.

164.2.6 Steel Posts, Rails, and Braces

(1) Line posts, rails, and braces shall conform to the requirements of ASTM F1043 or ASTM F1083 as follows:

a. Galvanized tubular steel pipe shall conform to the requirements of Group IA, (Schedule 40) coatings conforming to Type A, or Group IC (High Strength Pipe), External coating Type B, and internal coating Type B or D.

b. Roll Formed Steel Shapes (C-Sections) shall conform to the requirements of Group IIA, and be galvanized in accordance with the requirements of ASTM F1043, Type A.

c. Hot-Rolled Shapes (H Beams) shall meet the requirements of Group III, and be galvanized in accordance with the requirements of ASTM F1043, Type A.

d. Aluminum Pipe shall conform to the requirements of Group IB.

e. Aluminum Shapes shall conform to the requirements of Group IIB.

f. Vinyl or polyester coated steel shall conform to the requirements of ASTM F1043, Paragraph 7.3, Optional Supplemental Color Coating.

g. Composite posts shall conform to the strength requirements of ASTM F1043 or ASTM F1083. The strength loss of composite posts shall not exceed 10% when subjected to 3,600 hours of exposure to light and water in accordance with ASTM G152, ASTM G153, ASTM G154, and ASTM G155.

h. Posts, rails, and braces furnished for use in conjunction with aluminum alloy fabric shall be aluminum alloy or composite.

i. Posts, rails, and braces, with the exception of galvanized steel conforming to ASTM F1043 or ASTM F1083, Group 1A, Type A, or aluminum alloy, shall demonstrate the ability to withstand testing in salt spray in accordance with ASTM B117 as follows:

i. External: 1,000 hours with a maximum of 5% red rust.

ii. Internal: 650 hours with a maximum of 5% red rust.

(2) The dimensions of the posts, rails, and braces shall be in accordance with Tables I through VI of Federal Specification RR-F-191/3.

164.2.7 Staples

(1) The staples shall be No. 9 galvanized steel wire, one inch long for hardwood posts and 1-1/2 inch long for use in softwood posts.

164.2.8 Concrete Pads at Gates

(1) Concrete shall conform to SHS 501 with a minimum 28-day compressive strength of 3,000 psi.

164.2.9 Weed Control Material

(1) A commercially available weed control material shall be applied at the manufacturer's recommended rate.

164.3 Construction

164.3.1 General

(1) The fence shall be constructed in accordance with the details on the Plans using new materials. All work shall be performed in a workmanlike manner, satisfactory to the Engineer. Before beginning the work, or at the request of the Contractor, the Engineer shall establish and mark the property line or fence line for the work. Contractor shall install swale crossings in accordance the details and at the locations shown on the Plans. If a swale crossing is not shown on the Plans at a particular location, Contractor shall span the opening below the fence, greater than six inches, with barbed wire at all locations where it is not practical to conform the fence to the general contour of the ground surface because of natural or manmade features.

(2) The new fence shall be permanently tied to the terminals of existing fences whenever required by the Engineer. The finished fence shall be plumb, taut, true to line and ground contour, and complete in every detail. When shown on the Plans or directed by the Engineer, the Contractor shall stake down the woven wire fence at several points between posts. The Contractor shall arrange the work so construction of the new fence immediately follows the removal of existing fences. The length of unfenced section at any time shall not exceed 300 feet. The work shall progress in this manner, and at the close of the working day, the newly constructed fence shall be tied to the unremoved existing fence.

164.3.2 Clearing Fence Line

(1) The site of the fence shall be sufficiently clear of obstructions, and surface irregularities. The fence line shall be graded so that the fence will conform to the general contour of the ground. The fence line shall be cleared to a minimum width of 10 feet on each side of the centerline of the fence. This clearing shall consist of the removal of all stumps, brush, rocks, trees, over-hanging branches, or other obstructions

that will interfere with proper construction of the fence. Stumps within the cleared area of the fence line shall be grubbed or excavated. The bottom of the fence shall be placed a uniform distance above ground as specified in the Plans. When shown on the Plans or as directed by the Engineer, the existing fences which interfere with the new fence location shall be removed by the Contractor as part of the construction work, unless removal is listed as a separate item in the bid schedule. All holes remaining after post and stump removal shall be refilled with suitable soil, gravel, or other suitable material and shall be compacted with tampers.

(2) The work shall include the handling and disposal of all material cleared, of excess excavation and the removal of spoiled material regardless of the type, character, composition, or condition of such material encountered.

(3) Grubbing shall not be allowed in wetlands and construction in wetlands maybe subject to other restrictions and scheduling requirements. Contractor shall comply with permits and requirements for construction shown on the Plans or described in the Special Provisions.

164.3.3 Setting Posts

(1) Wood posts shall be set with large ends down, plumb, and in a straight line on the side on which the wire is to be fastened. Posts shall be set full depth as shown on the Plans and shall not be cut off to eliminate rock or other excavation. Where rock is encountered, it shall be removed, to provide full-depth and full-size holes. The bottom of all posts shall be cut off square. The diameter of the holes shall be at least 6 inches larger than the diameter of the posts. When cleats are used on posts, the holes shall be dug large enough to accommodate the cleat.

(2) Steel posts shall be spaced as shown on the Plans. Corner, brace, anchor, end, and gate posts shall be set in concrete bases as shown on the Plans. The top of the base concrete shall be slightly above the ground surface, trowel finished, and sloped to drain. Post holes of full depth and size for the concrete bases for posts shall be provided. All line posts may be either driven or set in dug holes to a penetration depth of 3 feet minimum or as shown on the Plans. All post setting shall be done carefully and to true alignment. Dirt removed for placing posts, anchor bars, and flanges shall be replaced, tamped, and leveled. When posts are driven, care shall be exercised to prevent marring or buckling of the posts. Damaged posts shall be replaced at the Contractor's expense.

(3) After posts are placed and lined, the holes shall be backfilled with suitable material that shall be properly compacted by the use of tampers.

(4) The posts adjacent to end, corner, anchor, and gate posts shall be set and braced with braces and wire, as shown on the Plans.

(5) No extra compensation shall be made for rock excavation.

164.3.4 Anchoring

(1) Corner, end, gate, and adjacent intermediate posts shall be anchored, by gaining and spiking cleats to the sides of the posts, as indicated on the Plans.

(2) No cleats will be required on other intermediate posts or on anchor posts.

164.3.5 Bracing

(3) End, corner, anchor, and gate posts shall be braced by using a post of sufficient length or a piece of sawed lumber of the proper size, together with a wire cable. The wooden brace shall be gained and securely spiked into the end, corner, anchor, or gate posts and into the next intermediate posts about 6 inches from the top of the respective posts. A cable made of a double strand of galvanized soft wire shall be looped around the end, corner, anchor, or gate post near the ground and around the next intermediate post about 12 inches from the top. After the cable has been stapled in this position, it shall be twisted until tight. The staples used to hold the cable shall be not less than 1-1/2 inches long. The tool used for twisting the cable shall be left in placed to permit later adjustment of bracing if found necessary. Anchor posts shall be set at intervals not to exceed 500 feet and braced to the adjacent posts. Posts shall be braced before the wire fencing is placed.

164.3.6 Installing Wire

(1) The wire shall be placed on the side of the posts away from the airport or as directed. The wire fence shall be placed on the posts at the height indicated on the Plans. Longitudinal wires shall be installed parallel and drawn uniformly taut. The vertical stay wires of the woven wire fencing shall be straight and vertical. At end and gate posts the woven wire and barbed wire shall be wrapped once around the post; each longitudinal wire shall be stapled at least three times and the ends of these wires shall be tied with a snug, tight twist. Each longitudinal wire shall be stapled to each intermediate post with one steel wire staple; at the corner and anchor posts, two or more staples shall be used. The top strands of barbed

wire of all fences shall be stapled with two staples in each post. All staples shall be set diagonally with the grain of the wood and driven up tight. After the fence has been erected, the tops of the wood posts shall be sawed off with a 1-to-3 pitch. The bottom wire of the wire fencing shall clear the ground by not more than 2 inches or less than one inch at any place.

164.3.7 Splicing Wire

(1) Wire splices in longitudinal wires will be permitted if made with an approved galvanized bolt-clamp splice or a wire splice made as follows: the end of the wires shall be carried 3 inches past the splice tool and wrapped around the other wire away from the tool for at least six turns in opposite directions. After the tool is removed, the space occupied by it shall be closed by pulling the ends together. The unused ends of the wires shall be cut close to make a neat, workmanlike installation. Woven wire shall be spliced only at posts.

164.3.8 Installing Chain-Link Skirt Fabric

(1) Excavate trench to the depth required for proper installation of the chain-link fabric. Obtain Engineer's approval of depth of excavation before placing the wire fabric. Place the fabric and lap splice it to existing fence fabric and tie with wire ties at 2-foot spacing. Cut wire fabric around fence post footing to allow proper placement. Backfill with native soil to original grade.

164.3.9 Installing Gates

(1) Gates shall be hung on gate fittings. Fittings on the gate posts shall be clamped, screwed, or bolted to prevent slipping. Gates shall be erected to swing in the direction indicated and shall be provided with gate stops, as specified or as shown on the Plans. Gates shall be erected at locations shown on the Plans. Gate concrete pads shall be installed at each gate or as shown on the Plans.

164.3.10 Existing Fence Connections

(1) Wherever the new fence joins an existing fence, either at a corner or at the intersection of straight fence lines, a corner or anchor post shall be set at the junction and braced and anchored the same as described for corner posts. If the connection is made at other than the corner of the new fence, the last span of the old fence shall contain a brace span.

164.3.11 Electrical Grounds

(1) Electrical grounds shall be constructed where a power line passes over the fence at intervals not to exceed 500 feet along the fence line. The ground shall be installed directly below the power line point of crossing. The ground shall be constructed with a copper clad rod ten feet long and a minimum of 3/4 inches in diameter driven vertically until the top is 6-inches below the ground surface. A No. 6 solid copper conductor shall be clamped to the rod and to the fence in such a manner that each element of the fence is grounded. Installation of ground rods shall not constitute a Pay Item and shall be considered incidental to fence construction. The Contractor shall comply with FAA-STD-019, Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment, Paragraph 4.2.3.8, Lightning Protection for Fences and Gates when fencing is adjacent to FAA facilities.

164.3.12 Weed Control Application.

(1) Weed control material shall be applied along the fence line over an area 5 feet wide measured from the fence centerline, (10 feet total width), and over the chain link wildlife fence. Apply weed control material as recommended by the manufacturer's instructions and in compliance with state and local regulations.

164.3.13 Cleaning Up

(1) The Contractor shall remove from the vicinity of the completed work all tools, buildings, equipment, etc., used during construction. All disturbed areas shall be graded and seeded per Item T-901.

164.4 Measurement

164.4.1 General

(1) Wildlife Exclusion Fence shall be measured in place from outside to outside of end posts or corner posts and shall be the length in linear feet of fence actually constructed, except for the space occupied by the gates. Measurements shall be rounded to the nearest even foot.

(2) Chain-Link Fence Skirt Fabric shall be measured for payment by the linear foot to the nearest foot. Measurement shall be along the fence from center to center of end or corner posts, excluding the length occupied by gate openings.

(3) Vehicle Gates and Pedestrian Gates shall be measured in units per each for each gate installed and accepted. Swale Crossings shall be measured in units per each for each crossing location installed and accepted.

(4) Concrete gate pads shall be measured by the unit per each completed and accepted.

(5) Weed Control application shall be measured by the linear foot or square yard.

164.5 Payment

164.5.1 General

(1) Payment for Wildlife Exclusion Fence will be made at the Contract unit price per linear foot for wire or chain-link fence. This price shall be full compensation for furnishing all materials and for preparation, erection, and installation of these materials, cleaning up, grading and seeding, and for all labor, equipment, tools and incidentals necessary to complete the work.

(2) Payment for Chain-Link Fence Skirt Fabric shall be made at the Contract unit price per linear foot. This price shall be full compensation for furnishing materials, all labor, installation, (including preparation, excavation, backfill, fill, and installation), cleaning up, grading and seeding, equipment, tools, and incidentals necessary to complete this item. Utility locates shall be included in this Pay Item.

(3) Payment for Vehicle Gates and Pedestrian Gates will be made at the Contract unit price per each for driveway or for walkway gates. This price shall be full compensation for furnishing all materials and for all preparation, erection, and installation of these materials, for cleaning up, grading and seeding, and for all labor, equipment, tools, and necessary incidentals to complete the item.

(4) Payment for Concrete Pads at Gates shall be made at the Contract unit price for each pad. This price shall be full compensation for furnishing materials, all labor, installation (including preparation, excavation, backfill, placement of concrete, reinforcing steel, and forms), cleaning up, grading and seeding, equipment, tools, and incidentals necessary to complete this item.

(5) Payment for Weed Control Application shall be made at the contract unit price per linear foot or square yard. This price shall be full compensation for furnishing materials, all labor, equipment, tools, and incidentals necessary to complete this item.

(6) Payment for Swale Crossing shall be made at the Contract unit price per each for the type and location of the Swale Crossing shown. This price shall be full compensation for furnishing materials, installation, cleaning up, grading and seeding, all labor, equipment, tools, and incidentals necessary to complete this item.

(7) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

164.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
F164.010 through F164.014	Wildlife Exclusion Fence (height)	Linear Foot (LF)
F164.015	Chain-Link Fence Skirt Fabric	Linear Foot (LF)
F164.020 through F164.029	Vehicle Gate (height) (opening size)	Each (EA)
F164.030 through F164.039	Pedestrian Gate (height) (opening size)	Each (EA)
F164.040 through F164.049	Wildlife Exclusion Fence Gate (location)	Lump Sum (LS)
F164.050	Concrete Gate Pad	Each (EA)
F164.060	Weed Control	Linear Foot (LF)
F164.065	Weed Control	Square Yard (SY)
F164.070 through F164.079	Swale Crossing (type) (location)	Each (EA)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM A116 Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric

ASTM A121	Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A392	Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A491	Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM F668	Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and other Organic Polymer Coated Steel Chain-Link Fence Fabric
ASTM F1043	Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework
ASTM F1083	Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F1183	Standard Specification for Aluminum Alloy Chain Link Fence Fabric
ASTM F1345	Standard Specification for Zinc 5% Aluminum-Mischmetal Alloy Coated Steel Chain-Link Fence Fabric
ASTM G152	Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G153	Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials
ASTM G155	Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials

American Wood Preservers Association (AWPA)

AWPA U1	Use Category System: User Specification for Treated Wood

Federal Specifications (FED SPEC)

FED SPEC RR-F-191/Gen	Fencing, Wire, and Post Metal (and Gates, Chain-link Fence Fabric, and Accessories) (General Specification)
FED SPEC RR-F-191/4	Fencing, Wire and Post, Metal (Chain-Link Fence Accessories)

FAA Standard

FAA-STD-019	Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment

FAA Order

5100.38	AIP Handbook

END OF SPECIFICATION F164

Part 11 – Drainage

Specification D701 - Pipe for Storm Drains and Culverts

701.1 Description
701.1.1 General

(1) This work shall consist of the construction of pipe culverts and storm drains in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the Plans.

701.2 Materials
701.2.1 General

(1) Materials shall meet the requirements shown on the Plans and specified below. Underground piping and components used in drainage systems for terminal and aircraft fueling ramp drainage shall be noncombustible and inert to fuel in accordance with National Fire Protection Association (NFPA) 415.

701.2.2 Pipe

(1) The pipe shall be of the type called for on the Plans or in the Special Provisions and shall be in accordance with the requirement found in the American Association of State Highway and Transportation Official (AASHTO) and the American Society for Testing Materials (ASTM) standards reference in the Specifications and on the Plans.

701.2.3 Concrete.

(1) Concrete for pipe cradles shall have a minimum compressive strength of 2,000 psi at 28 days and conform to the requirements of ASTM C94.

701.2.4 Rubber Gaskets.

(1) Rubber gaskets for rigid pipe shall conform to the requirements of ASTM C443. Rubber gaskets for PVC pipe, polyethylene, and polypropylene pipe shall conform to the requirements of ASTM F477. Rubber gaskets for zinc-coated steel pipe and precoated galvanized pipe shall conform to the requirements of ASTM D1056, for the “RE” closed cell grades. Rubber gaskets for steel reinforced thermoplastic ribbed pipe shall conform to the requirements of ASTM F477.

701.2.5 Joint Mortar.

(1) Pipe joint mortar shall consist of one part Portland cement and two parts sand. The Portland cement shall conform to the requirements of ASTM C150, Type I. The sand shall conform to the requirements of ASTM C144.

701.2.6 Joint Fillers.

(1) Poured filler for joints shall conform to the requirements of ASTM D6690.

701.2.7 Plastic Gaskets.

(1) Plastic gaskets shall conform to the requirements of ASTM C990.

701.2.8. Apron End Walls

701.2.8.1 Reinforced Concrete Apron Endwalls

(1) Reinforced Concrete Apron Endwalls for reinforced concrete pipe shall be manufactured with reinforcement and concrete conforming to the pertinent requirements of ASTM C 76 for Class II, Wall B, reinforced concrete pipe and shall be in accordance with the design, and details shown on the Plans.

701.2.8.2 Corrugated Steel Apron Endwalls

(1) Steel Apron Endwalls for Corrugated Steel culvert pipe shall be manufactured in accordance with the pertinent requirements for corrugated steel pipe and shall conform to the dimensions, thickness, design and details shown on the Plans.

701.2.9 Precast Box Culverts

(1) Manufactured in accordance with and conforming to ASTM C1433.

701.2.10 Precast Concrete Pipe

(1) Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or American Concrete Pipe Association QCast Plant Certification program.

701.3 Construction
701.3.1 Excavation.

(1) The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe, but it shall not be less than the external diameter of the pipe plus six inches on each side. The trench walls shall be approximately vertical.

(2) Contractor shall comply with all current Federal, state and local rules and regulations governing the safety of men and materials during the excavation, installation and backfilling operations. Specifically, the Contractor shall observe that all requirements of the Occupational Safety and Health Administration (OSHA) relating to excavations, trenching and shoring are strictly adhered to. The width of the trench shall be sufficient to permit satisfactorily jointing of the pipe and thorough compaction of the bedding material under the pipe and backfill material around the pipe, but it shall not be greater than the widths shown on the plans trench detail. The trench bottom shall be shaped to fully and uniformly support the bottom quadrant of the pipe.

(3) Where rock, hardpan, or other unyielding material is encountered, the Contractor shall remove it from below the foundation grade for a depth of at least eight inch or 1/2 inch for each foot of fill over the top of the pipe (whichever is greater) but for no more than three-quarters of the nominal diameter of the pipe. The excavation below grade shall be backfilled with selected fine compressible material, such as silty clay or loam, and lightly compacted in layers not over six inches in uncompacted depth to form a uniform but yielding foundation.

(4) Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, the unstable soil shall be removed and replaced with approved granular material for the full trench width. The Engineer shall determine the depth of removal necessary. The granular material shall be compacted to provide adequate support for the pipe.

(5) The excavation for pipes placed in embankment fill shall not be made until the embankment has been completed to a height above the top of the pipe as shown on the Plans.

701.3.2 Bedding.

(1) The pipe bedding shall conform to the class specified on the Plans. The bedding surface for the pipe shall provide a firm foundation of uniform density to support the pipe throughout its entire length. When no bedding class is specified or detailed on the Plans, the requirements for Class B bedding shall apply.

701.3.2.1 Rigid Pipe.

(1) Class A bedding shall consist of a continuous concrete cradle conforming to the Plan details.

(2) Class B bedding shall consist of a bed of granular material having a thickness of at least six inches below the bottom of the pipe and extending up around the pipe for a depth of not less than 30 percent of the pipe's vertical outside diameter. The layer of bedding material shall be shaped to fit the pipe for at least 10 percent of the pipe's vertical diameter and shall have recesses shaped to receive the bell of bell and spigot pipe. The bedding material shall be sand or select sandy soil with 100 percent passing a 3/8 inch sieve and not more than 10 percent passing a No. 200 sieve.

(3) Class C bedding shall consist of bedding the pipe in its natural foundation material to a depth of not less than 10 percent of the pipe's vertical outside diameter. The bed shall be shaped to fit the pipe and shall have recesses shaped to receive the bell of bell and spigot pipe.

701.3.2.2 Flexible Pipe.

(1) For flexible pipe, the bed shall be roughly shaped to fit the pipe, and a bedding blanket of sand or fine granular material shall be provided as follows:

Flexible Pipe Bedding

Pipe Corrugation Depth		Minimum Bedding Depth	
inch	mm	inch	mm
1/2	12	1	25
1	25	2	50
2	50	3	75
2-1/2	60	3-1/2	90

701.3.2.3 PVC, Polyethylene, and Polypropylene Pipe.

(1) For PVC, polyethylene, and polypropylene pipe, the bedding material shall consist of coarse sands and gravels with a maximum particle size of 3/4 inches. For pipes installed under paved areas, no more than 12 percent of the material shall pass the No. 200 sieve. For all other areas, no more than 50 percent of the material shall pass the No. 200 sieve. The bedding shall have a thickness of at least 6 inches below

the bottom of the pipe and extend up around the pipe for a depth of not less than 50 percent of the pipe's vertical outside diameter.

701.3.3 Laying Pipe.

(1) The pipe laying shall begin at the lowest point of the trench and proceed upgrade. The lower segment of the pipe shall be in contact with the bedding throughout its full length. Bell or groove ends of rigid pipes and outside circumferential laps of flexible pipes shall be placed facing upgrade.

(2) Paved or partially lined pipe shall be placed so that the longitudinal center line of the paved segment coincides with the flow line.

(3) Elliptical and elliptically reinforced concrete pipes shall be placed with the manufacturer's reference lines designating the top of the pipe within five degrees of a vertical plane through the longitudinal axis of the pipe.

701.3.4 Joining Pipe.

(1) Joints shall be made with Portland cement mortar, Portland cement grout, rubber gaskets, plastic gaskets, or coupling bands.

(2) Mortar joints shall be made with an excess of mortar to form a continuous bead around the outside of the pipe and shall be finished smooth on the inside. Molds or runners shall be used for grouted joints to retain the poured grout. Rubber ring gaskets shall be installed to form a flexible watertight seal.

701.3.4.1 Concrete Pipe.

(1) Concrete pipe may be either bell and spigot or tongue and groove. The method of joining pipe sections shall be so the ends are fully seated and the inner surfaces are flush and even. Concrete pipe joints shall be sealed with rubber gaskets meeting ASTM C443 when leak resistant joints are required. When shown on the Plans or specified in the Special Provisions, concrete pipe joints shall be sealed with butyl mastic meeting ASTM C990 or mortar when soil tight joints are required. Joints shall be thoroughly wetted before applying mortar or grout.

701.3.4.2 Metal Pipe.

(1) Metal pipe shall be firmly joined by form-fitting bands conforming to the requirements of ASTM A760 for steel pipe and AASHTO M196 for aluminum pipe.

701.3.4.3 PVC, Polyethylene and Polypropylene Pipe.

(1) Joints for PVC, Polyethylene, and Polypropylene pipe shall conform to the requirements of ASTM D3212 when water tight joints are required. Joints for PVC and Polyethylene pipe shall conform to the requirements of AASHTO M304 when soil tight joints are required. Fittings for polyethylene pipe shall conform to the requirements of AASHTO M252 or ASTM M294. Fittings for polypropylene pipe shall conform to ASTM F2881, ASTM F2736, or ASTM F2764.

701.3.5 Backfilling

(1) Pipes shall be inspected before backfill is placed; pipes found to be out of alignment, unduly settled, or damaged shall be removed and re-laid or replaced at the Contractor's expense.

701.3.5.1 Backfill Material Requirements

701.3.5.1.1 Concrete Pipe

(1) Provide backfill material as shown on the Plans, if not shown provide backfill material and compaction requirements in accordance with the applicable Type of Standard Installation (Types 1, 2, 3, or 4) per ASTM C1479.

701.3.5.1.2 Plastic and fiberglass Pipe

(1) Backfill material shall meet the requirements of ASTM D3282, A-1, A-2-4, A-2-5, or A-3. Backfill material shall be free of organic material, stones larger than 1.5 inches in the greatest dimension, or frozen lumps. Embedment material shall extend to 12 inches above the top of the pipe. Alternative backfill material may be shown on Plans.

701.3.5.1.3 Metal Pipe

(1) Backfill material shall be granular as specified in the contract document and specifications, and shall be free of organic material, rock fragments larger than 1.5 inches in the greatest dimension and frozen lumps. As a minimum, backfill materials shall meet the requirements of ASTM D3282, A-1, A-2, or A-3. Embedment material shall extend to 12 inches above the top of the pipe.

701.3.5.2 Placing Backfill

(1) Material for backfill shall be fine, readily compatible soil or granular material selected from the excavation or alternative material if indicated on the Plans or in the Special Provisions. It shall not contain frozen

lumps, stones that would be retained on a two-inch sieve, chunks of highly plastic clay, or other objectionable material. Granular backfill material shall have 95 percent or more passing the a 1/2 inch sieve, with 95 percent or more being retained on the No. 4 sieve.

(2) When the top of the pipe is even with or below the top of the trench, the backfill shall be compacted in layers not exceeding six inches on each side of the pipe and shall be brought up one foot above the top of the pipe or to natural ground level, whichever is greater. Thoroughly compact the backfill material under the haunches of the pipe without displacing the pipe. Material shall be brought up evenly on each side of the pipe for the full length of the pipe.

(3) When the top of the pipe is above the top of the trench, the backfill shall be compacted in layers not exceeding six inches and shall be brought up evenly on each side of the pipe to one foot above the top of the pipe. The width of backfill on each side of the pipe for the portion above the top of the trench shall be equal to twice the pipe's diameter or 12 feet, whichever is less.

(4) For PVC, polyethylene, and polypropylene pipe, the backfill shall be placed in two stages; first to the top of the pipe and then at least 12 inches over the top of the pipe. The bedding and backfill material shall meet the requirements of 701.3.2.3 and 701.3.5, respectively.

(5) All backfill shall be compacted to the density required under Specification P152.

(6) It shall be the Contractor's responsibility to protect installed pipes and culverts from damage due to construction equipment operations. Contractor shall be responsible for installation of extra trench support or backfill required to protect pipes from the construction equipment.

701.3.6 Apron Endwalls

(1) Excavate the trench for apron endwalls to the required width and grade. For metal aprons with toe plates, excavate a trench to permit placement of the toe plate against the inner face of the trench when the apron is in its final position. After the apron has been properly secured to the pile, backfill and firmly compact this trench.

(2) Place reinforced concrete apron endwalls with its tongue (or groove) fully entered in the groove (or tongue) of the pipe.

(3) Backfill for the apron is the same as required for the pipe, unless otherwise directed by Engineer.

701.3.7 Joint Ties

(1) When shown on the Plans, furnish and install joint ties for concrete pipe in accordance with the details and at locations indicated. Joint ties shall be incidental and the cost included in the Contract price for Apron Endwalls.

701.4 Measurement

701.4.1 Pipe Culverts

(1) Pipe culverts will be measured in linear feet of pipe in place, completed, and approved. It shall be measured along the centerline of the pipe between the points of connection to apron endwalls; or if there are no endwalls, then between the ends of the pipe. The several classes, types and size shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipe being measured.

701.4.2 Storm Sewer

(1) Storm sewer will be measured by the linear foot in place, completed, and accepted in accordance with the Contract, measured along the centerline of the pipe. Measurement will be from the pipe end at a free outlet to the center of the end catch basin, manhole, inlet, junction or other drainage structure; or from center to center of catch basins, end manholes, inlets, other drainage structures or junctions. There will be no deduction from these measured lengths for intermediate catch basins, manholes, inlets, other drainage structures, junctions, or fittings.

701.4.3 Pipe Cradles

(1) The volume of concrete for pipe cradles will not be measure separately; the cost shall be included in the Contract prices for pipe culverts and storm sewer.

701.4.4 Rock Excavation

(1) The volume of rock shall be the number of cubic yards of rock excavated. No payment shall be made for the cushion material placed for the bed of the pipe.

701.4.5 Apron Endwalls

(1) Apron Endwalls will be measure by the unit per each for the various diameters and materials required on the Plans and Specifications. Materials will be reinforced concrete or Corrugated Steel.

701.5 Payment

701.5.1 General

(1) Payment will be made at the Contract unit price per linear foot for Pipe Culverts on Storm Sewer of the type, class, and size designated; and at the Contract unit price per cubic yard for rock excavation. Payment will be made at the Contract unit price for each type and size of Apron Endwalls.

(2) These prices shall fully compensate the Contractor for furnishing all materials and for all preparation, excavation, and installation of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

(3) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

701.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
D701.100 through D701.399	Pipe Culvert (type)(class)(size)	Linear Foot (LF)
D701.400 through D701.599	Apron Endwalls (type)(size)	Each (EA)
D701.600 through D701.799	Storm Sewer (type)(class)(size)	Linear Foot (LF)
D701.800	Rock Excavation for Trenches	Cubic Yard (CY)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M167 Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches

AASHTO M190 Standard Specification for Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches

AASHTO M196 Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains

AASHTO M198 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

AASHTO M219 Standard Specification for Corrugated Aluminum Alloy Structural Plate for Field-Bolted Pipe, Pipe-Arches, and Arches

AASHTO M243 Standard Specification for Field Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches

AASHTO M252 Standard Specification for Corrugated Polyethylene Drainage Pipe

AASHTO M294 Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter

AASHTO M304 Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter

AASHTO MP20 Standard Specification for Steel Reinforced Polyethylene (PE) Ribbed Pipe, 300- to 900-mm (12- to 36-in.) Diameter

ASTM International (ASTM)

ASTM A760 Standard Specification for Corrugated Steel Pipe, Metallic Coated for Sewers and Drains

ASTM A761	Standard Specification for Corrugated Steel Structural Plate, Zinc Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
ASTM A762	Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM A849	Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
ASTM B745	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
ASTM C14	Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C94	Standard Specification for Ready Mixed Concrete
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C506	Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C507	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe
ASTM C655	Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe
ASTM C990	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C1433	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
ASTM D1056	Standard Specification for Flexible Cellular Materials Sponge or Expanded Rubber
ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3262	Standard Specification for "Fiberglass" (Glass-Fiber Reinforced Thermosetting Resin) Sewer Pipe
ASTM D3282	Standard Practice for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
ASTM D4161	Standard Specification for "Fiberglass" (Glass-Fiber Reinforced Thermosetting Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM D6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F667	Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings
ASTM F714	Standard Specification for Polyethylene (PE) Plastic Pipe (DR PR) Based on Outside Diameter
ASTM F794	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe & Fittings Based on Controlled Inside Diameter

ASTM F894	Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F949	Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
ASTM F2435	Standard Specification for Steel Reinforced Polyethylene (PE) Corrugated Pipe
ASTM F2562	Specification for Steel Reinforced Thermoplastic Ribbed Pipe and Fittings for Non-Pressure Drainage and Sewerage
ASTM F2736	Standard Specification for 6 to 30 in. (152 to 762 mm) Polypropylene (PP) Corrugated Single Wall Pipe and Double Wall Pipe
ASTM F2764	Standard Specification for 30 to 60 in. (750 to 1500 mm) Polypropylene (PP) Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications
ASTM F2881	Standard Specification for 12 to 60 in. (300 to 1500 mm) Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications
National Fire Protection Association (NFPA)	
NFPA 415	Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways

END SPECIFICATION D701

Specification D702 - Slotted Drains

702.1 Description

702.1.1 General

(1) This Work shall consist of the construction of steel slotted drains or cast iron slotted vane drains in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the Plans. Typical details shall be shown on the Plans.

702.2 Materials

702.2.1 General

(1) All slotted drains shall meet the requirements shown on the Plans and specified below. All slotted drains shall meet specified hydraulic design requirements and shall support the loadings specified.

702.2.2 Pipe

702.2.2.1 Steel Slotted Drain

(1) Pipe shall be metallic coated (galvanized or aluminized type 2) corrugated steel type I meeting the requirements of ASTM A760. Pipe diameter and gauge shall be as shown on the Plans.

(2) The corrugated steel pipe shall have a minimum of two rerolled annular ends.

702.2.2.2 Cast Iron Slotted Vane Drain

(1) Polyvinyl Chloride (PVC) pipe shall meet the requirements of ASTM D3034. Pipe diameter shall be as shown on the Plans. The pipe shall have an open slot to accept the cast iron slotted vane drain castings.

702.2.3 Grates and Castings

702.2.3.1 Steel Slotted Drain

(1) Grates shall be manufactured from ASTM A36 Grade 36 steel. Spacers and bearing bars (sides) shall be 3/16 inch material. The spacers shall be welded to each bearing bar with four 1-1/4 inch long by 3/16 inch wide fillet welds on each side of the bearing bar at spacings not exceeding six inches. The grates shall be six inches high or as shown on the Plans and shall have a maximum 1-3/4 inch opening in the top.

(2) Grates shall be galvanized in accordance with ASTM A123 except with a 2 ounce/square feet galvanized coating.

(3) The grates shall be fillet welded to the corrugated steel pipe with a minimum weld one inch long on each side of the grate at every other corrugation. Weld areas and the heat affected zones where the slot is welded to the corrugated pipe shall be thoroughly cleaned and painted with a zinc-rich paint in accordance with repair of damaged coatings in ASTM A760.

(4) Each 20-foot length of drain delivered to the job site shall be within the following tolerances: vertical bow plus or minus 3/8 inch, horizontal bow plus or minus 5/8 inch, twist plus or minus ½ inch.

702.2.3.2 Cast iron Slotted Vane Drain

(1) Castings shall meet the requirements of ASTM A48, Class 35B gray iron. Castings shall be furnished with no coatings.

(2) Castings shall be designed to fit on open slots in 15 inch PVC pipe. Casting sections shall not exceed three feet in length. Casting sections shall have a built-in vane configuration with bar spacings not exceeding six inches. The opening at the surface shall not exceed 3-3/4 inch, and the vane shall be constructed on a radius so that the opening shall be less than 1-1/2 inch at a depth of 1-1/2 inch as measured vertically from the surface. Casting sections shall integrally lock into the concrete by use of top and bottoms flanges and shear tabs. Castings shall accept bolts for bolting sections together and shall accept wire for fitting to pipe.

702.2.4 Concrete

702.2.4.1 Steel Slotted Drain

(1) Concrete shall have a minimum compressive strength of 3,000 psi at 28-days when tested in accordance with ASTM C39.

(2) Plain or reinforced concrete used shall conform to the requirements of Specification P610.

702.3 Construction

702.3.1 Excavation

(1) The width of the trench shall be sufficient to permit satisfactory installation and jointing of the slotted drain and placing of a high slump concrete backfill material under and around the drain, but shall not be

less than the external pipe diameter plus 6 inches on each side. The depth of the trench shall be a minimum of two inches below the invert for steel slotted drain and 6 inches below the invert for a cast iron slotted vane drain.

(2) The trench may be roughly shaped to the slotted drain bed.

702.3.2 Installation

(1) Steel slotted drain shall be laid in sections joined firmly together as shown on the Plans. The top of all drains shall be held firmly in place to the proper grade, to preclude movement during the backfilling operation.

702.3.3 Joining

(1) Slotted steel drain joints shall be firmly joined by modified hugger type bands, or as indicated, to secure the pipe and prevent infiltration of the backfill. When the slotted steel drain is banded together, the adjacent grates shall have a maximum three inch gap. Cast iron drain castings shall be bolted together.

702.3.4 Backfilling

(1) Slotted drains shall be inspected before any backfill is placed. Damaged drains shall be aligned or replaced at the expense of the Contractor.

(2) The trench holding the slotted drain assembly shall be backfilled with concrete that will easily flow under and around the drain and the trench wall. The opening in the top of grates and castings shall be covered to prevent unwanted material from entering the drain during the backfilling and subsequent surfacing operations.

702.4 Measurement
702.4.1 General

(1) The length of slotted drain shall be measured in linear feet of slotted drain in place, completed, and approved. It shall be measured along the centerline of the drain from end or center of structure to the end or center of structure, whichever is applicable. The several classes, types, and sizes shall be measured separately. All fittings shall be included in the footage as typical pipe sections being measured.

702.5 Payment
702.5.1 Basis

(1) Payment shall be made at the Contract unit price per linear foot for each kind of slotted drain type and size designated and at the Contract unit price per cubic yard of concrete for backfill.

(2) These prices shall be full compensation for all materials, all preparation, excavation and installation of these materials; and all labor, equipment, tools, and incidentals necessary to complete the item.

(3) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

702.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
D702.010 through D702.029	Slotted Drain (type)(size)	Linear Foot (LF)
D702.050	Concrete Backfill for Slotted Drain	Cubic Yard (CY)

REFERENCES

ASTM International (ASTM)

ASTM A36	Standard Specification for Carbon Structural Steel
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A760	Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains

ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO-AGC-ARTBA Task Force 13 Report A Guide to Standardized Highway Drainage Products

END OF SPECIFICATION D702

Specification D705 - Pipe Underdrains for Airports

705.1 Description

705.1.1 General

(1) This Work shall consist of the construction of pipe underdrains in accordance with these Specifications and in conformity with the lines and grades shown on the Plans.

705.2 Materials

705.2.1 General

(1) Materials shall meet the requirements shown on the Plans and described in this Specification.

705.2.2 Pipe

(1) The pipe shall be of the type called for on the Plans or in in Special Provisions and shall be in accordance with ASTM F758, unless other requirements are indicated in the Plan or Special Provisions.

705.2.3 Joint Mortar

(1) Pipe joint mortar shall consist of one part by volume of Portland cement and two parts sand. The Portland cement shall conform to the requirements of ASTM C150, Type I. The sand shall conform to the requirements of ASTM C144.

705.2.4 Elastomeric Seals

(1) Elastomeric seals shall conform to the requirements of ASTM F477.

705.2.5 Porous Backfill

(1) Porous backfill shall be free of clay, humus, or other objectionable matter, and shall conform to the gradation in Table 705.2.5 when tested in accordance with ASTM C136. Use Porous Material No. 2 unless Porous Material No. 1 in indicated on the Plans or Special Provisions.

Table 705.2.5
Gradation of Porous Backfill

Sieve Designation (square openings)	Percentage by Weight Passing Sieves	
	Porous Material No. 1	Porous Material No. 2
1-1/2 inch		100
1 inch		90 - 100
3/8 inch	100	25 - 60
No. 4	95 – 100	5 - 40
No. 8		0 - 20
No. 16	45 – 80	
No. 50	10 – 30	
No. 100	0 – 10	

(2) When two courses of porous backfill are specified in the Plans, the finer of the materials shall conform to particle size tabulated herein for porous material No. 1. The coarser granular material shall meet the gradation given in the tabulation for porous material No. 2.

705.2.6. Granular Material

(1) Granular material used for backfilling shall conform to the requirements of ASTM D2321 for Class IA, IB, or II materials, or shall meet the requirements of AASHTO Standard Specification for Highway Bridges Section 30.

705.2.7. Filter Fabric

(1) Filter fabric shall conform to the requirements of AASHTO M288 Class 2.

Table 705.2.7

Fabric Property	Test Method	Test Requirement
Grab Tensile Strength, lbs.	ASTM D4632	125 min
Grab Tensile Elongation %	ASTM D4632	50 min
Burst Strength, psi	ASTM D3785	125 min
Trapezoid Tear Strength, lbs.	ASTM D4533	55 min
Puncture Strength, lbs.	ASTM D4833	40 min
Abrasion, lbs.	ASTM D4886	15 max loss
Equivalent Opening Size	ASTM D4751	70-100
Permittivity sec^{-1}	ASTM D4491	0.80
Accelerated Weathering (UV Stability) (Strength Retained - %)	ASTM D4355 *(500 hrs. exposure)	70

705.3 Construction

705.3.1 Equipment

(1) All equipment required for the construction of pipe underdrains shall be on the project, in good working condition, before construction is permitted to start.

705.3.2 Excavation

(1) The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe, but shall not be less than the external diameter of the pipe plus six inches on each side of the pipe. The trench walls shall be approximately vertical.

(2) Where rock, hardpan, or other unyielding material is encountered, it shall be removed below the foundation grade for a depth of at least four inches. The excavation below grade shall be backfilled with selected fine compressible material, such as silty clay or loam, and lightly compacted in layers not over six inches in uncompacted depth to form a uniform but yielding foundation.

(3) Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, the unstable soil shall be removed and replaced with approved granular material for the full trench width. The Engineer shall determine the depth of removal necessary. The granular material shall be compacted to provide adequate support for the pipe.

(4) Excavated material not required or acceptable for backfill shall be disposed of by the Contractor. The excavation shall not be carried below the required depth; if this occurs, the trench shall be backfilled at the Contractor's expense with material approved by the Engineer and compacted to the density of the surrounding material.

(5) The pipe bed shall be shaped so at least the lower quarter of the pipe shall be in continuous contact with the bottom of the trench. Spaces for the pipe bell shall be excavated to allow the pipe barrel to support the entire weight of the pipe.

(6) The Contractor shall construct trench bracing, sheathing, or shoring necessary to perform and protect the excavation as required for safety and conformance to Federal, state and local laws. Unless otherwise provided, the bracing, sheathing, or shoring shall be removed by the Contractor after the backfill has reached at least 12 inches over the top of the pipe. The sheathing or shoring shall be pulled as the granular backfill is placed and compacted to avoid any unfilled spaces between the trench wall and the backfill material. The cost of bracing, sheathing, or shoring, and the removal of same, shall be included in the unit price bid per foot for the pipe.

705.3.3 Laying and Installing Pipe

705.3.3.1 Concrete Pipe

(1) The laying of the pipe in the finished trench shall be started at the lowest point and proceed upgrade. When bell and spigot pipe is used, the bells shall be laid upgrade. If tongue and groove pipe is used, the groove end shall be laid upgrade. Holes in perforated pipe shall be placed down, unless otherwise shown on the plans. The pipe shall be firmly and accurately set to line and grade so that the invert will be smooth and uniform. Pipe shall not be laid on frozen ground.

(2) Pipe which is not true in alignment, or which shows any settlement after laying, shall be taken up and re-laid by the Contractor at no additional expense. Making adjustments in grade by exerting force on the barrel of the pipe with excavating equipment, by lifting and dropping the pipe, or by lifting the pipe and packing bedding material under it shall be prohibited. If the installed pipe section is not to grade, the pipe section shall be completely removed, the grade corrected, and the pipe rejoined.

705.3.3.2 Metal Pipe

(1) The metal pipe shall be laid with the separate sections joined firmly together with bands, with outside laps of circumferential joints pointing upgrade, and with longitudinal laps on the sides. Any metal in the pipe or bands that is not protected thoroughly by galvanizing shall be coated with a suitable asphaltum paint.

(2) During installation, the asphalt-protected pipe shall be handled without damaging the asphalt coating. Breaks in the bitumen or treatment of the pipe shall be refilled with the type and kind of bitumen used in coating the pipe originally.

705.3.3.3 PVC or Polyethylene Pipe

(1) PVC or polyethylene pipe shall be installed in accordance with the requirements of ASTM D2321 or AASHTO Standard Specification for Highway Bridges Section 30. Perforations shall meet the requirements of AASHTO M252 or AASHTO M294 Class 2, unless otherwise indicated on the Plans. The pipe shall be laid accurately to line and grade. Fiberglass per ASTM D3839 Standard Guide for Underground Installation of "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Pipe.

705.3.3.4 All Types of Pipe

(1) The upgrade end of pipelines, not terminating in a structure, shall be plugged or capped as approved by the Engineer.

(2) Unless otherwise shown on the Plans, a four inch bed of granular backfill material shall be spread in the bottom of the trench throughout the entire length under all perforated pipe underdrains.

(3) Pipe outlets for the underdrains shall be constructed when required or shown on the Plans. The pipe shall be laid with tight-fitting joints. Porous backfill is not required around or over pipe outlets for underdrains. All connections to other drainage pipes or structures shall be made as required and in a satisfactory manner. If connections are not made to other pipes or structures, the outlets shall be protected and constructed as shown on the Plans.

(4) Holes in perforated pipe shall be placed down, unless otherwise shown on the Plans. Pipe shall be installed lower than adjacent pavement subbase and drainage layers.

705.3.3.5 Filter Fabric

(1) The filter fabric shall be installed in accordance with the manufacturer’s recommendations, or in accordance with AASHTO M288 Appendix, unless otherwise shown on the Plans.

705.3.4 Mortar

(1) The mortar shall be of the desired consistency for caulking and filling the joints of the pipe and for making connections to other pipes or to structures. Mortar that is not used within 45 minutes after water has been added shall be discarded. Retempering of mortar shall not be permitted.

705.3.5 Joints in Concrete Pipe

(1) When open or partly open joints are required or specified, they shall be constructed as indicated on the Plans. The pipe shall be laid with the ends fitted together as designed. If bell and spigot pipe is used, mortar shall be placed along the inside bottom quarter of the bell to center the following section of pipe.

(2) The open or partly open joints shall be surrounded with granular material meeting requirements of porous backfill No. 2 in Table 705.2.5 or as indicated on the Plans. This backfill shall be placed so its thickness will be not less than three inches nor more than six inches, unless otherwise shown on the Plans.

(3) When the original material excavated from the trench is impervious, commercial concrete sand or granular material meeting requirements of porous backfill No. 1 shall surround porous backfill No. 2 (Table 705.2.5), as shown on the Plans or as directed by the Engineer.

(4) When the original material excavated from the trench is pervious and suitable, it may be used as backfill in lieu of porous backfill No. 1, when indicated on the Plans or as directed by the Engineer.

705.3.6 Backfilling

705.3.6.1 Earth

(1) All trenches and excavations shall be backfilled soon after the pipes are installed, unless additional protection of the pipe is directed. The backfill material shall be select material from excavation or borrow and shall be approved by the Engineer. The select material shall be placed on each side of the pipe out to a distance of the nominal pipe diameter and one foot over the top of the pipe and shall be readily compacted. It shall not contain stones three inches or larger in size, frozen lumps, chunks of highly plastic clay, or any other material that is objectionable to the Engineer. The material shall be moistened or dried, as required to aid compaction. Placement of the backfill shall not cause displacement of the pipe. Thorough compaction under the haunches and along the sides to the top of the pipe shall be obtained.

(2) The backfill shall be placed in loose layers not exceeding six inches in depth under and around the pipe, and not exceeding eight inches over the pipe. Successive layers shall be added and thoroughly compacted by hand and pneumatic tampers, approved by the Engineer, until the trench is completely filled and brought to the planned elevation. Backfilling shall be done to avoid damaging top or side pressures on the pipe.

(3) In embankments and other unpaved areas, the backfill shall be compacted per Specification P152 to the density required for embankments in unpaved areas. Under paved areas, the subgrade and backfill shall be compacted per Specification P152 to the density required for embankments for paved areas.

705.3.6.2 Granular Backfill

(1) When granular backfill is required, placement in the trench and about the pipe shall be as shown on the Plans. The granular backfill shall be in accordance with P203 and shall not contain an excessive amount of foreign matter, nor shall soil from the sides of the trench or from the soil excavated from the trench be allowed to filter into the granular backfill. When required by the Engineer, a template shall be used to properly place and separate the two sizes of backfill. The backfill shall be placed in loose layers not exceeding 6 inches in depth. The granular backfill shall be compacted by hand and pneumatic tampers to the requirements as given for embankment. Backfilling shall be done to avoid damaging top or side pressure on the pipe. The granular backfill shall extend to the elevation of the trench or as shown on the Plans.

(2) When perforated pipe is specified, granular backfill material shall be placed along the full length of the pipe. The position of the granular material shall be as shown on the Plans. If the original material excavated from the trench is pervious and suitable, it shall be used in lieu of porous backfill.

(3) If porous backfill in accordance with 705.2.5 is placed in paved or adjacent to paved areas before grading or subgrade operations is completed, the backfill material shall be placed immediately after laying the pipe. The depth of the granular backfill shall be not less than 12 inches, measured from the top of the underdrain. During subsequent construction operations, a minimum depth of 12 inches of backfill shall be maintained over the underdrains. When the underdrains are to be completed, any unsuitable material shall be removed exposing the porous backfill. Porous backfill containing objectionable material shall be removed and replaced with suitable material. The cost of removing and replacing any unsuitable material shall be at the Contractor's expense.

(4) If a granular subbase blanket course is used which extends several feet beyond the edge of paving to the outside edge of the underdrain trench, the granular backfill material over the underdrains shall be placed in the trench up to an elevation of two inches above the bottom surface of the granular subbase blanket course. Immediately prior to the placing of the granular subbase blanket course, the Contractor shall blade this excess trench backfill from the top of the trench onto the adjacent subgrade where it can be incorporated into the granular subbase blanket course. Unsuitable material that remains over the underdrain trench shall be removed and replaced. The subbase material shall be placed to provide clean contact between the subbase material and the underdrain granular backfill material for the full width of the underdrain trench.

705.3.6.3 Flexible Pipe Deflection Testing

(1) Flexible pipe shall be inspected by the Contractor during and after installation to ensure that the internal diameter of the pipe barrel has not been reduced by more than 5 percent. For procedure on properly sizing mandrels, refer to ASTM D3034 and ASTM F679 appendices.

705.3.7 End Section

(1) Construct underdrain end section in accordance with the details and at the location shown on the Plans.

705.3.8 Risers

(1) Construct underdrain risers in accordance with the details and at the locations shown on the Plans.

705.3.9 Connections

(1) When the Plans call for connections to existing or proposed pipe or structures, these connections shall be watertight and made to obtain a smooth uniform flow line throughout the drainage system.

705.3.10 Cleaning and Site Restoration

(1) After the backfill is completed, the Contractor shall dispose of all surplus material, soil, and rubbish from the site. Surplus soil may be deposited in embankments, shoulders, or as directed by the Engineer. Except for paved areas of the airport, the Contractor shall restore all disturbed areas to their original condition.

705.4 Measurement

705.4.1 General

(1) The length of underdrain shall be the number of linear feet of pipe underdrains in place, completed, and approved; measured along the centerline of the pipe from end or center of structure to the end or center of structure, whichever is applicable. The several types, and sizes shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipeline being measured.

705.4.2 Risers and End Sections

(1) Airport Underdrain Risers and End Section will be measured on the basis of the amount per each installed and accepted.

705.5 Payment

705.5.1 General

(1) Payment will be made at the contract unit price per linear foot for airport underdrains of the type, and size designated. These prices shall be full compensation for furnishing all materials and for all preparation, excavation, and installation of these materials, including pipe, porous material, geotextile fabric, fittings, connections, backfill compacting, and for all labor, equipment, tools, and incidentals necessary to complete the Work.

(2) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

705.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
D705.106	Airport Underdrain 6-Inch	Linear Foot (LF)
D705.108	Airport Underdrain 8-Inch	Linear Foot (LF)
D705.110	Airport Underdrain 10-Inch	Linear Foot (LF)
D705.112	Airport Underdrain 12-Inch	Linear Foot (LF)
D705.201	Airport Underdrain Riser	Each (EA)
D705.306	Airport Underdrain End Section 6-Inch	Each (EA)
D705.308	Airport Underdrain End Section 8-Inch	Each (EA)
D705.310	Airport Underdrain End Section 10-Inch	Each (EA)
D705.312	Airport Underdrain End Section 12-Inch	Each (EA)
D705.406	Airport Underdrain Unperforated 6-Inch	Linear Foot (LF)
D705.408	Airport Underdrain Unperforated 8-Inch	Linear Foot (LF)
D705.410	Airport Underdrain Unperforated 10-Inch	Linear Foot (LF)
D705.412	Airport Underdrain Unperforated 12-Inch	Linear Foot (LF)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM A760	Standard Specification for Corrugated Steel Pipe, Metallic Coated for Sewers and Drains
ASTM A762	Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C444	Standard Specification for Perforated Concrete Pipe
ASTM C654	Standard Specification for Porous Concrete Pipe
ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F758	Standard Specification for Smooth Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
ASTM F794	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe & Fittings Based on Controlled Inside Diameter
ASTM F949	Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
ASTM F2562	Specification for Steel Reinforced Thermoplastic Ribbed Pipe and Fittings for Non-Pressure Drainage and Sewerage

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M190	Standard Specification for Bituminous - Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M196	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
AASHTO M252	Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M288	Standard Specification for Geotextile Specification for Highway Applications
AASHTO M294	Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500- mm (12- to 60-in.) Diameter
AASHTO M304	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter
AASHTO MP20	Standard Specification for Steel-Reinforced Polyethylene (PE) Ribbed Pipe, 300- to 900-mm (12- to 36-in.) diameter
AASHTO	Standard Specifications for Highway Bridges

END OF SPECIFICATION D705

Specification D751 - Manholes, Catch Basins, Inlets and Inspection Holes

751.1 Description

751.1.1 General

(1) This work shall consist of construction of manholes, catch basins, inlets, and inspection holes, in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the Plans or required by the Engineer.

751.2 Materials

751.2.1 Brick

(1) Brick shall conform to the requirements of ASTM C32, Grade MS.

751.2.2 Mortar

(1) Mortar shall consist of one part Portland cement and two parts sand. The Portland cement shall conform to the requirements of ASTM C150, Type I. The sand shall conform to the requirements of ASTM C144.

751.2.3 Concrete

(1) Plain and reinforced concrete used in structures, connections of pipes with structures, and the support of structures or frames shall conform to the requirements of Specification P610.

751.2.4 Precast Concrete Pipe Manhole Rings

(1) Precast concrete pipe manhole rings shall conform to the requirements of ASTM C478. Unless otherwise specified, the risers and offset cone sections shall have an inside diameter of not less than 36 inches nor more than 48 inches. There shall be a gasket between individual sections and sections cemented together with mortar on the inside of the manhole. Gaskets shall conform to the requirements of ASTM C443.

751.2.5 Corrugated Metal

(1) Corrugated metal shall conform to the requirements of American Association of State Highway and Transportation Officials (AASHTO) M36.

751.2.6 Frames, Covers, and Grates

(1) Castings shall conform to one of the following requirements:

a. ASTM A48, Class 35B: Gray iron castings
b. ASTM A47: Malleable iron castings
c. ASTM A27: Steel castings
d. ASTM A283, Grade D: Structural steel for grates and frames
e. ASTM A536, Grade 65-45-12: Ductile iron castings
f. ASTM A897:Austempered ductile iron castings

(2) All castings or structural steel units shall conform to the dimensions shown on the Plans and shall be designed to support the loadings, aircraft gear configuration and/or direct loading, specified.

(3) Each frame and cover or grate unit shall be provided with fastening members to prevent it from being dislodged by traffic but which will allow easy removal for access to the structure.

(4) All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A123.

751.2.7 Steps

(1) Steps or ladder bars shall be gray or malleable cast iron or galvanized steel. The steps shall be the size, length, and shape shown on the Plans and those steps that are not galvanized shall be given a coat of bituminous paint, when specified.

751.2.8 Precast inlet Structures

(1) Manufactured in accordance with and conforming to ASTM C913.

751.3 Construction Methods

751.3.1 Excavation

751.3.1.1 Excavation

(1) Contractor shall excavate for structures and footings to the lines and grades or elevations, shown on the Plans, or as staked by the Engineer. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown. The elevations of the bottoms of

footings, as shown on the Plans, shall be considered as approximately only; and the Engineer may direct, in writing, changes in dimensions or elevations of footings necessary for a satisfactory foundation.

751.3.1.2 Removals

(1) Boulders, logs, or other objectionable material encountered in excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped, or serrated, as directed by the Engineer. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. Rock excavation as defined in P152 shall be extra work. Where concrete will rest on a surface other than rock, the bottom of the excavation shall not be disturb and excavation to final grade shall not be made until immediately before the concrete or reinforcing is placed.

751.3.1.3 Bracing, Sheathing, and Shoring

(1) Contractor shall do all bracing, sheathing, or shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheathing, or shoring shall be included in the unit price bid for the structure.

(2) All bracing, sheathing, or shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall not disturb or damage finished masonry. The cost of removal shall be included in the unit price bid for the structure.

751.3.1.4 Notification

(1) After excavation is completed for each structure, the Contractor shall notify the Engineer. No concrete or reinforcing steel shall be placed until the Engineer has approved the depth of the excavation and the character of the foundation material.

751.3.2 Brick Structures

751.3.2.1 Foundations

(1) A prepared foundation shall be placed for all brick structures after the foundation excavation is completed and accepted. Unless otherwise specified, the base shall consist of reinforced concrete mixed, prepared, and placed in accordance with the requirements of Specification P610.

751.3.2.2 Laying Brick

(1) All brick shall be clean and thoroughly wet before laying so that they will not absorb any appreciable amount of additional water at the time they are laid. All brick shall be laid in freshly made mortar. Mortar not used within 45 minutes after water has been added shall be discarded. Retempering of mortar shall not be permitted. An ample layer of mortar shall be spread on the beds and a shallow furrow shall be made in it that can be readily closed by the laying of the brick. All bed and head joints shall be filled solid with mortar. End joints of stretchers and side or cross joints of headers shall be fully buttered with mortar and a shoved joint made to squeeze out mortar at the top of the joint. Bricks that may be loosened after the mortar has taken its set, shall be removed, cleaned, and re-laid with fresh mortar. No broken or chipped brick shall be used in the face, and no spalls or bats shall be used except where necessary to shape around irregular openings or edges; in which case, full bricks shall be placed at ends or corners where possible, and the bats shall be used in the interior of the course. In making closures, no piece of brick shorter than the width of a whole brick shall be used; and wherever practicable, whole brick shall be used and laid as headers.

751.3.2.3 Joints

(1) All joints shall be filled with mortar at every course exterior faces shall be laid up in advance of backing. Exterior faces shall be plastered or parged with a coat of mortar not less than 3/8 inch thick before the backing is laid up. Prior to parging, all joints on the back of face courses shall be cut flush. Unless otherwise noted, joints shall be not less than 1/4 inch nor more than 1/2 inch wide and the selected joint width shall be maintained uniform throughout the work.

751.3.2.4 Pointing

(1) Face joints shall be neatly struck, using the weather-struck joint. All joints shall be finished properly as the laying of the brick progresses. When nails or line pins are used the holes shall be immediately plugged with mortar and pointed when the nail or pin is removed.

751.3.2.5 Cleaning

(1) Upon completion of the work all exterior surfaces shall be thoroughly cleaned by scrubbing and washing with water. If necessary to produce satisfactory results, cleaning shall be done with a five percent solution of muriatic acid which shall then be rinsed off with liberal quantities of water.

751.3.2.6 Curing and Cold Weather Protection

(1) The brick masonry shall be protected and kept moist for at least 48 hours after laying the brick. Brick masonry work or pointing shall not be done when there is frost on the brick or when the air temperature is below 50 degrees Fahrenheit unless the Contractor has, on the project ready to use, suitable covering and artificial heating devices necessary to keep the atmosphere surrounding the masonry at a temperature of not less than 60°F for the duration of the curing period.

751.3.3 Concrete Structures

(1) Concrete structures, which are to be cast-in-place within the construction limits, shall be built on prepared foundations, conforming to the dimensions and shape indicated on the Plans. The construction shall conform to the requirements specified in Specification P610. Reinforcement required shall be placed as indicated on the Plans and shall be approved by the Engineer before the concrete is placed.

(2) All invert channels shall be constructed and shaped accurately to be smooth, uniform, and cause minimum resistance to flowing water. The interior bottom shall be sloped to the outlet.

751.3.4 Precast Concrete Structures

(1) Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another engineer approved third party certification program.

(2) Precast concrete structures shall conform to ASTM C478. Precast concrete structures shall be constructed on prepared or previously placed slab foundations conforming to the dimensions and locations shown on the Plans. All precast concrete sections necessary to build a completed structure shall be furnished. The different sections shall fit together readily. Joints between precast concrete risers and tops shall utilize a rubber gasket per ASTM C443, or be fully-bedded in a butyl rubber (rope form) gasket consisting of a preformed, high adhesion material, packaged ready for use between protective paper strips, conforming to Federal Spec SS-S-210A. The top of the upper precast concrete section shall be suitably formed and dimensioned to receive the metal frame and cover or grate, or other cap, as required. Provision shall be made for connections for lateral pipe, including drops and leads that may be installed in the structure. The flow lines shall be smooth, uniform, and cause minimum resistance to flow. The metal or metal encapsulated steps that are embedded or built into the side walls shall be aligned and placed in accordance with ASTM C478. When a metal ladder replaces the steps, it shall be securely fastened into position.

751.3.5 Corrugated Metal Structures

(1) Corrugated metal structures shall be prefabricated. All standard or special fittings shall be furnished to provide pipe connections or branches with the correct dimensions and of sufficient length to accommodate connecting bands. The fittings shall be welded in place to the metal structures. The top of the metal structure shall be designed so that either a concrete slab or metal collar may be attached to allow the fastening of a standard metal frame and grate or cover. Steps or ladders shall be furnished as shown on the Plans. Corrugated metal structures shall be constructed on prepared foundations, conforming to the dimensions and locations as shown on the Plans. When indicated, the structures shall be placed on a reinforced concrete base.

751.3.6 Inlet and Outlet Pipes

(1) Inlet and outlet pipes shall extend through the walls of the structures a sufficient distance beyond the outside surface to allow for connections. They shall be cut off flush with the wall on the inside surface of the structure, unless otherwise directed. For concrete or brick structures, mortar shall be placed around these pipes to form a tight, neat connection.

751.3.7 Placement and Treatment of Castings, Frames, and Fittings

(1) All castings, frames, and fittings shall be placed in the positions indicated on the Plans or as directed by the Engineer, and shall be set true to line and elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

(2) When frames or fittings are placed on previously constructed masonry, the bearing surface of the masonry shall be brought true to line and grade and shall present an even bearing surface so the entire face or back of the unit will come in contact with the masonry. The unit shall be set in mortar beds and anchored to the masonry as indicated on the Plans or as directed by the Engineer. All units shall set firm and secure.

(3) After the frames or fittings have been set in final position, the concrete or mortar shall be allowed to harden for seven days before the grates or covers are placed and fastened down.

751.3.8 Installation of Steps

(1) Steps shall be installed as indicated on the Plans. When the steps are to be set in concrete, they shall be placed and secured in position before the concrete is placed. When the steps are installed in brick masonry, they shall be placed as the masonry is being built. The steps shall not be disturbed or used until the concrete or mortar has hardened for at least seven days. After seven days, the steps shall be cleaned and painted, unless they have been galvanized.

(2) When steps are required with precast concrete structures, they shall meet the requirements of ASTM C478. The steps shall be cast into the side of the sections at the time the sections are manufactured or set in place after the structure is erected by drilling holes in the concrete and cementing the steps in place.

(3) When steps are required with corrugated metal structures, they shall be welded into aligned position at a vertical spacing of 12 inches.

(4) Instead of steps, prefabricated ladders may be installed. For brick or concrete structures, the ladder shall be held in place by grouting the supports in drilled holes. For metal structures, the ladder shall be secured by welding the top support to the structure and grouting the bottom support into drilled holes in the foundation or as directed by the Engineer.

751.3.9 Backfilling

751.3.9.1 Placing Backfill

(1) After a structure has been completed, the area around it shall be backfilled with approved material, in horizontal layers not to exceed eight inches in loose depth, and compacted to the density required in Specification P152. Each layer shall be deposited evenly around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the Plans.

751.3.9.2 Backfill Schedule

(1) Backfill shall not be placed against any structure until approved by the Engineer. For concrete structures, approval shall not be given until the concrete has been in place seven days, or until tests establish that the concrete has attained sufficient strength to withstand any pressure created by the backfill and placing methods.

751.3.9.3 Payment for Backfill

(1) Backfill shall not be measured for direct payment. Performance of this work shall be considered incidental and the cost included in the contract price for the structure involved.

751.3.10 Cleaning and Restoration of Site

(1) After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankments, shoulders, or as approved by the Engineer. Contractor shall restore all disturbed areas to their original condition. Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

751.4 Measurement

751.4.1 General

(1) Manholes, catch basins, inlets, and inspection holes shall be measured by the unit per each.

751.5 Payment

751.5.1 General

(1) The accepted quantities of manholes, catch basins, inlets, and inspection holes will be paid for at the Contract unit price per each in place completed and accepted. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials; furnishing and installation of casting, steps or ladders, chimneys, adjusting rings, poured invert, and other features, and connections to pipes and other structures required to complete the work as shown on the Plans; and for all labor equipment, tools and incidentals necessary to complete the structure.

(2) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

751.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
D751.010 through D751.029	Manhole (type)	Each (EA)
D751.030 through D751.049	Manhole (location)	Lump Sum (LS)
D751.050 through D751.069	Catch Basin (type)	Each (EA)
D751.070 through D751.079	Inlets (type)	Each (EA)
D751.080	Inspection Holes	Each (EA)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM A27	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A47	Standard Specification for Ferritic Malleable Iron Castings
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A283	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A897	Standard Specification for Austempered Ductile Iron Castings
ASTM C32	Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
ASTM C478	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C913	Standard Specification for Precast Concrete Water and Wastewater Structures.

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M36	Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains

Federal Specification

SS-SS-210A	Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

END OF SPECIFICATION D751

Specification D752 - Concrete Culverts, Headwalls, and Miscellaneous Drainage Structures

752.1 Description

752.1.1 General

(1) This item shall consist of plain or reinforced concrete culverts, headwalls, and miscellaneous drainage structures constructed in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the Plans.

752.2 Materials

752.2.1 Concrete

(1) Plain or Reinforced concrete shall meet the requirements of Specification P610.

752.3 Construction

752.3.1 Excavation

752.3.1.1 Excavation

(1) Trenches and foundation pits for structures or structure footings shall be excavated to the lines and grades and elevations shown on the Plans. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown. The elevations of the bottoms of footings, as shown on the Plans, shall be considered as approximate only; and the Engineer may approve, in writing, changes in dimensions or elevations of footings necessary to secure a satisfactory foundation.

752.3.1.2 Removal

(1) Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped, or serrated, as directed by the Engineer. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. Rock excavation as defined in P152 shall be extra work. When concrete will rest on a surface other than rock, the bottom of the excavation shall not be disturbed and excavation to final grade shall not be made until immediately before the concrete or reinforcing steel is placed.

752.3.1.3 Bracing, Sheathing and Shoring

(1) Contractor shall do all bracing, sheathing, or shoring necessary to perform and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheathing, or shoring shall be included in the unit price bid for excavation. All bracing, sheathing, or shoring shall be removed by the Contractor after the completion of the structure. Removal shall be not disturb or damage the finished concrete. The cost of removal shall be included in the unit price bid for excavation.

752.3.1.4 Notification

(1) After each excavation is completed, the Contractor shall notify the Engineer. No concrete or reinforcing steel shall be placed until the Engineer has approved the depth of the excavation and the character of the foundation material.

752.3.2 Backfilling

752.3.2.1 Constructing Backfill

(1) After a structure has been completed, backfilling with approved material shall be accomplished by placing the fill in horizontal layers not to exceed 8 inches in loose depth, and compacted. The field density of the compacted material shall be at least 90 percent of the maximum density for cohesive soils and 95 percent of the maximum density for noncohesive soils. The maximum density shall be determined in accordance with ASTM D698. The field density shall be determined in accordance with ASTM D1556.

752.3.2.2 Backfill Schedule

(1) No backfilling shall be placed against a structure until approved by the Engineer. For concrete, approval shall not be given until the concrete has been in place seven days, or until tests establish that the concrete has attained sufficient strength to withstand any pressure created by the backfill or the placement methods.

752.3.2.3 Backfill Requirement

(1) Fill placed around concrete culverts shall be deposited on each side at the same time and to approximately the same elevation. All slopes bounding or within the areas to be backfilled shall be stepped or serrated to prevent wedge action against the structure.

752.3.2.4 Payment for Backfill

(1) Backfill will not be measured for direct payment. Performance of this work shall be considered incidental and the cost included in the Contract unit price for Excavation for Structures (if provided) or in the Contract unit price for the structure involved.

752.3.3 Weep Holes

(1) Weep holes shall be constructed as shown on the Plans.

752.3.4 Cleaning and Site Restoration of Site

(1) After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankment, shoulders, or as approved by the Engineer. The Contractor shall restore all disturbed areas to their original condition. The Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

752.4 Measurement

752.4.1 Excavation for Structures

(1) The quantity of excavation for structures shall be the number of cubic yards, measured in original position, of material excavated in accordance with the Plans; but in no case shall yardage be included in the measurement for payment which is outside of a volume bounded by vertical planes 18 inches outside of and parallel to the neat lines of the footings.

752.4.2 Structural Concrete

(1) Concrete shall be measured by the number of cubic yards of structural concrete, complete in place and accepted. In computing the yardage of concrete for payment, the dimensions used shall be those shown on the Plans or approved by the Engineer. No measurements or other allowances shall be made for forms, false work, cofferdams, pumping, bracing, expansion joints, or finishing of the concrete. No deductions in yardage shall be made for the volumes of reinforcing steel or embedded items.

752.4.3 Reinforcing Steel

(1) The quantity of reinforcing steel shall be the calculated theoretical number of pounds (km) placed as shown on the Plans, complete in place and accepted. The unit weight used for deformed bars shall be the weight of plain square or round bars, as the case may be, of equal nominal size.

752.4.4 Complete Structure

(1) Structures; at a particular location, and of the type designated, will be measure for payment as a single complete unit of Work, per lump sum.

752.5 Payment

752.5.1 General

(1) Payment will be made at the Contract unit price per cubic yard for excavation for Structures; at the contract unit price per cubic yard for concrete for the structures; and at the contract unit price per pound for reinforcing steel. These prices shall be full compensation for furnishing all materials and for all preparation, excavation, and placing the materials, and for all labor, equipment, tools, and incidentals necessary to complete the structure.

(2) Structures of the type designated, and at a particular location will be paid on a lump sum basis, which shall be full compensation for site preparation, excavation (unless a separate Pay Item is provided for excavation), construction of the structure, structural concrete, reinforcing steel, casting, hardwares, and other appurtenant items which are part of the structure backfilling, and site finishing. Site work identified the Plan shall also be included. The lump sum price shall be full compensation for all materials, and construction, and for all labor, equipment, tools, testing, and incidentals necessary to complete the structure.

(3) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices. If a Pay Item is not provided for excavation for structures, the cost of excavation

752.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
D752.010	Excavation for Structures	Cubic Yard (CY)
D752.012	Structural Concrete	Cubic Yard (CY)
D752.014	Reinforcing Steel	Pound (LB)
D752.020 through D752.039	Structure (type) (location or number)	Lump Sum (LS)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3 (600 kN-m/m^3))

ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

END OF SPECIFICATION D752

Specification D754 - Concrete Gutters, Ditches, and Flumes

754.1 Description

754.1.1 General

(1) This Work shall consist of Portland cement concrete gutters, ditches, and flumes constructed in accordance with these Specifications at the specified locations in accordance with the dimensions, lines, and grades as shown on the Plans.

754.2 Materials

754.2.1 Concrete

(1) Plain and reinforced Portland cement concrete shall meet the requirements of Specification P610.

754.2.2 Joints

(1) Joint filler materials and premolded joint material shall conform to Specification P610.

754.3 Construction

754.3.1 Preparing subgrade

(1) Excavation shall be made to the required width and depth, and the subgrade upon which the item is to be built shall be compacted to a firm uniform grade. All soft and unsuitable material shall be removed and replaced with suitable approved material. When required, a layer of approved granular material, compacted to the thickness indicated on the Plans, shall be placed to form a subbase. The underlying course shall be checked and accepted by the Engineer before placing and spreading operations are started.

754.3.2 Placing

(1) The forms and the mixing, placing, finishing, and curing of concrete shall conform to the requirements of Specification P610 and the following requirements.

(2) The concrete shall be tamped until it is consolidated and mortar covers the top surface. The surface of the concrete shall be floated smooth and the edges rounded to the radii shown on the Plans. Before the concrete is given the final finishing, the surface shall be tested with a 12-foot straightedge, and any irregularities of more than 1/4 inch in 12-foot shall be eliminated.

(3) The concrete shall be placed with dummy-grooved joints not to exceed 25 feet apart and no section shall be less than four feet long.

(4) Expansion joints of the type called for in the Plans shall be constructed to replace dummy groove joints at spacings of approximately 100 feet. When the gutter is placed next to concrete pavement, expansion joints in the gutter shall be located opposite expansion joints in the pavement. When a gutter abuts a pavement or other structure, an expansion joint shall be placed between the gutter and the other structure.

(5) Forms shall not be removed within 24 hours after the concrete has been placed. Minor defects shall be repaired with mortar containing one part cement and two parts fine aggregate.

(6) Depositing, compacting, and finishing the item shall be conducted to build a satisfactory structure. If any section of concrete is found to be porous, or is otherwise defective, it shall be removed and replaced by the Contractor without additional compensation.

754.3.3 Backfilling

(1) After the concrete has set sufficiently, the spaces adjacent to the structure shall be refilled to the required elevation with material specified on the Plans and compacted by mechanical equipment to at least 90 percent of the maximum density as determined by ASTM D698. The in-place density shall be determined in accordance with ASTM D1556.

754.3.4 Cleaning and Restoration of Site

(1) After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankments, shoulders, or as ordered by the Engineer. The Contractor shall restore all disturbed areas to their original condition. The Contractor shall remove all tools and equipment, leaving the entire site free, clear and in good condition.

(2) Performance of the work described in this section shall be considered as a subsidiary obligation of the Contractor, covered under the contract unit price for the structure.

754.4 Measurement

754.4.1 General

(1) Concrete gutters, ditches, and flumes will be measured at the Contract unit price per linear foot or square foot for facilities constructed in accordance with the Specifications and details shown on the Plans.

754.5 Payment

754.5.1 General

(1) Payment shall be made at the Contract unit price per linear foot or square foot for concrete gutter, ditch and flume of the various types designated. This price shall be full compensation for furnishing all materials and for all preparation, excavation, forms, construction, backfill, hauling, and placement of the material, and for all labor, equipment, tools, and incidentals necessary to complete this Work.

(2) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

754.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
D754.010 though D754.019	Concrete Gutter (type)	Linear Foot (LF)
D754.020 through D754.029	Concrete Gutter (type)	Square Foot (SF)
D754.030 through D754.039	Concrete Ditch (type)	Linear Foot (LF)
D754.040 through D754.049	Concrete Ditch (type)	Square Foot (SF)
D754.050 through D754.059	Concrete Flume (type)	Linear Foot (LF)
D754.060 through D754.069	Concrete Flume (type)	Square Foot (SF)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3 (600 kN-m/m^3))

ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

END OF SPECIFICATION D754

Part 12 – Turfing

Specification T901 – Seeding

901.1 Description

(1) This section describes preparing seed beds and furnishing and sowing the required seed on slopes, appurtenances, and other areas, and on borrow pits and material disposal sites.

(2) This section also describes furnishing and sowing temporary seed mixture on the slopes and appurtenances of temporary embankments and airport facilities areas.

901.2 Materials

901.2.1 Seed

901.2.1.1 General Requirements

(1) Conform to the Wisconsin statutes and Wisconsin administrative code chapter ATCP 20 regarding noxious weed seed content and labeling.

http://docs.legis.wi.gov/statutes/statutes/

http://docs.legis.wi.gov/code/admin_code/atcp/020/20.pdf

(2) Use seed within one year of the test date appearing on the label.

(3) Seed mixtures 70, 70A, 75, and 80 contain wild type forbs and grasses. Wild type is defined as seed that is derived directly from native, wild stock, including seed that was wild collected and placed into production or has been harvested directly from native stands.

901.2.1.2 Purity and Germination

(1) Test seed according to the methods and procedures used for sampling and analyzing seed for purity, germination, and noxious weed seed content specified in the current edition of Rules for Testing Seed, published by the Association of Official Seed Analysts.

901.2.1.3 Inoculation

(1) Inoculate legume seed (white clover, red clover, ladino clover, alsike clover, alfalfa, partridge pea, purple prairie clover, Canada tick-trefoil, and lupine) unless it has been pre-inoculated by the vendor. Follow the inoculation instructions that come with the culture purchases. If applying the seed according to method B, 901.3.3.2, treat seeds requiring inoculation with five times the amount of inoculant recommended in the instructions.

(2) Avoid exposure of the culture or inoculated seed to the sunlight, and in no case shall any exposure exceed 1/2 hour.

901.2.1.4 Storing Seed

(1) Store any seed delivered before use in a way that protects it from damage by heat, moisture, rodents, or other causes. Discard and replace any previously tested and accepted seed that becomes damaged.

901.2.1.5 Seed Mixture Requirements

(1) Seed mixtures for use on airports and adjacent properties shall, unless specified otherwise, be composed of seeds of the purity, germination, and proportions, by weight, as given in the Table 901.1 - Highway Seed Mixtures and the Table 901.2 - Native Seed Mixtures.

(2) Use seed of the species and varieties listed below. If no variety is listed, there will be no restriction on the variety furnished, except as follows:

a. Species composed of pure live seed (PLS) shall contain no named or improved varieties. PLS shall be grown in Wisconsin or northern Illinois, northeastern Iowa, or eastern Minnesota. Seed produced out-of-state must be grown in one of the following counties:

i. From northern Illinois:

Boone	Bureau	Carroll	Cook	De Kalb	Du Page	Grundy
Henry	Jo Daviess	Kane	Kendall	Lake	La Salle	Lee
McHenry	Ogle	Putnam	Rock Island	Stevenson	Whiteside	Will
Winnebago						

ii. From northeastern Iowa:

Allamakee	Benton	Black Hawk	Bremer	Buchanan	Cedar	Chickasaw
Clayton	Clinton	Delaware	Dubuque	Fayette	Floyd	Howard

Jackson	Johnson	Jones	Linn	Mitchell	Muscatine	Scott
Winneshiek						

iii. From eastern Minnesota:

Aitkin	Anoka	Carlton	Carver	Chisago	Dakota	Dodge
Fillmore	Goodhue	Hennepin	Houston	Isanti	Kanabec	La Sueur
Mille Lacs	Mower	Olmsted	Pine	Ramsey	Rice	Scott
Sherburne	Steele	Wabasha	Washington	Winona	Wright	

b. PLS for seed mixtures 70, 70A, 75, and 80 shall be packaged separately by species and clearly labeled with the vendor's name, species common and botanical names, gross weight, percent PLS, year of harvest and any specialized treatments that have been applied to ensure or enhance germination. If PLS is not listed, determine PLS by multiplying the percent germination times the percent purity.

c. Minimum percent purity for native for species is 90 percent. If a listed species is not available, substitutions may be made with Engineer's approval and must be documented.

(3) Mix native species at the project site. Clean and debeard seeds having awns or excessive hairs before mixing.

SPECIES COMMON NAME	SPECIES BOTANICAL NAME	ACCEPTABLE VARIETIES
Kentucky Bluegrass	Poa pratensis	Low Maintenance
Red Fescue	Festuca rubra	Creeping
Hard Fescue	Festuca ovina var. duriuscula	Improved
Tall Fescue	Festuca arundinacea	Improved turf type
Salt Grass	Puccinella distans	Fult's
	Puccinella distans	Salty
Redtop	Agrostis alba	
Timothy	Phleum pratense	
Canada Wild Rye[1]	Elymus canadensis	
Perennial Ryegrass	Lolium perenne	
Perennial Ryegrass	Lolium perenne	Improved Fine
Annual Ryegrass	Lolium multiflorum	
Alsike Clover	Trifolium hybridum	
Red Clover	Trifolium pratense	
White Clover	Trifolium repens	
Japanese Millet	Echinochola crusgalli var. frumentacea	
Annual Oats	Avena sativa	
Alfalfa	Medicago sativa	
Bromegrass	Bromus inermis	
Orchardgrass	Dactylis glomerata	
Ladino Clover	Trifolium repens var. latum	Ladino
Agricultural Rye	Secale cereale	
Winter Wheat	Triticum aestivum	

[1] Pure live seed

TABLE 901.1 HIGHWAY SEED MIXTURES

SPECIES	PURITY minimum %	GERMINATION minimum %	MIXTURE in percent PROPORTIONS				
			NO.10	NO.20	NO.30	NO.40	NO.60
Kentucky Bluegrass	98	85	40	6	10	35	
Red Fescue	97	85	25		30	20	
Hard Fescue	97	85		24	25	20	
Tall Fescue	98	85		40			
Salt Grass	98	85			15		
Redtop	92	85	5				
Timothy	98	90					12
Canada Wild Rye		PLS[1]					10
Perennial Ryegrass	97	90	20	30			
Improved Fine Perennial Ryegrass	96	85			20	25	
Annual Ryegrass	97	90					30
Alsike Clover	97	90					4
Red Clover	98	90					4
White Clover	95	90	10				
Japanese Millet	97	85					20
Annual Oats	98	90[1]					20

[1] *Substitute winter wheat for annual oats in fall plantings started after September 1.*

TABLE 901.2 NATIVE SEED MIXTURES

SPECIES		SPECIES BOTANICAL NAME	PURITY & GERMINATION minimum %	MIXTURE PROPORTIONS in percent			
				NO. 70	NO. 70A	NO. 75	NO. 80
FORBES	Canada Anemone	*Anemone canadensis*	PLS	2			
	Butterflyweed	*Asclepias tuberosa*	PLS		2		
	New England Aster	*Aster novae-angliae*	PLS	2	2		
	Partridge-pea	*Chamaecrista (Cassia) fasciculata*	PLS		2		
	PurplePrairie Clover	*Dalea (Petalostemum) purpurea*	PLS	2	2	4	
	Canada Tick-trefoil	*Desmodium canadense*	PLS	2			
	Flowering Spurge	*Euphorbia corollata*	PLS		2		
	Wild Geranium	*Geranium maculatum*	PLS	2			
	Western Sunflower	*Helianthus occidentalis*	PLS	3	2		
	Rough Blazingstar	*Liatris aspera*	PLS		2		
	Prairie Blazingstar	*Liatris pycnostachya*	PLS	2			
	Lupine	*Lupinus perennis*	PLS		3		
	Wild Bergamot	*Monarda fistulosa*	PLS	2			
	Horse Mint	*Monarda punctata*	PLS		2		
	Yellow Coneflower	*Ratibida pinnata*	PLS	2	2		
	Blackeyed Susan	*Rudbeckia hirta*	PLS			1	
	Showy Goldenrod	*Solidago speciosa*	PLS	2	2		
	Spiderwort	*Tradescantia ohiensis*	PLS	2	2		
	Golden Alexanders	*Zizia aurea*	PLS	2			
GRASSES	Big Bluestem	*Andropogon gerardi*	PLS	15	15	10	
	Sideoats Grama	*Bouteloua curtipendula*	PLS	15	20	20	25
	Canada Wildrye	*Elymus Canadensis*	PLS	15	15	35	23
	Slender Wheatgrass	*Elymus trachycaulus*	PLS				20
	Junegrass	*Koeleria macrantha*	PLS		5		
	Annual Ryegrass	*Lolium multiflorum*	[1]			10	10
	Switchgrass	*Panicum virgatum*	PLS				10
	Salt Grass	*Puccinella distans*	[1]				2
	Little Bluestem	*Schizachyrium (Andropogon) scoparium*	PLS	15	20	10	10
	Indiangrass	*Sorgastrum nutans*	PLS	15		10	
ALTERNATE FORBES	Sky Blue Aster	*Aster azureus*	PLS	[2]	[2]		
	White Wild Indigo	*Baptisia leucantha*	PLS	[2]	[2]		
	Pale Purple	*Echinacea pallida*	PLS	[2]	[2]		
	White Prairie Clover	*Petalostemum candidum*	PLS	[2]	[2]		
	Stiff Goldenrod	*Solidago rigida*	PLS	[2]	[2]		
	Hoary Vervain	*Verbena stricta*	PLS	[2]	[2]		

[1] *Provide the minimum purity and germination specified in 901.2.1.5 in the Table 901.1 - Highway Seed Mixtures.*

[2] *Contractor may, if the Engineer approves, substitute an alternate forb for a required forb that is not available using the same percentage as specified for the required forb. Use a different alternate forb for each unavailable required forb. Provide documentation showing that a required forb is not available before using an alternate.*

901.2.1.6 Seed Mixture Use

(1) The Contractor shall select a seed mixture or mixtures that meet with the Engineer's approval, and unless specified otherwise in the Contract, shall conform to the following:

a. Use seed mixture No. 10 where average loam, heavy clay, or moist soils predominate.

b. Use seed mixture No. 20 where light, dry, well-drained, sandy, or gravelly soils predominate and for all high cut and fill slopes generally exceeding 6 to 8 feet, except where using No. 70.

c. Use seed mixture No. 10 or No. 20 on all ditches, inslopes, median areas, and low fills, except where using No. 30 or No. 70.

d. Use seed mixture No. 30 for medians and on slopes or ditches generally within 15 feet of the shoulder where a salt-tolerant turf is preferred.

e. Use seed mixture No. 40 in urban or other areas where a lawn type turf is preferred.

f. Use seed mixture No. 60 only on areas, the Contract designates or the Engineer specifies. Use it as a cover seeding for newly graded wet areas or as a nurse crop for specified wetland seed mixtures. The Contractor shall not apply it to flooded areas.

g. Use seed mixture Nos. 70 and 70A on slopes and upland areas the Contract designates or the Engineer specifies. Use seed mixture No. 70 on loamy soils and seed mixture No. 70A on sandy soils.

h. Use seed mixture No. 75 where native grasses are desired for erosion control.

i. Use seed mixture No. 80 on in slopes where a salt tolerant seed mix containing native grasses is desired.

901.2.1.7 Temporary Seeding

(1) Under the Seeding Temporary Pay Item, use a temporary seed mixture conforming to 901.2.1.9. Use oats in spring and summer plantings. Use winter wheat or rye for fall plantings started after September 1st.

901.2.1.8 Seeding Nurse Crop

(1) If seeding bare soil with either mixture 70, 70A, 75, or 80, include the Seeding Nurse Crop Pay Item.

901.2.1.9 Borrow Pits and Material Disposal Sites

(1) For seeding borrow pits and material disposal sites outside the Airport property, use seed mixtures conforming to seed mixture 10, 20, 70, 70A, or 75 of 901.2.1.5 or a borrow pit mixture composed of seeds of the species, purity, germination and proportions, by weight as given below:

PERMANENT

SPECIES	% MINIMUM PURITY	% MINIMUM GERMINATION
Alfalfa	98	90
Bromegrass	85	85
Orchardgrass	80	85
Timothy	98	90
Red Clover	98	90
Alsike Clover	97	90
Ladino Clover	95	90
Kentucky Bluegrass	98	85

TEMPORARY

SPECIES	% MINIMUM PURITY	% MINIMUM GERMINATION
Annual Oats	98	90
Agricultural Rye	97	85
Winter Wheat	95	90

NURSE CROP

SPECIES	% MINIMUM PURITY	% MINIMUM GERMINATION
Annual Oats	98	90
Annual Ryegrass	97	90
Winter Wheat	95	90

(2) For the borrow pit mixture use, by weight, 60 percent temporary species seeds and 40 percent permanent species seeds.

(3) For the temporary component, use any combination of temporary seeds listed in the table above.

(4) For the permanent component, use seeds from not more than 4 of the permanent species listed in the table above in any combination.

(5) When nurse crop is required for spring seeding before June 15, use annual oats. For fall seeding after October 15, use winter wheat, or annual ryegrass.

901.2.2 Fertilized and Agricultural Lime

(1) Provide fertilizer and Agricultural lime as required in T902.

901.2.3 Water

(1) Water for irrigating seeding shall be free from oil, acid, alkali, salt, and other substances harmful to the growth of grass.

901.3 Construction

901.3.1 General

(1) If not protecting with a mulch cover or soil stabilizer, perform seeding, except Nos. 60, 70 and 70A mixtures at times of the year when temperature and moisture conditions are suitable for seeding, except during midsummer. Cover seed within 48 hours of sowing.

(2) Perform seeding, except Nos. 60, 70 and 70A mixtures, in conjunction with mulching as specified in T908 at any time the Engineer allows.

(3) Contractor may perform seeding of Nos. 60, 70 and 70A mixtures at any time soil conditions are suitable, except between June15 and October 15, unless the Engineer allows otherwise.

(4) Perform seeding with the selected seed mixture, sown at the specified rate.

901.3.2 Preparation of Seed Bed

(1) Complete grading, shouldering, topsoiling, and fertilizing, if part of the work under contract, before permanent seeding, except the Contractor may place the fertilizer and seed mixture in one operation if using equipment designed for the purpose.

(2) Just before seeding, work the area being seeded with discs, harrows, or other appropriate equipment to obtain a reasonably even and loose seedbed. Place topsoil as specified in T905.

901.3.3 Sowing

(1) Select the method of sowing from either method A, method B, method C, or an appropriate combination of methods A, B, and C. Obtain the Engineer's approval for the sowing method and specific procedures used for each seed mixture used before sowing that mixture.

901.3.3.1 Method A

(1) Sow the selected seed mixture using equipment adapted to the purpose, or by scattering it uniformly over the areas to be seeded. Lightly rake or drag to cover the seed with approximately 1/4 inch of soil. After seeding, lightly roll or compact the areas using suitable equipment, preferably the cultipacker type, when the Engineer judges the seedbed too loose, or if the seedbed contains clods that might reduce seed germination. The Contractor shall not roll slopes steeper than one-foot vertical to three-feet horizontal.

(2) If scattering seed by hand, perform this work with satisfactory hand seeders and only when the air is calm enough to prevent seeds from blowing away.

901.3.3.2 Method B

(1) Sow or spread the seed upon the prepared bed using a stream or spray of water under pressure and operated from an engineer-approved machine designed for that purpose. Place the selected seed mixture and water into a tank, provided within the machine, in sufficient quantities that when spraying the seed on a given area it is uniformly spread at the required application rate. During this process, keep the tank contents stirred or agitated to provide uniform distribution. Spread the tank contents within one hour after adding the seed to the tank. The Engineer will reject seed that remains mixed with the water for longer than one hour. The Engineer will not require dragging or rolling.

901.3.3.3 Method C

(1) For spring seeding of seed mixtures 70 and 70A into existing ground cover, mow existing vegetation to four inches or less in height two to four weeks before seeding. Ten to 14 days after mowing, spray with vegetation control herbicide conforming to 901.3.3.3(4).

(2) For fall seeding of seed mixtures 70 and 70A into existing ground cover, mow existing vegetation to four inches or less in height four to six weeks before seeding. Ten to 14 days after mowing, spray with vegetation control herbicide conforming to 901.3.3.3(4). Retreat with vegetation control herbicide 10 to 14 days after initial application if live vegetation persists.

(3) Seed with a rangeland type drill with one or more seed boxes that can be calibrated independently to deliver different sized seeds uniformly at the required rate and equipped with a rear-mounted press wheel for each seed drop tube. If seeding into existing vegetation or thatch, use a rangeland type drill equipped with a no-till attachment that can cut through the vegetation or thatch in front of the V disc and seed drop tube. If the configuration of the area to be seeded allows, apply seed at 1/2 the specified seed rate and apply the second 1/2 in a perpendicular direction.

(4) Vegetation control herbicide consists of a post-emergence herbicide that, if applied to leaves and stems of vegetation, is absorbed and translocated to all parts of the plant including roots and underground stems and is by this means capable of killing the entire plant. Provide a water-soluble herbicide that deactivates on contact with soil, and leaves no harmful residue.

901.3.3.4 Borrow Pits and Material Disposal Sites

(1) Seed borrow pits, and material disposal sites off the airport property, with the selected seed mixture specified in 901.2.1.9. Consult with the landowner or the landowner's agent when selecting the seed mixture.

901.3.3.5 Seeding Rates

901.3.3.5.1 General

(1) Use the following sowing rate for seeds in pounds per 1000-square feet:

a. Seed mixture No. 10 at 1.5 pounds
b. Seed mixture No. 20 at 3 pounds
c. Seed mixture No. 30 at 2 pounds
d. Seed mixture No. 40 at 2 pounds
e. Seed mixture No. 60 at an equivalent seeding rate of 1.5 pounds[1]
f. Seed mixture No. 70 or 70A at 0.4 pounds
g. Seed mixture No. 75 at an equivalent seeding rate of 0.7 pounds[1]
h. Seed mixture No. 80 at an equivalent seeding rate of 0.8 pounds[1]
i. Temporary seeding at 3 pounds
j. Nurse crop seeding at 0.8 pounds

[1] *Determine the actual seeding rate by multiplying the equivalent seeding rate by the sum of the unadjusted and adjusted percentages of the various species in the seed mixtures as sown.*

(2) The unadjusted percentage equals the minimum percent of purity and germination specified in the table of seed mixtures contained in 901.2.1.5 for the applicable species.

(3) Obtain the adjusted percentage for each of the PLS species by dividing the specified percentage of the species by the product of the percent of purity and the percent of germination for each of the PLS species as delivered.

901.3.3.5.2 Borrow Pits and Material Disposal Areas

(1) For seeding borrow pits and material disposal off the airport property, sow the seed mixtures specified in 901.2.1.9 at the following rates per pound per 1000 square feet:

a. Seed mixture No. 10 at 0.75 pound
b. Seed mixture No. 20 at 1 pound
c. Seed mixture No. 70 or 70A at 0.4 pounds
d. Seed mixture No 75 at 0.7 pounds
e. Borrow pit mixture at 1.5 pounds

901.3.3.6 Establishment Period for Native Seeding

(1) During the growing season after planting seed mixture 70 or 70A, mow all seeded areas twice as the engineer directs. Mow vegetation back to 6 inches when it has reached a height of at least 12 inches.

(2) During the growing season after planting seed mixture 70 or 70A, eradicate the following species from the seeded areas as soon as they become evident:

SPECIES COMMON NAME	SPECIES BOTANICAL NAME
Musk thistle	Carduus nutans
Spotted knapweed	Centaurea maculosa
Canada thistle	Cirsium arvense
Bull thistle	Cirsium vulgare
Field bindweed	Convolvulus arvensis
Leafy spurge	Euphorbia esula
Sweetclover	Melilotus species
Wild parsnip	Pastinaca sativa

(3) Eradicate by hand pulling or by applying a vegetation control herbicide conforming to 901.3.3.3(4) to individual plants.

901.3.4 Watering Seeding

(1) Water seeded areas located within 10 feet of the edge of pavement in accordance with the requirements of this paragraph. Seeded areas shall receive rain or be watered as necessary to maintain adequate soil moisture for seed germination. After germination, Contractor shall water seeded areas in order to provide a total of 1-inch of water per week from natural rainfall and Contractor applied water. Watering shall continue for a minimum of four weeks or until Engineer directs watering to stop. Apply water utilizing hydro-spray equipment. Do not drive on seeded areas, unless allowed by Engineer. Water trucks with bar spreader will not be permitted. Apply water in a manner that will avoid soil erosion.

(2) Water all seed areas to produce seeding conforming to 901.3.5(2).

901.3.5 Maintenance of Seeded Areas.

(1) Contractor shall protect seeded areas against traffic or other use by warning signs or barricades. Surfaces gullied or otherwise damaged following seeding shall be repaired by regrading and reseeding. Contractor shall mow, water as required, and otherwise maintain seeded areas in a satisfactory condition until final inspection and acceptance of the work.

(2) Contractor establish a good stand of grass of uniform color and density. A grass stand shall be considered adequate when bare spots are one square foot or less, and the total bare area does not exceed three percent of the area seeded.

901.4 Measurement

(1) Measure the Seeding Pay Items by the pound acceptably completed.

(2) Measure quantities based on net weights of seed shipments, or on quantities weighed on Department-approved scales provided by Contractor.

(3) Do not include quantities wasted or not actually incorporated in the Work in the measurement for payment.

(4) Determine the equivalent pounds of seed furnished and applied by dividing the actual pounds of seed applied by the sum of the unadjusted and adjusted percentages of the various species in the seed mixture sown.

(5) Use the unadjusted and adjusted percentages determined in 901.3.3.5.1.

(6) Watering Seeding will be measured by volume per 1000 gallons. The quantity to be measured for payment shall be the amount of water furnished and applied. The volume will be determined based on meter readings from tanks of known capacity.

901.5 Payment

(1) Payment shall be made at the Contract unit price per pound for Seeding Pay Items. Payment for the Seeding Pay Items is full compensation for providing, handling, and storing all seed; for providing the required culture and inoculating seed as specified; and for preparing the seed bed, sowing, covering and firming the seed.

(2) Payment will be made at the Contract unit price per 1000 gallons for Water Seeding. This price shall be full compensation for all labor and material necessary to water seeded areas. Pay Items for this work are as follows:

(3) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. Contractor shall water seeding as required in the previous specification, separate payment will only be made when

a Pay Item for watering is included in the Bid; if there is no Pay Item for watering included in the Bid, watering shall be considered incidental and the cost included in price for seeding.

(4) Pay items for covering the seed, such as mulch, erosion mat, and soil stabilizer, will be paid separately under the appropriate bid items when included in the contract. If not included in the contract, the work to cover the seed shall be considered incidental to the seed pay item(s).

901.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
T901.010 through T901.029	Seeding (mixture)	Pound (LB)
T901.030	Seeding Temporary	Pound (LB)
T901.032	Seeding Borrow Pit	Pound (LB)
T901.034	Seeding Nurse Crop	Pound (LB)
T901.040	Watering Seeding	1000-gallons (MGAL)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C602 Standard Specification for Agricultural Liming Materials

Federal Specifications (FED SPEC)

FED SPEC JJJ-S-181, Federal Specification, Seeds, Agricultural

Advisory Circulars (AC)

AC 150/5200-33 Hazardous Wildlife Attractants on or Near Airports

FAA/United States Department of Agriculture

Wildlife Hazard Management at Airports, A Manual for Airport Personnel

END OF SPECIFICATION T901

Specification T902 - Fertilizer and Agricultural Limestone

902.1 Description

(1) This Specification describes furnishing and incorporating fertilizing material in the soil on areas of proposed seeding or proposed sodding.

(2) This section also describes furnishing and incorporating agricultural limestone in the soil.

902.2 Materials

902.2.1 Fertilizers

902.2.1.1 General

(1) Use fertilizers for seeding, sodding, or other planting that are standard, commercial, packaged or bulk products, in granular or liquid form conforming to Wisconsin statutes and the Wisconsin Administrative Code Chapter ATCP 40. Ensure that each container of packaged fertilizer is plainly marked with the analysis of the contents showing minimum percentages of total nitrogen, available phosphoric acid, and soluble potash. If furnishing the fertilizer in bulk, include an invoice in each shipment indicating the minimum percentages of total nitrogen, available phosphoric acid, and soluble potash in the contents.

http://docs.legis.wi.gov/statutes/statutes/

http://docs.legis.wi.gov/code/admin_code/atcp/020/40.pdf

(2) If using fertilizer with a total of nitrogen, phosphoric acid, and potash greater than 32 percent for Type A or 50 percent for Type B, apply them at a rate that provides equal nitrogen, phosphoric acid, and potash.

902.2.1.2 Type A

(1) Type A fertilizer shall conform to the following minimum requirements:

Nitrogen, not less than 16%
Phosphoric Acid, not less than 6%
Potash, not less than 6%

(2) The total of nitrogen, phosphoric acid, and potash shall equal at least 32 percent.

(3) Total nitrogen shall at least equal the sum of the phosphoric acid and soluble potash.

902.2.1.3 Type B

(1) Type B fertilizer shall conform to the following minimum requirements:

Nitrogen, not less than 16%
Phosphoric Acid, not less than 6%
Potash, not less than 24%

(2) The total of nitrogen, phosphoric acid, and potash shall equal at least 50 percent.

902.2.2 Agricultural Limestone

(1) Conform to Chapter 94.66 of the Wisconsin Statutes and of the Wisconsin Administrative Code Chapter ATCP 41. Furnish limestone with a neutralizing index of not less than 40 or more than 109.

http://docs.legis.wi.gov/statutes/statutes/94

http://docs.legis.wi.gov/code/admin_code/atcp/020/41.pdf

(2) Before using, furnish a statement to the Engineer indicating the index zone or grade of the limestone for each deposit.

902.3 Construction

902.3.1 Fertilizer

902.3.1.1 General

(1) Uniformly apply the fertilizer selected for the seeding areas and incorporate into the soil by light discing or harrowing. If applying granular fertilizer, ensure it is well pulverized and free from lumps.

(2) If incorporating fertilizer into topsoiled areas, the Contractor may apply it just before, and in conjunction with, final discing or harrowing, or if hand manipulating the topsoil, apply it just before final raking and leveling.

(3) If placing fertilizer on surfaces with no topsoil, prepare the soil by discing or harrowing to at least 6 inches deep and then incorporate the fertilizer as specified above.

(4) If sowing seeding areas by pressure sprayer, then fertilize by placing the required amount of fertilizer in the tank, mixing with the water and the seed, agitating constantly, and apply during the seeding operation. If applying fertilizer this way then the Department will not require discing and harrowing after placement.

(5) If fertilizing areas to receive sod, spread the fertilizer uniformly over the soil before sodding at the rate specified below, and then work the fertilizer into the soil while preparing as specified for preparing the earth bed in T904.

902.3.1.2 Type A

(1) Apply fertilizer containing 32 percent total of nitrogen, phosphoric acid, and potash at seven pounds per 1000-square feet, unless the Contract specifies otherwise. For Type A fertilizer that contains a different percentage of components, determine the new application rate by multiplying the specified rate by a dimensionless conversion factor determined as follows:

Conversion Factor = 32 / New Percentage of Components

902.3.1.3 Type B

(1) Apply fertilizer containing 50 percent total of nitrogen, phosphoric acid, and potash at seven pounds per 1000-square feet, unless the Contract specifies otherwise. For Type B fertilizer that contains a different percentage of components, determine the new application rate by multiplying the specified rate by a dimensionless conversion factor determined as follows:

Conversion Factor = 50 / New Percentage of Components

902.3.2 Agricultural Limestone Treatment

(1) Unless the Contract specifies otherwise, spread agricultural limestone over the Contract-designated areas at a uniform rate, measured in pounds per 1000-square feet, as follows:

INDEX ZONES	40-49	50-59	60-69	70-79	80-89	90-99	100-109
RATE	140	120	100	90	80	70	60

(2) To conveniently check the required application rate, Contractor may measure materials used on a volumetric basis, providing the conversion from weight to volume is determined from representative samples of materials used.

(3) Incorporate the agricultural limestone with the required fertilizers into the soils in the designated areas. The pertinent construction requirements applicable to fertilizers shall apply to those materials also.

902.4 Measurement

(1) Measure Fertilizer Pay Items by the hundred pounds (CWT) acceptably completed, measured based on an application rate of 7 pounds per 1000-square-feet. The measured quantity equals the number of hundred-weight (CWT) of material determined by multiplying the actual number of CWT of material incorporated by the ratio of the actual percentage of fertilizer components used to 32 percent for Type A and to 50 percent for Type B.

(2) Measure Agricultural Limestone Treatment by the ton acceptably completed, measured based on an application rate of 100 pounds per 1000-square feet and an index zone of 60-69. The measured quantity equals the number of tons of material determined by multiplying the actual number of tons of material incorporated by 100 and dividing by the application rate required for the index zone of the material used.

902.5 Payment

(1) Payment for the Fertilizer Pay Items shall be made at the Contract unit price per hundred-weight, which shall be full compensation for providing, hauling, placing, and incorporating in the work.

(2) Payment for Agricultural Limestone Treatment shall be made at the Contract unit price per ton and shall be full compensation for furnishing, hauling, placing, and incorporating the required materials in the soil.

(3) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

902.5.1 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
T902.010	Fertilizer Type A	CWT
T902.020	Fertilizer Type B	CWT
T902.030	Agricultural Limestone Treatment	TON

END OF SPECIFICATION T902

Specification T904 – Sodding

904.1 Description

(1) This Specification describes furnishing and laying live sod at designated locations, and constructing sod ditch checks shown the Plans.

904.2 Materials

904.2.1 Sod

(1) Sod shall consist of a dense, well-rooted growth of permanent and desirable grasses, indigenous to the general locality it is to be placed, that is practicably free from weeds or undesirable grasses. When cutting the sod, the grass should be approximately two-inches long. If longer, cut the grass to approximately this length and rake the sod free of debris.

(2) Cut the sod in uniform commercial size strips.

(3) Make the sod thickness as uniform as possible, approximately 3/4 inch or more, depending on the nature of the sod, so that practicably all of the dense root system is retained, but exposed, in the sod strip and so that handling the sod causes no undue tearing or breaking.

(4) If the sod is in a dry condition such that cutting it causes crumbling or breaking, Contractor shall, at least 12 hours before cutting, apply water to it in sufficient quantities to provide a well-moistened sod throughout the depth it is cut.

(5) Sod provided under the Sodding Pay Item shall have a lush appearance, be dense, have a uniform texture, and be bright in color throughout. The sod shall not contain blade widths of 1/4 inch or greater. Provide a weed free sod that contains no more than 3/8 inch of thatch over the base soil. The sod shall consist of a blend or mix of at least four fine-leafed-turf grasses. At least 2/3 of the grasses by weight, as determined by initial seeding proportions, consists of improved/elite type Kentucky bluegrass varieties.

(6) Under the Sod Erosion Control Pay Item, provide a low maintenance type, dense, and of uniform texture. Provide a sod free of noxious weeds and that contains a combined total of three percent or less grassy weeds, sedges, broadleaf weeds, or coarse grasses. The sod shall consist of a blend or mix of at least four fine-leafed-turf grasses. At least 70 percent of the grasses by weight, as determined by initial seeding proportions, shall consist of acceptable low maintenance varieties or species as listed by the UW Extension. Contractor may obtain this list from the UW Madison, horticulture department, turf grass extension.

(7) The Sod Erosion Control Sandy Soil Pay Item shall conform to all requirements for Sod Erosion Control and shall be commercially produced on soil having 10 percent or less organic matter by mass.

904.2.2 Water

(1) When watering sodded areas, use clean water, free of impurities or substances that might injure the sod.

904.3 Construction

(1) Contractor shall provide the type of sod the Plan designates or the Engineer directs consistent with the following criteria:

a. Under the Sod Erosion Control Pay tem, use on limited areas of a project where a quick stand of vegetation is needed for erosion control purposes, or in urban or suburban areas where the primary objective is aesthetics, but where maintenance is limited to mowing.

b. Under the Sod Erosion Control Sandy Soil Pay Item, use in the same areas as Sod Erosion Control, but where sandy or gravelly soils predominate.

904.3.1 Preparing the Earth Bed

(1) Before sodding, construct the proposed area to the required cross section and contour, and round the tops and bottoms of the slopes to a minimum four-foot-radius curve. Ensure that the sodded areas are free from stones, roots, or other undesirable foreign material. Loosen the soil on the sodded area to at least one inch deep and bring it to a reasonably fine granular texture by equipment or hand methods adapted to the purpose.

904.3.2 Placing the Sod

(1) Moisten the earth bed that the sod is being placed on to the loosened depth, if not naturally sufficiently moist. Do not place frozen sod, nor place sod on frozen soil. Place the sod on the bed within

approximately 24 hours after cutting. Lay the sod so that the joints at abutting ends of sod strips are not continuous. Lay each sod strip to abut snugly against the previously laid strip.

(2) Lay sod in strips of commercial size where possible. Do not lay partial-size strips of sod smaller than 18 inches by 24 inches. When laying the sod, roll it or firmly but lightly tamp with suitable wooden or metal tampers to set or press the sod into the underlying soil.

(3) At points where water will flow over a sodded area, turn the upper edges of the sod strips into the soil below the adjacent area and place a layer of earth over this juncture. Compact the earth thoroughly so surface water flows over the upper edge of the sod.

(4) At the limits of sodded areas, if possible, place the end strips to achieve a broken line, and turn the ends of the strips in and treat as described above.

904.3.3 Staking and Cleanup

(1) On all slopes steeper than one unit vertical to four units horizontal (1:4), stake the sod, or peg with pieces of wood plasterers' lath or equivalent stakes (metal stake or staples are prohibited), at least six inches long, spaced as the soil nature and slope steepness dictate, from 18 to 36 inches apart along the length of the sod strip. If possible, place stakes near the top edge of the sod strip and drive plumb through the sod. After installing, stakes should hold the sod firmly in place and present no danger to pedestrians or mowing crews.

(2) Stake all sod placed in ditches, flumes, or other drainage components, where a concentrated flow of water is expected, regardless of the slope. After completing the surface staking, clear the surface of loose sod, excess soil, or other foreign material.

904.3.4 Fertilizer

(1) If the Contract contains the Pay Item Fertilizer, then fertilize areas receiving sod according to T902 unless otherwise specified.

904.3.5 Watering

(1) Under the Sod Water Pay Item, furnish and apply water to sodded areas. After staking and cleanup, moisten the sod thoroughly by sprinkling with water. Keep all sodded areas thoroughly moist by watering or sprinkling if rainfall is not sufficient to achieve sod rooting to the earth bed. Water for 30 days after placement or as the Engineer directs. Apply water in a manner to preclude washing or erosion.

904.4 Measurement

(1) Measure Sodding, Sod Erosion Control, and Sod Erosion Control Sandy Soil by the square yard acceptably completed.

(2) The Department will measure Sod Water by volume in 1000-gallons (MGal) acceptably completed. Determine volume by engineer-approved meters provided by Contractor or from tanks of known capacity.

904.5 Payment

(1) Payment for Sodding, Sod Erosion Control, and Sod Erosion Control Sandy Soil is full compensation for preparing the earth bed; and for furnishing, placing, staking, and rolling the sod. Payment also includes watering if the Contract does not contain the Sod Water Pay Item.

(2) Payment for Sod Water is full compensation for providing, hauling, and applying the water.

(3) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

904.5.1 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
T904.010	Sodding	Square Yard (SY)
T904.012	Sod Erosion Control	Square Yard (SY)
T904.014	Sod Erosion Control Sandy Soil	Square Yard (SY)
T904.020	Sod Water	1000-gallons (MGAL)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5200-33 Hazardous Wildlife Attractants on or Near Airports

FAA/United States Department of Agriculture

Wildlife Hazard Management at Airports, A Manual for Airport Personnel

END OF SPECIFICATION T904

Specification T905 - Topsoil and Salvaged Topsoil

905.1 Description

905.1.1 General

(1) This Work shall consist of preparing the ground surface for topsoil application, removing topsoil from designated stockpiles, salvaging topsoil from the site, providing imported topsoil from approved sources off the site, and placing and spreading the imported and salvaged topsoil on prepared areas in accordance with this Specification at the locations shown on the Plans.

905.2 Materials

905.2.1 Topsoil

(1) Topsoil shall be the surface layer of soil with no admixture of refuse or material toxic to plant growth, and it shall be reasonably free from subsoil and stumps, roots, brush, stones (2 inches or more in diameter), and clay lumps or similar objects. Brush and other vegetation that will not be incorporated with the soil during handling operations shall be cut and removed. Ordinary sod and herbaceous growth such as grass and weeds are not to be removed, but shall be thoroughly broken up and intermixed with the soil during handling operations. Heavy sod or other cover, which cannot be incorporated into the topsoil by discing or other means, shall be removed. The topsoil or soil mixture, unless otherwise specified or approved, shall have a pH range of approximately 5.5 pH to 7.6 pH, when tested in accordance with the methods of testing of the Association of Official Agricultural Chemists in effect on the date of invitation of bids. Organic content shall be not less than three percent nor more than 20 percent as determined by the wet-combustion method (chromic acid reduction). There shall be not less than 20 percent nor more than 80 percent of the material passing the 200 mesh sieve as determined by the wash test in accordance with ASTM C117. Natural topsoil may be amended by the Contractor with approved materials and methods to meet the Specifications.

(2) Salvage topsoil meeting the requirements for topsoil shall consist of the loam, sandy loam, silt loam, silty clay loam or clay loam humus-bearing soils available from overlying portions of areas within the grading limits of the project.

905.2.2 Inspection and Tests.

(1) Prior to beginning construction, notify Engineer of the source of imported topsoil to be furnished by the Contractor. The topsoil shall be inspected to determine if the selected soil meets the requirements specified and to determine the depth to which stripping will be permitted. At this time, the Contractor may be required to take representative soil samples from several locations within the area under consideration and to the proposed stripping depths, for testing purposes as specified in 905.2.1.

905.3 Construction

905.3.1 General

(1) Areas to be topsoiled will be shown on the Plans. If topsoil is available on the site, the location of the stockpiles will be shown on the Plans.

(2) Suitable equipment necessary for proper preparation and treatment of the ground surface, stripping of topsoil, and for the handling and placing of all required materials shall be on hand, in good condition, before the various operations are started.

905.3.2 Preparing the Ground Surface.

(1) Immediately prior to placing and spreading the imported topsoil or salvaged topsoil, the surface shall be loosened by discs or spike-tooth harrows, or by other means to a minimum depth of two inches to facilitate bonding of the topsoil to the covered subgrade soil. The surface of the area to be topsoiled shall be cleared of all stones larger than two inches in diameter and all litter or other material which may be detrimental to proper bonding, the rise of capillary moisture, or the proper growth of the desired planting. Limited areas, as shown on the Plans, which are too compact to respond to these operations shall receive special scarification.

(2) Grades on the area to be topsoiled, which have been established by others as shown on the plans, shall be maintained in a true and even condition. Where grades have not been established, the areas shall be smooth-graded and the surface left at the prescribed grades in an even and compacted condition to prevent the formation of low places or pockets where water will stand.

(3) Undercut or underfill all areas designated to receive topsoil to a degree that when covered to the required depth with topsoil, the finished work will conform to the required lines, grades, slopes and cross sections shown on the Plans.

905.3.3 Obtaining Topsoil.

(1) Prior to the stripping of topsoil from designated areas, vegetation, briars, stumps and large roots, rubbish or stones found on such areas, which may interfere with subsequent operations, shall be removed. Heavy sod or other cover, which cannot be incorporated into the topsoil by discing or other means shall be removed.

(2) When suitable topsoil is available on the site, Contractor shall remove this material from the designated areas and to the depth as directed by Engineer. Spread topsoil on areas already tilled and smooth-graded, or stockpiled in areas approved by Engineer. Topsoil stockpiled by the Contractor shall be rehandled and placed without additional compensation. Topsoil that has been stockpiled on the site by others, and is required for topsoiling purposes, shall be removed and placed by the Contractor. The sites of all stockpiles and areas adjacent thereto which have been disturbed by the Contractor shall be graded if required and put into a condition acceptable for seeding.

(3) When suitable topsoil is secured off the airport site, the Contractor shall locate and obtain the supply, subject to the approval of the Engineer. Contractor shall notify the Engineer sufficiently in advance of operations in order that necessary measurements and tests can be made. Contractor shall remove the topsoil from approved areas. Topsoil shall be hauled to the site of the work and placed for spreading, or spread as required. Topsoil hauled to the site of the work and stockpiled shall be rehandled and placed without additional compensation.

(4) Under the Salvage Topsoil Pay Item, remove topsoil from excavation areas up to the quantity necessary to cover the slopes of the areas designated on the Plans to be topsoiled. Salvage additional topsoil from embankment areas when additional material is required to cover the slopes.

905.3.4 Placing Topsoil and Salvaged Topsoil

(1) The topsoil shall be evenly spread on the prepared areas to a uniform depth of four inches after compaction, unless otherwise shown on the Plans or stated in the Special Provisions. Spreading shall not be done when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the work. Spreading shall be carried on so that turfing operations can proceed with a minimum of soil preparation or tilling.

(2) After spreading, large, stiff clods and hard lumps shall be broken with a pulverizer or by other effective means, and all stones or rocks (two inches or more in diameter), roots, litter, or foreign matter shall be raked up and disposed of by the Contractor. (Contractor shall remove stones one inch and greater in diameter when required on the Plans or Special Provisions.) After spreading is completed, the topsoil shall be satisfactorily compacted by rolling with a cultipacker or by other means approved by the Engineer. The compacted topsoil surface shall conform to the required lines, grades, and cross-sections. Topsoil or other dirt falling upon pavements as a result of hauling or handling of topsoil shall be promptly removed.

(3) Where using either sod or seed mixture 40 ensure that, for the upper two inches, 100 percent of the material passes a one-inch sieve and at least 90 percent passes the No. 10 sieve.

(4) Remove rocks, twigs, foreign material, and clods that cannot be broken down. Dress the entire surface to present a uniform appearance.

(5) If light sandy soils are covered with heavier clay bearing loam topsoil, then mix or blend the two types of soils to a more or less homogeneous mixture by using the appropriate equipment.

905.4 Measurement

905.4.1 Imported Topsoil

(1) Measure Imported Topsoil acceptably completed by the square yard or by the cubic yard, whichever the Contract specifies.

(2) When measured by the square yard, the measured quantity shall equal the actual number of square yards of area covered with topsoil to the depth specified within the limits of construction designated on the Plans, or in the Contract.

(3) If measured by the cubic yard, material will be measured in the vehicle. If Contractor transports the material in vehicles not adapted for measurement, measure the material in cubic yards of volume in its original position computed by the method of average end areas with no correction for curvature; or if the Engineer elects, by the method of truncated prisms.

905.4.2 Salvaged Topsoil

(1) Measure Salvaged Topsoil by the square yard acceptably completed. The quantity measured for payment shall equal the actual number of square yards of area topsoiled to the depth specified within the limits of construction designated on the Plans or in the Contract.

905.5 Payment

905.5.1 Imported Topsoil

(1) Payment for Imported Topsoil is full compensation for providing, excavating, loading, hauling, and placing this material; and for undercutting excavations, or underfilling embankments necessary to receive this material. No allowance, adjustment, or measurement for payment under the Excavation Pay Items will be made for undercutting cut sections, or underfilling embankments.

905.5.2 Salvaged Topsoil

(1) Payment for Salvaged Topsoil is full compensation for removing, stockpiling, reclaiming, hauling, and placing this material; and for undercutting excavations, or underfilling embankments necessary to receive this material. No deductions from the Excavation Pay Items for the quantities of Salvaged Topsoil material obtained from areas of cut sections will be made. Additionally, Department will not measure or pay for the volumes of Salvaged Topsoil removed from sites of proposed embankments under the Excavation Pay Items, or make allowance, adjustment, or measurement for payment under the Excavation Pay Items for undercutting cut sections, or underfilling embankments.

(2) If an area is damaged by erosion after partial acceptance, the Department will pay for restoring topsoil in these areas at a unit price determined by multiplying the Contract unit price bid for Salvaged Topsoil by three, or absent that Pay Item in the Contract, as the Contract unit price bid for Topsoil multiplied by three, The Department will pay for other required restoration work based on Contract unit prices.

(3) The Department will not pay for removing topsoil from outside the pavement foundation in embankment areas unless that material is necessary to cover the slopes.

905.5.3 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
T905.010	Imported Topsoil	Square Yard (SY)
T905.012	Imported Topsoil	Cubic Yard (CY)
T905.015	Salvaged Topsoil	Square Yard (SY)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C117 Materials Finer than 75 μm (No. 200) Sieve in Mineral Aggregates by Washing

Advisory Circulars (AC)

AC 150/5200-33 Hazardous Wildlife Attractants on or Near Airports

FAA/United States Department of Agriculture

Wildlife Hazard Management at Airports, A Manual for Airport Personnel

END OF SPECIFICATION T905

Specification T908 – Mulching

908.1 Description

(1) This Specification describes furnishing, hauling, placing, and anchoring a mulch cover, on areas indicated on the Plans. Mulch is usually placed in connection with seeding.

(2) Standard Mulching Pay Items shall include furnishing straw, hay, wood excelsior fiber, or wood chip material, placing the material and securing it by Method A, B, or C, as required in this Specification.

(3) Hydro-mulching Pay Item shall include a cellulose fiber and tackifier or acceptable bonding product mixed with water and applied in a spray application, as required in this Specification.

(4) Mulching Pay Items shall allow the use of Standard Mulching or Hydro-mulching as determined by Contractor.

908.2 Materials

908.2.1 Standard Mulching

(1) Mulching material consists of straw or hay in an air-dry condition, wood excelsior fiber, wood chips, or other suitable material of a similar nature that the Engineer approves, and is substantially free of noxious weed seeds and objectionable foreign matter.

(2) If using tackifier, the Department will prequalify it before use. Select tackifiers from the Department's erosion control product acceptability list (PAL). Contractor may obtain a copy of the PAL and the prequalification procedure for products not on the PAL from the Department.

908.2.2 Hydro-mulching

(1) Mulch shall be a thermally refined wood fiber mulch or a blend of thermally refined wood fibers and cellulose fibers. If a blend is used, the wood fiber content must be a minimum of 60% by volume. The rate of application for the mix shall be a minimum of 1,500 pounds/acre.

(2) The fibers shall be processed in such a manner that it will not contain germination or growth inhibiting factors. Fibers shall have the property of becoming evenly dispersed and suspended when agitated in water. When sprayed uniformly on the surface of the soil, the fibers shall form a blotter-like ground cover, which readily absorbs water and allows infiltration to the underlying soil.

(3) To bond the mix, a tackifier or acceptable bonding product shall be used. The tackifier or acceptable bonding product shall conform to the PAL.

(4) The hydro-mulch shall be dyed an appropriate color to allow visual metering of the application. The dye shall not be colorfast so it will bleach out in two to three weeks and only temporarily stain masonry, concrete, asphalt and painted surfaces. The dye shall be non-toxic to plant or animal life.

(5) Water shall be free from oil, acid alkali, salt and other substances harmful to the growth of grass. Providing water from other than a potable water source shall meet all applicable Wisconsin Laws and regulations.

908.3 Construction

908.3.1 General

(1) Unless directed otherwise, place the mulch on the specified area within two days after completing the seeding.

(2) Contractor shall not perform mulching during periods of excessively high winds that might preclude proper mulch placement.

(3) Place the mulch loosely or open enough to allow some sunlight to penetrate and air to slowly circulate, but thick enough to shade the ground, conserve soil moisture, and prevent or reduce erosion.

(4) Maintain the mulched areas and repair all areas damaged by wind, erosion, traffic, fire or other causes.

908.3.2 Placing Standard Mulch

(1) Contractor shall perform the Work as specified in one of the following ways: Method A, Method B, or Method C, or a combination of the 3, unless a specific method is specified in the Contract.

908.3.2.1 Method A, Netting

(1) Uniformly spread the mulching material over the designated areas to a loose depth of 1/2 to 1-1/2 inches. Use a specific rate of application; dependent on the character of the material, that results in a cover conforming to the requirements specified above in 908.3.1. Loosen or make fluffy the mulch material from compacted bales before spreading in place. Unless directed otherwise, begin mulching at the top of the slopes and proceed downward.

(2) Securely anchor straw or hay mulch by using engineer-approved netting anchored to the ground with biodegradable pegs to prevent it from floating as the vegetation grows. As an alternative method to this anchorage, secure mulch by heavy biodegradable twine fastened by pegs or staples to form a grid with six to ten foot spacing.

(3) Contractor may use Department-approved erosion control mats, listed in the PAL, instead of separately applying mulch and netting. Only Class I, Urban erosion mats, in accordance with the PAL, that are double netted shall be allowed within 10 feet of airport pavements on airports classified as small airports by WBOA. If the airport is classified as an air carrier airport, large airport, or a medium airport no erosion mats are allowed within 30 feet of pavement used by aircraft. Only anchoring devices, in accordance with the PAL, meeting the requirements specified for Class I Urban, Type A, erosion mat anchoring devices shall be allowed in the installation of erosion mat for airport applications.

908.3.2.2 Method B, Tackifier

(1) Treat straw or hay with a tackifier, blow from a machine, and uniformly deposit over designated areas in one operation. Place straw or hay uniformly over the area 1/2 to one inch deep, using two to three tons of mulch per acre. Mix and place tackifier according to the PAL. Use an engineer-approved machine to place the mulch that blows or ejects by constant air stream a controlled amount of mulch and applies a spray of tackifier to partially coat the straw or hay, sufficient to hold together and keep in place the deposited straw or hay. Contractor may apply the tackifier as an overspray in a separate operation after placing the straw or hay.

(2) Apply wood fiber, wood chips, or similar material with engineer-approved blowing machines, or other engineer-approved methods, that place a controlled amount of mulch uniformly over the area 1/2 to 1-1/2 inches deep. Treat areas receiving wood chip mulch, with one pound of available nitrogen per 1000-square-feet before or after applying the chips.

(3) Throughout the process, feed the mulch material into the blowing machine to produce a constant and uniform ejection from the discharge spout, and operate in a position to produce mulch of uniform depth and coverage.

908.3.2.3 Method C, Crimping

(1) Spread the straw or hay mulch uniformly over the designated areas to a loose depth of 1/2 to 1-1/2 inches, using two to three tons of mulch per acre, by blowing from a machine, as specified in Method B, or by other engineer-approved methods.

(2) Immediately after spreading, anchor the mulch in the soil by using a mulch crimper consisting of a series of dull, flat discs with notched edges. Space the 20-inch diameter discs at about 8-inch centers. Equip the crimper with a ballast compartment to allow adjusting the weight for depth control.

(3) Impress the mulch into the soil 1-1/2 to 2-1/2 inches deep in one pass of the crimper. Mulch crimpers shall not operate on slopes so steep that damage to the mulch, seedbed, or soil occurs. Anchor the mulch on these areas by one of the following methods: Method A or Method B. Equip and operate tractors to minimize disturbing or displacing the soil. This process may require more than one pass of the crimper to ensure adequate anchoring of the mulch.

(4) Contractor shall not use Method C if it cannot impress the mulch to a minimum of 1-1/2 inch.

908.3.3 Placing Hydro-mulch

(1) Upon approval of the finished grade, begin applying fertilizer and seeding, followed by hydro-mulching operations to reduce erosion and excessive weed growth. Do not start or perform work under conditions that are not satisfactory to perform tasks due to inclement or impending inclement weather.

(2) Hydraulic equipment shall be used for the application of the slurry mix of fibers and adhesive. Hydraulic equipment shall have a built-in agitation system with an operation capacity sufficient to agitate, suspend and homogeneously mix a slurry containing a minimum 30-pounds to 40-pounds fiber mulch and four pounds to eight pounds of tackifier or acceptable bonding product for each 100 gallons of water. The slurry distribution lines shall be large enough to prevent stoppage. The discharge line shall be equipped with a set of hydraulic spray nozzles which provide even distribution of the slurry on the area to be covered. The slurry tank shall have a minimum capacity of 800 gallons and shall be mounted on a traveling unit, which may either be self-propelled or drawn with a separate unit which will place the slurry tank and spray nozzles within sufficient proximity to the areas to be covered, to provide uniform distribution without waste. Engineer may authorize equipment with a smaller tank capacity, provided the equipment has the necessary agitation system and sufficient pump capacity to spray the slurry in a uniform coat.

(3) Slurry preparation should begin when the water level in the tank is at least one-third filled, the engine is operating at half throttle, and good circulation has been established. With good circulation established, the fiber mulch shall be added. Continue to add water until the tank is half filled with water, then increase the engine speed to full throttle. Add remaining fiber mulch and water simultaneously until the tank is full. Spraying shall commence immediately when the tank is full and agitated for a minimum of 15 minutes. The operator shall spray that area with a uniform visible coat.

(4) Operators of hydro-mulching equipment shall be thoroughly experienced in this type of application. Apply the specified slurry mix in a motion to form a uniform mat at the specified rate. Operators shall keep the hydro-mulch within the areas designated. Immediately after application, thoroughly wash off all plant material, planting areas, or paved areas not intended to receive hydro-mulch mix.

(5) All airport electrical equipment and man-made structures shall be covered prior to application of hydro-mulch to eliminate coating the equipment or structures with the mix. Remove covers when hydro-mulching is complete.

(6) A two-step process shall be used to complete fertilizer, seeding, and hydro-mulching. Fertilizer and seeding shall be applied first to provide direct contact with the finished grade by traditional sowing methods. Secondarily, the hydro-mulch shall be applied in accordance with this Specification. Seeding is not permitted to be included in the hydro-mulch.

(7) Contractor shall ensure full coverage of all areas designated to be hyrdro-mulched by applying the slurry in a minimum of two passes, perpendicular to each other and overlapping the passes. Full coverage requires all areas to be covered with mulch material such that there is not more than three square feet of bare ground visible in each 100-foot by 100-foot area.

908.3.4 Maintenance

(1) Mulching shall be adequately maintained until turf is established. Areas damaged by erosion or areas that do not have an acceptable turfing shall be redone. Acceptance is based on a green, self-sustaining, uniform mat of vegetation.

908.4 Measurement

908.4.1 General

(1) Measure Standard Mulching for payment on a unit price basis per square yard (SY) or by the ton, completed and accepted.

(2) Measure Hydro-mulching and Mulching for payment on a unit price basis per square yard (SY), completed and accepted.

(3) If measured by the square yard, the measured quantity equals the number of square yards of surface area upon which the mulch was applied.

(4) If measured by the ton, the measured quantity equals the number of tons of mulch provided, placed, and acceptably completed.

(5) Tackifiers or nitrogen used for treating mulch are incidental to the cost of the work.

908.5 Payment

908.5.1 General

(1) Payment will be made for measured quantities for Standard Mulching at the Contract unit price per square yard or ton; this price is full compensation for providing all materials, including tackifiers or nitrogen; for all hauling, treating, placing, spreading, and anchoring of the mulch material; and for maintaining the work and repairing all damaged areas.

(2) Payment will be made for measured quantities for Hydro-mulching at the Contract unit price per square yard; this price is full compensation for providing all materials, including tackifiers; for all hauling, treating, placing, mixing, and applying of the mulch material; and for maintaining the work and repairing all damaged areas.

(3) Payment will be made for measured quantities for Mulching at the Contract unit price per square yard; this price is full compensation for providing all materials, including tackifiers or nitrogen; for all hauling, treating, placing, spreading, and anchoring of the mulch material; and for maintaining the work and repairing all damaged areas.

(4) If Contractor opts to use Department-approved erosion control mats instead of separately applying mulch and anchoring by Method A, B, or C, the erosion mat will be incidental and no addition payment will be added to the price for Mulching.

(5) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

908.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
T908.010	Standard Mulching	Square yard (SY)
T908.012	Standard Mulching	TON
T908.020	Hydro-Mulching	Square yard (SY)
T908.030	Mulching	Square yard (SY)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D977 Standard Specification for Emulsified Asphalt

Advisory Circulars (AC)

AC 150/5200-33 Hazardous Wildlife Attractants on or Near Airports

FAA/United States Department of Agriculture

Wildlife Hazard Management at Airports, A Manual for Airport Personnel

END OF SPECIFICATION T908

Part 13 – Lighting Installation

Specification L100 - Airport Lighting General Provisions

100.1 Description

100.1.1 General

(1) These Specifications cover requirements for all Airport lighting installations.

100.2 General Requirements

100.2.1 General

(1) The following General Requirements specifications govern all Contract Documents. All Work shall be performed in strict accordance with these Specifications. Installation details and material and equipment specifications shall be in conformity with the latest edition of the applicable FAA advisory circulars and revisions. Airport lighting equipment provided shall be from the FAA approved equipment list in the latest edition of AC 150/5345–53 Appendix 3.

(2) Contractor shall furnish all other basic wiring materials and products as listed by Underwriters Laboratories and as suitable for the purpose specified.

(3) All installation shall be in accordance with National Electrical Contractors Association (NECA) "Standard of Installations".

(4) Contractor's workers shall be trained and experienced in installing, testing and repairing Airport lighting systems. Contractor shall possess a copy of FAA Advisory Circular (AC) 150/5340–26, and be familiar with its contents. Contractor shall maintain a copy of the AC on site and follow all pertinent aspects as it relates to the Work.

(5) Specification L100 is not meant to replace but rather supplement Specification L125. If a conflict exists between these two specifications, L125 will take precedence.

100.2.2 Codes and Regulatory Requirements

(1) Contractor shall comply with all ordinances, laws, regulations and codes applicable, in particular, the Wisconsin Administrative Code Chapter Comm 16. This compliance does not relieve the Contractor from furnishing and installing Work shown or specified which exceeds the requirements of such ordinances, laws, regulations and codes.

(2) Inspections, approvals, and plan and specification reviews required by State Statutes, codes, rules, laws or ordinances shall be obtained by the Contractor. All costs and fees for inspections, approvals, and plan and specification reviews shall be paid by the Contractor.

(3) All electrical work completed under this Contract shall be done under the direct supervision of a Master Electrician certified by the State of Wisconsin. If there are local regulations relating to licensing or certification, the more stringent requirements will governed.

100.2.3 Electrical Utility Service Point

(1) Electrical Utility Services required by the Contract Documents shall include all Work from the utility point of service to the service main disconnect switch.

(2) Where "construction limits" designations are indicated on Contract Documents, they shall not apply to Electric Utility Service work necessary to serve the project and occurring outside of the "construction limits" designations. Cost for all Work by the Utility company shall be paid by the Contractor.

(3) Throughout the Specification, two terms are used to describe electrical systems that provide power for lighting and control equipment. The terms used are "Power Source" and "Utility Service". "Power Source" refers to products and materials necessary to connect, distribute, protect, and provide an electrical source for the circuits that feed lighting and control equipment. Under most circumstances, this includes circuit breakers, safety switches, boxes, building feeder circuits, branch circuits, raceways, splices, connections, and attachments. Depending on the circumstances, it may include outdoor direct burial feeders, control, and branch circuits. Although each project may vary, typically a Power Source is derived from an existing "Utility Service" and Distribution System, and all work to install a "Power Source" is incidental to some other work.

(4) "Electric Utility Service" refers to products and materials necessary to bring a Public Utility electrical source to the point where it connects to a "Power Source". Unless specified otherwise, this includes permits, fees, utility poles, transmission circuits, service laterals, utility transformers, or provisions for transformers, service metering equipment, main service disconnect switch, and any costs incurred by the Public Utility on and off the project site, inside and outside the construction limits, in order to bring electrical power to a service point. Although each project may vary, typically a "Utility Service" is a new

electrical power system and is paid for independently of all other work as provided in the Contract Documents.

100.2.4 Excavation

(1) Contractor shall provide excavation for underground Work in accordance with the construction methods and requirements for excavation in the Specifications. Compact backfill for trenches to densities required for adjacent embankment and cut areas.

100.2.5 Concrete

(1) Concrete shall be in accordance with P610 or SHS Section 501. Concrete conforming to P610 is preferred however in the absence of FAA or BOA spec concrete on the project or if providing this concrete is cost prohibitive, the use of concrete conforming to SHS Section 501 is acceptable. Provide Engineer with copies of mix designs at least 7 days prior to incorporation into the project. Do not use concrete that has not been approved by the Engineer.

100.2.6 Cutting and Patching

(1) Contractor shall perform all cutting and patching necessary in order to perform the Work. Special permission shall be obtained from the Engineer before cutting structural members of finished material. All patching shall be performed to return the facilities affected to the condition equal to or exceeding the undisturbed work.

100.2.7 Closing Openings

100.2.7.1 Firestopping

(1) All unused slots, sleeves and other penetrations in fire rated floors, walls or other general construction shall be closed and sealed with an approved firestopping material.

(2) Firestopping material shall be UL listed and tested silicone elastomer specifically formulated for use in horizontal and vertical applications. Material shall possess expansion characteristics and upon exposure to heat above 250 degrees Fahrenheit shall be UL listed and tested silicone elastomer specifically formulated for use in Firestopping material shall be UL listed for 3–hour protection, applied in accordance with the manufacturer's recommendation.

(3) Openings in floor slabs shall be closed with 16 gauge galvanized steel sheet, securely attached with power–driven studs into the building structure. Firestop with a layer of silicone elastomer not less than 1 inch thick which completely fills the opening. The sheet steel shall be located so that the top surface of the silicone elastomer shall be approximately 1 inch below the finished floor slab.

(4) Openings in walls shall be closed with 16 gauge galvanized steel sheet securely attached at the midpoint of the wall thickness and firestopped on both sides of the steel sheet with not less than 1/2–inch thick layer of non–sagging silicone elastomer to fully cover the opening.

(5) Single or multiple pipes passing through walls and floors shall have the annulus space between pipes or between pipes and structure filled with silicone elastomer to provide a 3–hour rated firestop for floors and walls.

(6) Patching Work shall be performed by experienced workers, skilled for the particular type of Work involved. Repair all cut surfaces and match adjacent surfaces. All holes in masonry shall be drilled with rotary drills.

100.2.8 Painting and Finishing Damage And Touch–Up

(1) Repair all marred or damaged painted finishes with materials and procedures to match original finishes.

100.2.9 Acceptance of Materials and Equipment

(1) Acceptance of equipment, where applicable, will be based on Section 100.2.10. Contractor shall be prepared to submit samples of equipment or material for review when requested by the Engineer.

(2) Contractor installed equipment (including FAA approved) shall not generate electromagnetic interference in the existing and/or new communications, weather, air navigation, and air traffic control equipment. Equipment generating such interference shall be replaced by the Contractor at no additional cost, with equipment not generating interference and meeting the applicable specifications.

(3) Contractor shall ascertain that all lighting system components furnished by them (including FAA approved equipment) are compatible in all respects with each other, and the remainder of new or existing systems. Non–compatible components furnished by the Contractor shall be replaced by the Contractor at no additional cost to the Owner.

(4) Manufactured items furnished shall be the current, cataloged product of the manufacturer. Replacement parts shall be available. There shall be a permanent service organization maintained or trained by the manufacturer to provide repair and replacement services.

(5) Contractor shall follow the manufacture's installation instructions. Contractor accepts full responsibility for their equipment and product selection, cost for materials, effort of installation and the compatibility with airport lighting equipment specified for the project.

(6) Where installation procedures are required to be in accordance with manufacturers' recommendations, the Contractor shall have printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to use recommendations shall be cause for rejection of the equipment or material.

(7) Damaged or broken materials or products shall be replaced. However, field repair may be authorized in writing by the Engineer instead of replacement on items with long delivery lead times. Repair authorization shall be in written form.

100.2.10 Shop Drawings

(1) Six sets of shop drawings shall be submitted for all electrical equipment. The Contractor shall:

a. Reference the Specification's article to which each shop drawings is applicable.

b. Number every page in the submittal with a unique, consecutive number.

c. Include complete catalog information such as product illustrations, ratings, and dimensions as applicable.

d. Submit shop drawings in complete groups of materials (i.e. cables, all lighting fixtures, etc.), and each item of material submitted shall be signed by the Contractor as verification that submittal has been reviewed in detail and is in fact, the Contractor's choice of materials. Bind catalog cuts, plate numbers, descriptive bulletins and drawings (11" x 17" or smaller) in sets with covers showing titles. Contractor shall verify dimensions of equipment and be satisfied as to code compliance for fit prior to submitting shop drawings for approval. When vendor sheets include more than one product code or catalog data, the Contractor shall clearly mark by underling or “boxing” the data pertinent to the specified material.

e. Each shop drawing submitted shall include the following paragraph:

i. “It is hereby certified that the (equipment) (material) shown and marked in this submittal is that proposed to be incorporated into the project, it is in compliance with the Contract Documents and Specifications, and can be installed in the allocated spaces."

f. Failure to add the preceding statement or departures from the enclosed procedure may result in delay of review of submittal.

g. Electrical equipment subject to shop drawing review shall be inspected by the Engineer before installation commences. Equipment that cannot be inspected in place, shall be exposed for inspection upon request of the Engineer. Non–conforming equipment shall be replaced at the Contractor's expense.

100.2.11 Operating and Maintenance Manual

(1) Contractor shall prepare Operation and Maintenance (O&M) Manuals for all electrical equipment furnished under the Contract. Provide three paper copies and on PDF file to the Engineer.

(2) The information included must be the exact equipment installed, not the complete "line" of the manufacturer. Where sheets show the equipment other than the equipment actually installed, the installed equipment shall be neatly and clearly identified on such sheets. Parts listed shall give full ordering information assigned by the original parts manufacturer. Relabeled and /or renumbered parts information as reassigned by equipment supplier is not acceptable.

(3) Manuals shall contain shop drawings, wiring diagrams, operating and maintenance instructions, replacement parts, lists, and equipment nameplate data for all control equipment and systems installed under the description information designed to acquaint Sponsor's maintenance personnel with equipment operation in each mode of operation. In addition, each manual shall contain a set of the project record drawings reduced to 11" x 17".

(4) Wiring diagrams for each piece of control equipment and system shall be complete drawings for the specific product installed under the contract. "Typical" line diagrams will not be acceptable.

(5) The information contained in the manuals shall be grouped in an orderly arrangement by specification Table of Contents. The manuals shall have a typewritten index and divider sheets between categories with identifying tabs. The completed manuals shall be bound with hard board 3–ring binders. The covers shall be imprinted with the name of the job, Sponsor, Contractor and year of completion. The back edge shall be imprinted with the name of the job, Sponsor, Contractor, and year of completion.

(6) A preliminary copy shall be submitted to the Engineer prior to completion of the project for review. The three corrected copies shall be delivered to the Sponsor before final payment is approved.

100.2.12 Tests

(1) Acceptance Test for equipment shall be conducted in presence of Engineer, which includes demonstrations, instructions, and tests as outlined in the respective Shop Drawings, equipment and system specifications, and as required by the Special Provisions.

a. Contractor shall make available at the site the following test equipment:
   i. Voltmeter/OHM with proper scales.
   ii. Clamp–on ammeter with proper scales.
   iii. Megohmeter to measure conductor insulation resistance with 100V, 500V and 1000VDC outputs.
   iv. Grounding system resistance tester.
   v. High voltage probe for measuring up to 5000 VAC.
b. Test equipment shall remain the property of the Contractor.
c. The Contractor shall have available a licensed electrician with necessary tools and materials to perform the following:
   i. To open and close equipment enclosures, covers to junction boxes, terminal panels and wireways when directed.
   ii. To open and reconnect splices other than the cast type when directed.
   iii. To make tests and demonstrate system performance.

100.2.13 Facility Starting and Commissioning

(1) Illuminated navigational aid equipment included in the Contract Documents shall not be energized for Sponsor use until the Engineer has inspected and the Owner has given written authorization for use to the Contractor. Prior to the written authorization, the Contractor may energize the equipment for short periods for testing purpose only and as approved by the Engineer. No equipment, illuminated navigational or otherwise, shall be operated unattended until it has been fully prepared, connected, tested, and made ready for normal operation. Damage to equipment occasioned by improper or ill–timed operation or testing shall be corrected at the Contractor's expense.

(2) A written statement shall be provided by the Contractor stating the date and time when the navigational aid equipment will be available for testing and operation. Equipment warranties will be in effect on the date of the written authorization by the Owner.

(3) All equipment requiring operation during construction shall require operating instructions for systems and equipment indicated in the Contract Documents. The operating instructions shall include wiring diagrams, control diagrams, and operating and control sequence for each principal system and equipment. Post instructions where directed or attach the operating instructions adjacent to each principal system and equipment including start–up, operating, shutdown, safety precautions and procedures in the event of equipment failure. Provide weather–resistant materials or weatherproof enclosures where appropriate for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal. Prior to project final acceptance and receipt of the O&M Manuals, the Contractor shall furnish full instructions for the care, adjustments, and operation and maintenance of all electrical equipment that functions by automation or manual control to the Sponsor's designated representative.

100.2.14 Contract Drawing

(1) Before roughing–in facilities or installation of equipment, the Contractor shall consult all Drawings for obstructions that affect the installation. The Contractor shall also verify that field measurements and circuiting arrangements are as shown on Drawings, and that abandoned wiring and equipment serve only abandoned facilities.

(2) The location of the circuits and conductors on the Drawings are diagrammatic, and subject to dimension provided in the details, and as determined by the actual field conditions.

(3) Space requirements and dimensions are nominal and based on typical manufacturer's data, with proper electrical clearances. The Contractor is totally responsible for selecting products that fit the available space, or expanding the given spaces to comply with their bid equipment, plus the necessary NEC code space. The Contractor will not be allowed extra compensation for their bid equipment that does not fit the available space.

100.2.15 Contract Drawing Symbols And Abbreviations

(1) Refer to Symbols and Abbreviations illustrated on Drawings. Other symbols are in common usage, but if uncertainty exists regarding Plan symbols or abbreviation, they shall be brought to the attention of the Engineer for clarification.

100.2.16 Contract Drawing Records

(1) Engineer will furnish a newly printed set of Contract Drawings for the Contractor to mark where construction differed from the original Drawings. The set shall be kept on site at all times and this Work shall be completed and the Drawings given to the Engineer before final payment is approved.

100.2.17 Demolition

(1) Contractor shall review all the demolition required by the Contract Documents to be removed, relocated, terminated, or extended to accommodate the new construction. As a minimum, the following is required:

a. Remove abandoned wiring to the source of supply.
b. Remove exposed abandoned conduit, including abandoned conduit behind accessible finishes. Cut conduit so that it is recessed with walls and floors, and patch surfaces.
c. Disconnect abandoned electrical outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank covers for abandoned outlets that cannot be removed.
d. Disconnect and remove electrical devices and equipment servicing abandoned outlets that have been removed.
e. Repair adjacent construction and finishes damaged during demolition work.
f. Maintain access to existing electrical installations which remain active. Modify installation or provide access to splices as appropriate.
g. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

(2) Demolition drawings are schematic and are based on existing record documents. Report discrepancies to Engineer before disturbing existing installations. Beginning of demolition signifies that the Contractor has investigated existing conditions and accepts the demolition requirement under these specifications.

100.2.18 Warranty

(1) All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve months, or as specified elsewhere in the Plans and Specifications, from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

(2) LED light sources shall have warranties in accordance with FAA Engineering Brief (EB) No. 67D.

100.3 Wiring Methods and Materials

100.3.1 General

(1) The following Wiring Methods and Materials Specifications govern airside electrical installations that are not otherwise covered by Advisory Circulars or other Parts of the Standard Specifications, and are intended to supplement the Standard Electrical Specifications L101 through L125 only.

(2) These Specifications are not intended to govern FAA approved manufactured assemblies tested under ETL, airport landside installations, or Special Provisions, unless they are explicitly mentioned as being included by the Special Provisions.

(3) Definitions:

a. Airside equipment refers to equipment installed as part of the airfield electrical systems governed or covered by FAA regulations, with restricted access to unauthorized personnel.
b. Landside equipment is electrical equipment installed as part of public and passenger handling areas, unrestricted.

100.3.2 Raceways

(1) Contractor shall provide raceways at locations indicated on the Drawings and in accordance with the following specifications. Refer to L110 for underground electrical duct bank installations.

100.3.2.1 General

1. Rigid Steel and Intermediate Conduit.
2. Rigid Nonmetallic Conduit.
3. Electrical Metallic Tubing.
4. Flexible Metal Conduit.
5. Flexible Polyethylene Duct, Coupling and Connectors.
6. Liquid–tight Flexible Metal Conduit.
7. Wireway, Auxiliary Gutters.
8. Raceway Fittings, Couplings and Connectors.
9. Bituminous Fiber Duct.

100.3.2.2. References

1. American National Standards Institute (ANSI). Comply with requirements of the following.
    a. ANSI C80.2 Rigid and Steel Conduit.
    b. ANSI C80.3 Electrical Metallic Tubing (EMT), Zinc Coated.
    c. ANSI 870 Wireways, Auxiliary Gutters and Associated Fittings.

2. National Electrical Manufacturers Association (NEMA). Comply with the requirements of the following.
    a. NEMA TC2 Electrical Plastic Tubing (EPT) and Conduit (EPC–40 and EPC–80).
    b. NEMA TC3 Fittings for PVC Conduit.
    c. NEMA TC7 Flexible Polyethylene Duct.

3. National Fire Protection Association (NFPA). Comply with requirements of the following
    NFPA 70 National Electric Code.

4. Underwriters Laboratories, Inc. (UL). Comply with the requirements of the following.
    a. UL 1 Flexible Metal Conduit.
    b. UL 360 Liquid–Tight Flexible.
    c. UL 514B Fittings for Conduit and Outlet Boxes.
    d. UL 886 Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.
    e. UL 1242 Intermediate Metal Conduit. Steel Conduit.
    f. UL 543 Bituminous Fiber Duct.

100.3.2.3 Products

100.3.2.3.1 Rigid Steel Conduit (RSC) and Intermediate Metal Conduit (IMC)

(1) Use for stub–ups from direct burial and wherever susceptible to severe physical damage.
(2) Use in hazardous (classified) location and Class I, Division 2.
(3) Use for burial in concrete slabs or concrete encasement.
(4) Use for direct contact with earth.

100.3.2.3.2 Rigid Nonmetallic Conduit

(1) Schedule 40–Use for direct burial under driveways and parking lots only. Use under runways, taxiways, and aprons only when encased in concrete.
(2) Schedule 80 – Use for direct burial and stub–ups from direct burial for a distance of two feet maximum. Use as an alternate to Rigid Steel and IMC Conduit, for stub up work only.

100.3.2.3.3 Electrical Metallic Tubing (EMT)

(1) Use for branch circuits in dry locations.
(2) Do not bury in ground or in slabs.
(3) Do not use in concrete.
(4) Do not use for circuits operating over 600–volts.

100.3.2.3.4 Flexible Metal Conduit

(1) Use in dry locations.
(2) Do not use in corrosive atmosphere or concealed work exterior locations.
(3) Use wherever equipment must be isolated for vibration or shifted to its final position.

100.3.2.3.5 Flexible Polyethylene Duct, Couplings, and Connectors

(1) Use for conductors and cables below grade installed in trench or by plowing methods as an alternate to underground cable installed in trench with sand base and backfill.
(2) Do not use above grade.

100.3.2.3.6 Liquid–Tight Flexible Metal Conduit

(1) Use for exterior and damp locations.
(2) Sizes 1–1/4–inch and smaller, provide with a continuous copper bonding conductor wound spirally between convolutions.
(3) Sizes 1–1/2–inch and larger, provide with an internal grounding conductor and grounding bushings.

100.3.2.3.7 Wireways, Auxiliary Gutters

(1) May be used to facilitate installation and future changes in wiring between panelboards, safety switches in close proximity to each other on same or adjacent walls or in same electrical equipment room or area.
(2) Provide NEMA 4 stainless enclosure where outdoors or subject to moisture and similar elements.
(3) Do not use for constant voltage circuits operating over 100V, unless an equipment grounding conductor is used and bonded to each wireway joint, and bonded to the grounding electrode conductor.

100.3.2.3.8 Raceway Fittings, Couplings and Connectors

(1) Use fittings listed and approved for specific conduit or raceway system used. For threaded rigid steel conduit do not use threadless or compression type fittings. For EMT, provide steel or malleable iron "concrete–tight" or "rain–tight" couplings and connectors, compression type or stainless steel multiple locking type. Do not use indentation or set screw type fittings.

(2) Bushing and connectors shall be insulated type which maintain continuity of conduit grounding system. Insulating material shall be molded or locked into metallic body of the fitting. Bushing made entirely of nonmetallic material will not be allowed.

(3) Connectors and couplings body shall have wall thickness at least equal to wall thickness of conduit used.

(4) Provide flexible metal conduit fittings made of steel of malleable iron and one of the following types:

a. Screw type having an angular wedge fitting between the convolutions of the conduit.

b. Squeeze or clamp type having a bearing surface contoured to wrap around the conduit and clamped by one or more screws.

c. Steel, multiple point type, for threading into internal wall of the conduit convolutions.

(5) Liquid–tight flexible metal conduit shall incorporate a steel, nylon or equal plastic compression ring and a gland for tightening. Fitting shall be steel, or malleable iron with insulated throat, with male thread and locknut or male bushing with or without "O" ring seal.

(6) Provide expansion fittings for all rigidly fastened conduits spanning a building expansion joint and if not otherwise mentioned, for all runs exceeding 150 feet in length. Fittings shall be hot–dipped galvanized malleable iron with a packing ring to prevent entrance of water, a pressure ring, a grounding ring and a separate external copper bonding jumper.

(7) Material such as "pot metal" shall not be used for any type of fitting.

100.3.2.3.9 Rigid Galvanized Steel (RGS)

100.3.2.4 Installation

(1) Complete installation of electrical raceways before starting installation of cables/wires within raceways.

(2) Prevent foreign matter from entering raceways; use temporary closure protection.

(3) During construction, protect stub–ups from damage. Arrange so curved portion of bends is not visible above the finished slab or grade.

(4) Make bends and offsets so the inside diameter is not effectively reduced.

(5) Unless otherwise indicated keep the legs of a bend in the same plane and the straight legs of offset parallel.

(6) Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location.

(7) Run concealed raceways with a minimum of bends. All bends shall have the longest possible radii.

(8) Install exposed raceways parallel and perpendicular to nearby surfaces or exposed structural members, and follow the surface contours.

(9) Run exposed, parallel or banked raceways together.

(10) Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory elbows may be used in banked runs where they can be installed parallel.

(11) Where the installation is such that joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system.

(12) Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the protection shoulder.

(13) Where chase nipples are used, align the raceway and coupling square to the box and tighten the chase nipple so no threads are exposed. Running threads are not allowed.

(14) Install pull wires in empty raceway. Use No. 14 AWG zinc–coated steel or plastic having not less than 200 pounds tensile strength unless indicated otherwise in the Contract Documents. Leave not less than 12 inches of slack at each end of the pull wire.

(15) In slabs and walls, locate raceways in middle third and leave at least 2 inches concrete cover. Lateral spacing of raceways shall be not less than three diameters of the raceway.

(16) Tie raceway to reinforcing rods or support to prevent sagging or disturbing when concrete is placed.

(17) At expansion joints, provide expansion fittings and cross at right angles to joint.

(18) Provide conduits stubbed up through or from concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside.

(19) Provide flexible conduits only for connections to electrical equipment when it is subject to movement, vibration, misalignment, or where noise transmission is to be eliminated or reduced. Install all bonding and grounding conductors for liquid–tight, flexible metallic conduit runs within the conduit. All PVC conduits directly buried shall be allowed to acclimate to the installed temperature before installation commences (one hour minimum). Flexible conduit shall be of the liquid–tight type when installed under any of the following conditions:

a. Exterior locations (ultra violet light rated)

b. Moisture or humidity laden atmospheres where it is possible for condensation to accumulate. Corrosive atmospheres.

c. Wherever there is a possibility of seepage or dripping of oil, grease or water.

d. Raceway Sealing Fittings shall be zinc coated, cast or malleable iron type. Fittings used to prevent passage of water vapor shall be of the continuous drain type.

i. Upon completion of installation of raceways, inspect interiors of raceways at all outlet, junction and pull boxes, and remove burrs and obstructions.

ii. Run a swab or mandrel to remove dirt and blockages. New raceways which are deformed and prevent the passage of a mandrel shall be replaced. Used raceways that are deformed and prevent the passage of a mandrel shall be replaced at the Engineer's discretion with payment in accordance with Extra Work Section 40–04.

iii. Remove dirt and construction debris from outlet, junction and pull boxes.

100.3.3 Feeder and Branch Circuit Wire and Cable

100.3.3.1 General

(1) Contractor shall provide feeder and branch circuit wire and cable at locations indicated on the Drawings and in accordance with the following Specifications. Refer to Specification L-108 for underground cable installations. This Section Includes:

a. Copper conductors.

b. Tap type connectors.

c. Split–bolt connectors.

d. Wire nut connectors.

100.3.3.2. References

1. American Society for Testing and Materials (ASTM). Comply with requirements of the following:
   a. ASTM B 1 Standard Specification for Hard Drawn Copper Wire
   b. ASTM B 2 Standard Specification for Medium–Hard–Drawn Copper Wire
   c. ASTM B 3 Standard Specification for Soft or Annealed Copper Wire
   d. ASTM B 8 Standard Specification for Concentric–Lay–Stranded Copper Conductors, Hard, medium–Hard, or Soft
   e. ASTM D 753 Standard Specification for General Purpose Polychloroprene Jacket for Wire and Cable.
2. Institute of Electrical and Electronics Engineers (IEEE). Comply with the following standards which apply to wiring systems:
   a. IEEE 82 Test Procedure for Impulse Voltage Tests on Insulated Conductors
   b. IEEE 241 Recommended Practice for Electric Power Systems in Commercial Buildings.
3. National Fire Protection Association (NFPA). Comply with NFPA 70 requirements for construction, installation and color coding of electrical wire, cable and connections.
4. National Electrical Manufacturers Association (NEMA). Comply with requirements of the following:
   a. NEMA WC 3S–19–81 Rubber–Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
   b. NEMA WC 5S–61–402 Thermoplastic–Insulated Wire and Cable for the transmission and Distribution of electrical Energy
   c. NEMA WC 7/S–66–524 Cross–Linked–Thermosetting–Polyethylene–Insulated Wire and Cable for the transmission and Distribution of Electrical Energy.
   d. NEMA WC 8/S–68–516 Ethylene–Propylene–Rubber–Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
5. Underwriters Laboratory (UL). Provide Material conforming to the following standards
   a. UL 44 Rubber–insulated Wires and Cables
   b. UL 83 Thermoplastic–Insulated Wires and Cables
   c. UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors
   d. UL 854 Service–Entrance Cables

100.3.3.3 Products

100.3.3.3.1 Conductors

(1) For all constant voltage circuits 600 volts or less, provide wire rated 600 V minimum of the single conductor annealed copper type.

(2) Conductors No. 10 AWG and smaller may be solid, and No. 8 AWG and larger shall be stranded.

(3) Conductivity shall not be less than 98 percent at 20 degrees Centigrade (68 degrees Fahrenheit) or resistivity shall not be less than 1.7 microhms per centimeter.

(4) For dry and wet locations provide Type THHN/THWN, 75 degrees maximum.

100.3.3.3.2 Cable

(1) For all constant voltage circuits 600 volts or less, provide UL listed cables of sizes, ampacity, temperature ratings and insulating materials as indicated on the drawings. Where no sizes, ampacity, temperature or insulating materials are indicated, use NFPA 70.

100.3.3.3.3 Connectors and Splices

(1) Provide UL listed metal connectors of sizes ampacity temperature ratings, materials, and classes required by NFPA 70 and NEMA standards for applications and services indicated.

(2) For Branch Circuit wires No. 10 AWG and smaller, provide solderless, insulated pressure cable type connectors, 600 V, of the compression or indent type or wire nut connectors. Temperature rating of connectors shall be at least equal to that of the wire on which they are used.

(3) For Branch Circuit wires No. 8 AWG and larger wire, provide socket head cap, hex screw or bolt clamp type connectors, manufactured of high conductivity copper alloy or bronze castings. Select proper connector for each wire size. Cable sizes 250 MCM and larger shall be retained in the connector by twin clamping elements.

100.3.3.3.4 Insulating Materials

(1) Provide plastic electrical insulating tape which is flame retardant, cold and weather resistant. Tape for use in areas subjected to temperatures 40°C, or where the tape will be subjected to an oil splash, tape shall have a minimum thickness of 8.5 mils, and shall consist of an oil–resistant vinyl backing with an oil–resistant acrylic adhesive.

(2) Provide all insulating materials for splices and connections such as glass and synthetic tapes, putties, resins, splice cases, or compositions of the type approved for the particular use, location, voltage and temperature, and apply and install in an approved manner, all in accordance with the manufacturer's recommendations.

100.3.3.3.5 Prohibited Products

(1) The use of non–metallic sheathed cable Types NM to NMC, armored–bushed cable (BX) and armor–clad cable (AC) and service entrance cables (SE and USE) is prohibited.

100.3.3.4 Installation – General

(1) Deliver wire and cable packaged in factory–sealed containers.

(2) Store wire and cable in a clean dry space in original containers. Protect products form weather, damaging fumes, construction debris and traffic.

(3) Handle wire and cable carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that the dielectric resistance integrity of wires and cables is maintained.

(4) Unless otherwise indicated in Contract Documents, all wiring shall be installed in conduit, in conformance with NFPA 70.

(5) Provide wire, cables and connectors necessary for a complete installation from point of service connection to all receptacles, lighting fixtures, devices, utilization equipment and outlets.

(6) Wire and cable manufactured more than 12 months prior to date of delivery to the site shall not be used.

(7) Neatly and securely bundle and tie all individual circuits located in branch circuit panelboards, signal cabinets, signal control boards, switchboards and motor control centers, switchboards, motor control centers and pull boxes. Bundle and tie with either marlin twine 2– or 3–ply lacing or nylon straps made of self–extinguishing nylon having a temperature range of –65°F to +350°F. Each strap shall be constructed with a locking hub of head on one end and a taper on the other.

(8) Securely fasten nonferrous identifying tags or pressure sensitive labels to all cables, feeders, and power circuits in vaults, pull boxes, manholes, and at termination of cables. Tags or labels shall be stamped or printed to correspond with markings on drawings or marked so that feeder or cable may be readily identified. If suspended type tags are provided, they shall be attached by approximately 55–pound test monofilament line or slip free plastic cable lacing units.

100.3.3.5. Installation – In Conduit

(1) Refer to L–100–3.2, RACEWAYS, for the preparation of raceways for wire and cables.

(2) Provide suitable installation equipment to prevent cutting and abrasion of conduits during the pulling of wires and cables, according to the following:

a. Ropes used for pulling of conductors in raceways with existing circuits shall be made of polyethylene or other suitable nonmetallic material.

b. Pull conductors simultaneously where more than one is being installed in same raceway.

c. Use pulling compound or lubricant where necessary; compound shall not deteriorate conductor or insulation.

d. Lubricants shall conform to UL requirement as applicable.

e. Pulling lines shall be attached to conductor cables by means of either woven basket grips or pulling eyes attached directly to the conductors. Rope hitches shall not be used.

f. Where polyethylene insulation is used, a pulling lubricant is required. The lubricant shall be non–injurious to such insulation.

(3) Install cable supports for all vertical feeders in accordance with the applicable sections of the NFPA 70. Provide cable supports of the wedge type which firmly clamp each individual cable and tighten due to the cable weight.

(4) Install exposed cable parallel and perpendicular to surfaces or exposed structural members and follow surfaces contours, where applicable.

100.3.3.6. Installation – Above Grade

(1) In making a splice, connectors shall be brought up securely upon the conductors such that all conductors are equally engaged, the insulation is not ruptured, no bare wires are exposed or have "backed off" due to the application of pressure and the connection will not loosen due to cycling or vibration, in order the insure an efficient splice.

(2) The number, size, and combinations of conductors permitted as listed on manufacturer's packaging connector shall be strictly followed.

(3) Connectors shall be fully insulated by a skirt, or taped to provide an insulation value at least equal to rating of wires being connected.

(4) Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values or comply with tightening torques specified in UL 486A and 468B.

(5) Color code all secondary service, feeder and branch circuit conductors throughout the project secondary electrical system as follows:

Phase	***208Y/120 Volts***	***240/120***	***480Y/277 Volts***
A	Black	Black	Yellow
B	Red	Red	Brown
C	Blue	—	Orange
Neutral	White	White	Gray
Ground	Green	Green	Green

(6) The colors shall be factory–applied entire length of the conductors by one of the following methods except as noted and limited in the following:

a. Solid color compound

b. Solid color coating

c. Surface printing every 12 inches, maximum spacing of 18 inches.

d. All grounding and phase conductors No. 10 AWG and smaller shall be solid color compound or solid color coating.

e. All grounding and phase conductors No. 8 AWG and larger color coded with pressure sensitive tape shall have a background color or shall have field applied color coding methods per UL and NFPA 70.

f. Color pressure–sensitive plastic tape shall be applied in half overlapping turns for a distance of six inches or all terminal points and in all boxes in which splices or taps are made. The last two laps of tape shall be applied with no tension to prevent possible unwinding.

g. Tape shall be 3/4–inch wide and colors shall be as specified.

h. Cable identification markings shall not be obliterated by taping and tape locations may be adjusted slightly to prevent obliteration of cable markings.

(7) Cables and conductors entering from underground shall be sealed between cable and raceway or sleeve, with a waterproof non–hardening sealing compound.

100.3.3.7. Installation – Manholes

(1) Install and support cables in manholes on steel racks with porcelain or equal insulators. Train cable around manhole walls but do not bend cable to a radius less than the limits in NFPA 70.

(2) Constant voltage power cables located in manholes and handholes shall be covered with arcproof and flameproof tape. The tape shall be applied in a single layer, one–half lapped, or as recommended by the manufacturer.

100.3.3.8. Installation – Below Grade

(1) Refer to L108 for underground cable installations.

(2) Tests conducted with a megohmeter on constant voltage circuits shall be performed so as not to harm the conductor insulation. Follow manufacturer's instructions and 100.2.12.

100.3.4 Control And Signal Wire And Cable.

100.3.4.1 General

(1) The Contractor shall provide control wire, signal wire, and cable at locations indicated on the Drawings and in accordance with the following specifications. Refer to Specification L-108 for underground cable installations. Section Includes Class 2 and Class 3.

100.3.4.2. Reference Standards

1. American Society for Testing and Materials (ASTM). Comply with requirements of the following:
   a. ASTM B 3 Standard Specification for Soft or Annealed Copper Wire.
   b. ASTM B 8 Standard Specification for Concentric–Lay–Stranded Copper conductors, Hard, Medium–Hard, or Soft.
2. Institute of Electrical and Electronics Engineers (IEEE): Comply with the following IEEE Standards:
   a. IEEE 82 Test Procedure for Impulse Voltage Tests on Insulated Conductors.
   b. IEEE 241 Recommended Practice for Electric Power Systems in Commercial Buildings.
   c. Vol. IGA–3 Reducing Electrical Noise in Instruments Circuits.
3. National Electrical Manufacturers Association (NEMA)/Insulated Cable Engineers Association, Inc. (ICEA): Comply with applicable requirements of the following:
   a. NEMA WC 3/S–19–81 Rubber–Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
   b. NEMA WC 5/S–61–402 Thermoplastic–Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
   c. NEMA WC 7/S–66–524 Cross–linked–thermosetting–Polyethylene–Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
   d. NEMA WC 8/S–68–516 Ethylene–Propylene–Rubber–Insulated Wire and Cable for the Transmission and Distribution of Electrical energy
4. National Fire Protection Association (NFPA): Comply with NFPA 70 requirements for construction, installation and color coding of control and signal sire Class 1, Class 2, and Class 3.
5. Underwriters Laboratories, Inc. (UL): Provide material conforming to the following UL Standards:
   a. UL 44 Rubber–Insulated Wires and Cables.
   b. UL 83 Thermoplastic–insulated Wires and Cables.
   c. UL Labeled: Provide control and signal wire UL listed and labeled.

100.3.4.3. Products

(1) Provide control and signal wires and cables single conductor and multiple conductors, shielded and unshielded, as indicated in the Contract Documents.

(2) Wires and cables shall have 75°C rating minimum, designed to provide a clean signal in a high noise level environment, and suitable to reject static magnetic, common mode and cross talk noise.

(3) Control and signal wire shall be coated copper solid or stranded Class B.

(4) Stranded conductors shall be constructed of short lay seven strand minimum concentric bare copper wires.

(5) The size of conductors shall be suitable for the current required for satisfactory operation of the apparatus controlled and with proper consideration of circuit's length, unless indicated otherwise in the Contract Documents.

(6) Provide conductors with a primary insulation material that is heat, moisture, flame, and chemical, resistant crosslinked polyethylene, or PVC high temperature insulation material.

(7) Cable shall have nonhydroscopic fillers and a high temperature nonhydroscopic tape shall be applied over the cable code.

(8) Multi–conductor cable shall have conductors color coded.

(9) Control cable for above grade dry locations shall have an outer covering, fabricated of thermoplastic with flame, heat and moisture resisting compounds.

100.3.4.4. Installation

(1) Deliver wire and cable packaged in factory–sealed containers, or wound on NEMA wire and cable reels. Cable ends shall be sealed with shrinkable self–sealing end caps or by other proper means which protects wires and cables against moisture and dust. Ensure that dielectric resistance integrity of wires and cables is maintained.

(2) Store wire and cable in a clean dry space in original containers. Protect products form weather, damaging fumes, construction debris and traffic.

(3) Handle wire and cable carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that the dielectric integrity of wires and cables is maintained.

(4) Wire and cables shall be rated for 600 volts minimum. Where the operating voltage is less than 100 volts, the wire and cables may be insulated for 300 volts.

(5) Wire and cable manufactured more than 12 months prior to date of delivery to the site shall not be used.

(6) All conductors in signal cabinets and signal control panels shall be neatly and securely bundled. Bundling and cabling shall be done with nylon straps made of self–extinguishing nylon having a temperature range of minus 65 degrees Fahrenheit to 350 degrees Fahrenheit.

(7) Provide pressure sensitive labels, securely fastened to each conductor at each termination of single conductor or multiconductor cables. Tags or labels shall be stamped or printed to correspond with markings on the Contract Documents. Conductors shall be marked so they can be readily identified.

(8) Splices in control wire are not permitted. All control wire shall be continuous from terminal block to terminal block.

(9) Pickup of magnetic and static noise shall be prevented by routing cables and wires away from noise sources such as power cables, generators, motors, and any arc producing equipment. Control wiring subject to noise shall be twisted and provided with a total coverage grounded shield.

(10) Cables and wires shall be prevented from picking up common mode noise by grounding the shield at one point. Location of the ground point shall be at the point where the instrument circuit is grounded and isolated form all other grounds.

(11) Pickup of cross talk noise on multiple pair cable shall be prevented by using cables with individually shielded, isolated pair shields.

100.3.5 Electrical Boxes and Fittings

100.3.5.1 General

(1) This Contractor shall provide electrical box and fittings on the drawings and in accordance with the following specifications. Section Includes.

a. Outlet boxes
b. Junction boxes
c. Pull boxes
d. Conduit bodies
e. Bushings
f. Locknuts
g. Knockout closures

100.3.5.2. References

1. National Electrical Manufacturers Association (NEMA): Comply with applicable requirements of the following.
   a. NEMA OS 1 Sheet Steel Outlet Boxes, Device Boxes, Covers and Box Supports
   b. NEMA FB 1 Fittings, Cast Metal Boxes
2. National Fire Protection Association (NFPA): Comply with NFPA 70, for construction and installation of electrical wiring boxes and fittings.

3. Underwriters Laboratories Inc. (UL): Comply with applicable requirements of the following.
    a. UL 50 Cabinets and Boxes
    b. UL 514A Metallic Outlet Boxes
    c. UL 514B Fittings for Conduit and Outlet Boxes, Flush–Device Boxes and Covers
    d. UL 886 Outlet Boxes and Fittings for Hazardous (Classified) Location.

100.3.5.3. Products

(1) Provide galvanized or other approved corrosion resistant finish for all boxes, accessories and fittings.

(2) Provide minimum 4–inch square by 1–1/2–inch deep, one piece, deep–drawn, galvanized steel outlet boxes for general use. Provide 4–inch octagonal concrete boxes and hung ceiling boxes of the folded or welded type where required by project conditions. Construct with stamped knockouts in the back and sides. Provide threaded screw holes with corrosion–resistant screws for securing box covers and wiring devices.

(3) Provide interior outlet box accessories as required for each installation, including covers, mounting brackets, hangers, extension rings, cable clamps, and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used and fulfilling requirements of individual wiring situations.

(4) Provide corrosion–resistant cast–metal weatherproof outlet boxes, of types, shapes and sizes, with threaded conduit ends, cast–metal face plates with spring–hinged waterproof caps suitable configured for each application, including face plate gaskets and corrosion–resistant fasteners.

(5) For Junction and Pull Boxes, provide galvanized sheet steel junction and pull boxes, with screw–on covers and of types, shapes and sizes, to suit each respective location and installation. Provide welded seams and stainless steel nuts, bolts, screws, and washers. Where necessary for boxes to provide a rigid assembly, provide integral structural steel bracing.

(6) Provide galvanized cast–metal conduit bodies, of types, shapes, and sizes, to suit respective locations and installation, construct with threaded–conduit–entrance ends, removable covers, and corrosion–resistant screws.

(7) Provide corrosion–resistant punched–steel box knockout closures, conduit locknuts, malleable iron conduit bushings and offset connectors of types and sizes to suit respective uses and installation.

(8) Provide boxes UL listed for the particular type and class for Hazardous Locations.

(9) Provide outlet boxes conforming to UL 886 for hazardous locations and install in conformance with NFPA 70 Articles 500 through 555 for Hazardous Locations.

100.3.5.4. Installation

(1) Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.

(2) Provide weatherproof outlets for all interior and exterior locations exposed to weather or moisture.

(3) Provide knockout closures to cap unused knockout holes where blanks have been removed.

(4) Provide boxes of sizes adequate to meet NFPA 70 volume requirements, but in no case smaller than sizes indicated in the Contract Documents.

(5) When the mounting height of a wall–mounted outlet box is shown on the drawings, it is defined as the height from the finished floor to a finished grade, to the horizontal center line of the cover plate. Where mounting heights are not indicated or where heights and locations interfere with mechanical, architectural or structural features, install outlet boxes as approved by the Engineer.

(6) Mount outlet boxes for switches with the long axis vertical. Mount boxes for receptacles either vertically or horizontally but consistently one way. Three or more gang boxes shall be mounted with the long axis horizontal. Do not use sectional (gangable) boxes, device plates as covers for boxes in exposed locations, or round boxes where conduit must enter box through side of box.

(7) Protect outlet boxes to prevent entrance of debris. Thoroughly clean foreign material from boxes before conductors are installed.

(8) At the following locations use threaded hub type boxes with gasketed weatherproof covers:
    a. Exterior locations.
    b. Where exposed to moisture laden atmosphere
    c. Where indicated in the Contract Documents.

(9) For installation of junction and pull boxes, conform to the following:
    a. For boxes exposed to rain or installed in wet locations use NEMA 4 stainless steel.
    b. Conductors larger than 3/0 in any pull or junction box including equipment grounding conductors shall not exceed the sizes in Table 1.

TABLE 1. CONDUCTORS

SIZE OF LARGEST CONDUCTORS	*MAXIMUM NUMBER OF CONDUCTORS*
No. 4/0 AWG	30
250 MCM	20
500 MCM	15
Over 500 MCM	10

(10) Provide each box with sufficient clamps, grids, or devices to which cables are secured in neat and orderly fashion permitting ready identification and so that no cable will have an unsupported length of more than 30 inches.

100.3.6 Wiring Devices

(1) The Contractor shall provide wiring devices at locations indicated on the Drawings and in accordance with the following Specifications. Section Includes:

a. Receptacles.
b. Ground–fault circuit interrupters.
c. Switches.
d. Photocells.

100.3.6.1 References

1. American National Standards Institute (ANSI): Provide plugs and receptacle devices constructed in accordance with ANSI C73, "Attachment Plugs and Receptacles."
2. Institute of Electrical and Electronics Engineers (IEEE): Construct and install wiring devices in accordance with requirements of IEEE 241, "Recommended Practice for Electric Power Systems in Commercial Buildings."
3. National Electrical Manufacturers Association (NEMA): Provide wiring devices constructed and configured in accordance with the requirements of:
   a. NEMA WD 1 General Requirements for Wiring Devices.
   b. NEMA WD 2 Semiconductor Dimmers for Incandescent Lamps.
   c. NEMA WD 6 Wiring Devices – Dimensional Requirements
4. National Fire Protection Association (NFPA): Comply with NFPA 70, as applicable to construction and installation of electrical wiring devices
5. Underwriters Laboratories, Inc. (UL): Provide wiring devices which are UL listed and comply with the requirements of:
   a. UL 5 Surface Metal Raceways and Fittings
   b. UL 20 General–Use Snap Switches
   c. UL 498 Attachment Plugs and Receptacles.
   d. UL 514A Metallic Outlet Boxes
   e. UL 514B Fittings for Conduit and Outlet Boxes.
   f. UL 943 Ground–Fault Circuit Interrupters.

100.3.6.2 Products

(1) Provide factory–fabricated wiring devices, in types, colors, and electrical ratings for applications indicated in the Contract Documents. Provide devices and wall plates submit color selections for approval by Engineer.

(2) Provide specification grade single and duplex receptacles, 2–pole, 3–wire grounding, with green hexagonal equipment ground screw, ground terminals and poles internally connected to mounting yoke, 20 A, 125 V, with metal plaster ears, design for side wiring with four captively held binding screws and provisions for back wiring with NEMA configuration 5–20R unless otherwise indicated in the Contract Documents.

(3) Provide feed–through type ground fault circuit interrupters, with duplex receptacles, capable of protecting connected downstream receptacles on single circuit, and installed in a 2–3/4 inch deep outlet

box without adapter. Provide grounding type UL rated Class A, Group 1. rated 20 A, 125 V, 60 Hz, solid–state ground fault sensing and signaling with 5 milliamperes ground fault trip level, equip with NEMA configuration 5–2OR.

(4) Provide weatherproof single and duplex receptacles, 20A, 125 V, NEMA 5–20R in cast metal box with gasketed, weatherproof cast metal cover plate and gasketed cap over each receptacle opening. Provide cap with spring hinged cover flap.

(5) Provide specification grade, general duty flush single pole 3–way and 4–way toggle and key operated AC quiet snap switches, 20 A, 120–277 V, with mounting yoke insulated from mechanism, equip with plaster ears, switch handle and back or side–wired screw terminals. Provide captive or terminal type terminal screws not smaller than No. 8. Provide back–wired devices with separate access holes for wiring. Color shall be selected by the Engineer.

(6) Provide switches for hazardous locations that meet all requirements of NFPA 70 for Class 1, division 1. Provide covers with a finish to match the housing for surface mounted units.

(7) Provide wall plate for each switch, receptacle, signal, or special purpose outlet. Do not use sectional gang plates. Provide multi–gang outlet plates for multi–gang boxes. Wall plates shall be in accordance with UL 514A, UL 514B, and UL 514C.

(8) Provide 0.04 inch satin finished steel in all unfinished areas and mechanical spaces. Match the finish of fastening crews with the plates. Provide plates for exposed screw jointed fittings that match the fittings with edges of plates flush with edges of fittings and made of heavy cadmium plated steel. Provide plates for finished areas subject to wet or rain as directed by the Engineer.

(9) For FAA approved lighting and NAVAIDS, provide FAA required photocells with (2) N.O. 20 amp contacts, surge protection, energizing at 35 foot candles and de-energizing at 60 foot candles, in cast aluminum enclosure. Photocell operation and performance shall comply with FAA Advisory Circular 150/5340-30. For all other lighting provide quick–response, cadmium–sulfide type photocell with 15 to 20 second built–in time delay to prevent response to momentary lightning flashes, car headlights or cloud movements. Photocell shall be adjustable and energize when north sky light decreases to 1.5 foot candles and shall remain energized until north sky light increases to a minimum of 3 footcandles. Provide photocells of voltage and wattage ratings as indicated in the Contract Documents.

100.3.6.3 Installation

(1) Handle wiring devices carefully to prevent damage. Do not install damaged wiring devices.

(2) Store wiring devices in a clean and dry place. Protect from dirt, construction debris, and physical damage.

(3) Install wiring devices as indicated, in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to fulfill project requirements. Where not indicated, mount switch adjacent to latch jamb of door.

(4) Coordinate with other Work, including painting, electrical boxes and wiring Work, as necessary to integrate installation of wiring devices with other Work.

(5) Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.

(6) Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A, "Wire connectors and Soldering Lugs for Use with Copper Conductors."

(7) Install switches with centerline located 4 feet above finished floor unless otherwise indicated. Install receptacles in machine with centerline 4 feet above finished floor. All other devices shall be located as indicated in the Contract Documents or as direct by the Engineer.

(8) Test wiring devices for electrical continuity, and for short–circuits prior to energizing circuitry. Ensure proper polarity of connections is maintained.

100.3.7 Cabinets And Enclosures

100.3.7.1 General

(1) Contractor shall provide covers, cabinets, and individual hinged–door enclosures for all electrical systems as indicated on the Drawings and in accordance with the following Specifications.

100.3.7.2. References

1. National Electric Manufacturers Association (NEMA). Comply with NEMA 250, "Enclosures for Electrical equipment 1000 Volts Maximum."

2. National Fire Protection Association (NFPA). Comply with NFPA 70, "National Electrical Code" for application, and installation of electrical cabinets and enclosures.
3. Underwriters Laboratories, Inc. (UL). Provide electrical cabinets and enclosures which are UL listed and labeled, and constructed in conformance with UL 50 "Cabinets and Boxes."

100.3.7.3. Products

(1) Provide cabinets and enclosures as follows:

a. Surface NEMA 1 Cabinets and Enclosures:
   i. Provide a front consisting of a one– piece sheet steel frame and a hinged door with catch and lock.
   ii. Provide each cabinet with a combination catch and flat key lock.
   iii. Doors shall be hinged directly to cabinet, with 3/4–inch flange around all edges shaped to cover edge of box.
b. Surface NEMA 12 Cabinets and Enclosures:
   i. Fabricate of minimum 16 MSG steel with continuous welded seams.
   ii. Provide removable doors, with neoprene door gasket attached with oil–resistant adhesive, and held in place with steel retaining strips. Provide removable internal mounting panel for component installation.
   iii. Provide multiple doors where required. Individual door width shall be no greater than 24 inches.
   iv. Provide butt hinges or continuous hinges.
   v. Furnish single door cabinets with padlock and hasp, and double door cabinets with 3–point handle–operated–latch plus hasp.
c. Surface NEMA 4 Cabinets and Enclosures:
   i. Provide features similar to those for NEMA 12 units except provide NEMA 4 protection against hose directed water. Provide multiple cover clamps in lieu of handle latches. Provide doors over 36 inches in height with vault handle and a 3–point catch, arrange to fasten door at top, bottom, and center.
d. Surface NEMA Type 3R Cabinets and Enclosures
e. Surface NEMA Type 4X Cabinets and Enclosures

(2) All cabinets and enclosures located in dry locations shall be painted, unless noted otherwise in the Contract Documents.

(3) In addition to a priming coat, all outside surfaces of trim and doors shall be given factory finish coat of gray paint. All cabinet interiors and panel mounted back plates shall be white.

(4) NEMA 4 stainless cabinets and enclosures shall maintain a natural finish.

(5) Provide cabinets and enclosures with provision for cabinet grounding without penetrating exterior wall of the enclosure.

100.3.7.4. Installation

(1) Touch up all scrapes and other mars in the enclosure finish equal to the manufacturer's finish.

(2) Mount cabinets at a uniform height, nominally 6 feet 6 inches to the top of the enclosure above finished floor, except as otherwise noted in the Contract Documents.

(3) Support and fasten all cabinets securely in place.

100.3.8 Supporting Devices

100.3.8.1 General

(1) Contractor shall provide all electrical supports, anchors, sleeves, seals, fastenings and other components indicated on the drawings and in accordance with the following specifications sections includes: Section Includes.

a. Clevis hangers.
b. Riser clamps.
c. C–clamps.
d. One–hole conduit straps.
e. Two–hole conduit straps.
f. Round steel rods.
g. Expansion anchors.

100.3.8.2. References

(1) National Fire Protection Association (NFPA). Comply with NFPA 70 as applicable to construction and installation of electrical supporting devices.

(2) Underwriters Laboratories, Inc (UL). Conform to UL listings and labeling.

100.3.8.3. Products

(1) Provide supporting devices with manufacturer's standard materials, designed and constructed in accordance with published product information.

(2) Provide all supports, support hardware and fasteners hot dipped galvanized for exterior installations and cadmium plated for interior installations.

(3) Provide manufactured standard supports including clevis hangers, risers clamps, conduit straps, threaded C–clamps with retainers, wall brackets and spring steel clamps.

(4) Provide U–channel strut system for mounting and supporting electrical equipment. Fabricate strut from 16–gauge hot–dip galvanized steel sheet, 9/16–inch diameter holes, 8–inches on center on top surface. Fittings shall be compatible with the U–channel struts.

100.3.8.4. Installation

(1) Install hangers, sleeves, seals, U–channel supports and fasteners as indicted and in accordance with manufacturer's written instructions. Comply with requirements of NFPA 70 and American National Standards Institute (ANSI)/National Electrical Manufacturers Association (NEMA) for installation of supporting devices.

(2) Coordinate with other electrical work, including raceway and wiring work.

(3) Provide raceway structural support capacity equal to the maximum weight of the raceway plus a safety factor of 200 pounds. Provide additional support strength where required to prevent distortion of raceway during wire pulling.

(4) Provide individual and multiple (trapeze) raceway hangers, and riser clamps as necessary to support raceways. Provide U–bolts, clamps, attachments, and other hardware necessary for hanger assembly, and for securing hanger rods and conduits.

(5) Arrange for grouping of parallel runs of horizontal raceways to be supported together on trapeze type hangers where possible.

(6) Support individual horizontal conduits and EMT 1–1/2 inch size and smaller by either one or two-hole pipe straps or separate pipe hangers. Use separate pipe hangers for larger sizes. Spring steel fasteners may be used in lieu of pipe straps or hangers for sizes 1–1/2–inch and smaller in dry locations. For hanger rods with spring steel fasteners, use a minimum 1/4–inch diameter or larger threaded steel to meet the safety factor. Use steel fasteners that are specifically designed for supporting single conduits or EMT. Do not use wire as a means of support.

(7) Space supports for metallic raceways in accordance with the requirements or this Section and the requirements of the NFPA 70, except as otherwise indicated.

(8) In vertical runs provide such support that the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports, with no weight load on raceway termination or conductor terminals.

(9) Provide supports for all miscellaneous electrical components as required to produce the same safety allowances as specified for raceway supports previously mentioned. Provide metal channel racks for mounting cabinets, panel boards, disconnects, control enclosures, pull boxes and junction boxes.

(10) Install cable supports in strict compliance with manufacturer's instructions. Spacing not to exceed NFPA 70 tabulation for spacing of conductor supports. Allow adequate slack in conductors to prevent any stress on terminations. Installation shall consider conductor thermal expansion and contraction.

(11) Securely fasten all electrical items and their supporting hardware including, but not limited to, conduits, raceways, cables, busways, cabinets, boxes, switches, and control components to a building structure, or structural fixture, unless otherwise indicated.

(12) Fasten by means of round head full threaded hood screws on wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; by machine screws; welded threaded studs, or spring–tension clamps on steel work. Threaded studs driven in by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts. Do not weld conduits or pipe strap inserts or steel structures. In partitions of light steel construction use sheet metal screws.

(13) Holes cut to a depth of more than1/2-inch in reinforced concrete or to a depth of more than 3/4–inch in concrete joints shall not cut the main reinforcing bars. Fill holes that are not used.

(14) Loads applied to any fastener shall not exceed one–fifth of the proof test load. Use vibration and shock–resistant fasteners, where applicable.

(15) Rawl plugs are not permitted.

100.3.9 Electrical Identification

100.3.9.1 General

(1) Contractor shall provide electrical identification as indicated on the drawings and in accordance with the following Specifications. Section Includes:

a. Buried electrical line warnings.
b. Identification of electrical power, control and communication, cables and conductors.
c. Operational instruction signs.
d. Warning and caution signs.
e. Equipment labels and signs.

100.3.9.2. References

1. American National Standards Institute (ANSI). Comply with requirements of ANSI A13.1, "Scheme for the Identification of Piping Systems" with regard to type and size of lettering for raceway and cable labels.
2. National Fire Protection Association (NFPA). Comply with NFPA 70, "National Electrical Code" requirements for identification and for provision of warning and caution signs for wiring and equipment.

100.3.9.3. Products

(1) Provide manufacturer's standard products of categories and types required for each application, except as otherwise indicated.

(2) Adhesive Marking Labels for Raceways shall be pre–printed, flexible, self–adhesive labels with legend indicating voltage and service. Size: 1–1/8 inches high by 4 inches long for raceway 1–inch diameter and less, 1–1/8 inches high by 8 inches long for raceway over 1–inch diameter. Color: Black legend on orange background.

(3) Underground Line Marking Tape shall be permanent bright–colored continuous–printed plastic tape compounded for all direct–burial signal and communication circuits; not less than 6 inches wide by 4 mils thick. Provide printed legend indicative of general type of underground line below.

(4) Vinyl or Vinyl Cloth Wire/Cable Designation Tape Markers shall be self-adhesive wrap–around cable/conductor markers with pre–printed numbers and letters for designation purposes.

(5) Aluminum Wrap–Around Cable Marker Bands shall be cut from 0.014–inch thick aluminum sheet and fitted with slots or ears for securing permanently around wire or cable jacket or around groups of conductors. Provide for legend application with stamped letters or numbers.

(6) Engraved Plastic–Laminate Labels, Sign and Instruction Plates shall be engraving stock melamine plastic laminate, 1/16–inch minimum thickness for up to 20 square inch sign or 8–inch length; 1/8 inch thickness for larger sizes. Engrave legend in white letters on black face and punch for mechanical fasteners.

(7) Baked Enamel Warning and Caution Signs shall be pre–printed aluminum signs appropriate to the location, punched for fasteners, and sized for good visibility.

(8) Fasteners for Plastic Laminate and Metal Signs shall be self-tapping stainless steel screws or No. 10/32 minimum stainless steel machine screws with nuts and flat and lock washers.

(9) Cable Ties shall be fungus–inert, self–extinguishing, one piece, self-locking nylon cable ties, 0.18 inch minimum width, 50 pounds minimum tensile strength and suitable for a temperature range from minus 50 degrees Fahrenheit to 350 degrees Fahrenheit. Provide ties in specified colors when used for color coding.

100.3.9.4. Installation

(1) Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations, specified or indicated in the Contract Documents. Provide numbers, lettering and wording as approved in submittals, as required by code, or as recommended by manufacturers.

(2) Install products covered by this Section where indicated on drawings or specified. Install products covered by this Section where required by NFPA 70, whether or not otherwise indicated. Install products in accordance with manufacturer's written instructions and requirements of NFPA 70.

(3) Where identification is to be applied to surfaces which require finish, install identification after completion of finish work.

(4) In all areas where inside circuits are routed from a vault through an inhabited space, identify all exposed high voltage feeder conduits (over 600 volts) by words "DANGER–HIGH VOLTAGE" in black letters 2

inches high, stenciled on adhesive labels at 10–foot intervals over continuous painted orange background applied as follows:

a. On entire floor area directly above conduits running beneath and within 12 inches of basement or ground floor in contact with earth or framed above unexcavated space.

b. On wall surfaces directly exterior to conduits run concealed within the wall.

c. On all accessible surfaces of concrete envelope around conduits in vertical shafts exposed at ceilings or concealed above suspended ceilings.

d. On entire surface of exposed conduits.

e. Clean surface of dust, loose material and oil films before painting.

f. Prime unpainted surfaces. For galvanized metal use single component acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units use heavy duty acrylic resin block–filler. For concrete surfaces use clear alkali–resistant alkyd binder type sealer.

g. Provide one intermediate and one finish coat of orange silicone alkyd enamel.

h. Apply all primer and finish materials in accordance with manufacturer's instructions.

(5) Pull and Connection Boxes shall be identified with pressure sensitive, self–adhesive labels indicating system voltage in black pre–printed on orange background as required by NFPA 70 for caution signs on all electrical power and lighting system boxes. Install on outside of box cover. Also label boxes covers to identify the circuits contained therein. Use pressure sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes.

(6) During backfilling of the trench for each exterior underground communications and control circuit, install continuous underground–type plastic line marker, located directly above line at 6 to 8 inches below finished grade. Where multiple lines are installed in a common trench or concrete envelope and do not exceed and overall width of 16 inches, install a single line marker.

(7) Provide identifying metal tags or aluminum wrap–around marker bands securely fastened to all power circuit cables, feeders, and power circuits in electrical equipment rooms, pull boxes, junction boxes, manholes and hand holes with tags or bands with 1/4–inch steel letter and number stamps with legend to correspond with designations on drawings. If metal tags are provided, attach them with approximately 55–pound test monofilament line or one piece self–locking nylon cable ties.

(8) Tag or label conductors as follows:

a. Tag or label all conductors with identification indicating source and circuit numbers.

b. Where Multiple branch circuits or control wiring or communications/signal conductors are present in the same box or enclosure, label each conductor or cable. Provide legend indicating source, voltage, circuit number as applicable. For control and communications/signal wiring, use wire/cable marking tape at terminations and at all intermediate locations where conductors appear in wiring boxes, troughs and control cabinets. Use consistent letter/ number conductor designations throughout on wire/cable marking tapes.

c. Match identification markings with designations used in panel boards, shop drawings, contract documents and similar previously established identification schemes for the facility electrical work.

d. Where required by NFPA 70, to ensure a safe operation and maintenance of electrical systems and of the items to which they connect, install warning, caution or instruction signs. Where instructions or explanations are needed for system or equipment operation, provide engraved plastic laminated instruction signs with approved legend. For outdoor items provide butyrate signs with metal backing.

e. For emergency instructions or other emergency operations, provide engraved laminated signs with approved white legend on red background with minimum 3/8–inch high lettering.

(9) Provide sign or stenciled legend to identify equipment concealed behind bolted covers of housing for disconnecting switches, transformers and switchboards.

(10) Stencil or provide equipment identification label of engraved plastic–laminate of each major unit of electrical equipment; including central or master unit of each electrical system. This includes communication /signal systems, unless unit is specified with its own self–explanatory identification. Except as otherwise indicated, provide single line of text, a minimum 1 inch high lettering. Engraved labels shall be 2 inches high black lettering in white field. Provide text that matches terminology and numbering of the contract document and shop drawings. Provide label for each unit of the following categories of electrical work:

a. Panelboards, electrical cabinets and enclosures.

b. Access doors and panels for concealed electrical items.

c. Electrical switchgear and switch boards.

d. Regulators.

e. Power transfer equipment.
f. Contactors.
g. Remote controlled switches.
h. Control devices.
i. Transformers.
j. Power generating units.

(11) For panel boards, provide circuit schedules with explicit description and identification of items controlled by each individual breaker.

(12) Stencil and install labels at locations for best convenience of viewing without interference with operation and maintenance of equipment.

100.3.10 Secondary Grounding

100.3.10.1 General

(1) Provide secondary grounding as indicated on the Drawings and in accordance with the following Specifications. This section Includes.

a. Materials and methods for grounding constant voltage 600V or less electrical systems only.
b. Grounding conductors.
c. Bonding jumpers.
d. Ground bus.
e. Ground rods and plates.
f. Grounding terminations.

100.3.10.2. References

1. American National Standards Institute (ANSI). Comply with the requirements of ANSI C2 National Electric Safety Code.
2. American Society for Testing and Materials (ASTM). Comply with the requirements of ASTM B1 Standard Specification for Hard–Drawn Copper Wire.

100.3.10.3 Products

(1) Provide insulated equipment grounding conductors which run in the same raceway with circuit wires.

(2) Provide bare ground conductors for grounding of transformers, switch gear, other service equipment, grounding service poles and electrical equipment structures both underground and above ground. Conductors shall be stranded copper conductors.

(3) Provide braided copper tape constructed of No. 30 gauge bare copper wires sized to suit the application.

(4) Ground rods and plates are as indicated by the Contract Documents and NFPA 70. All rods shall have a hard, clean, smooth continuous surface throughout the entire length of the rod.

(5) Where welded connections are required, such welds shall be made by the exothermic process utilizing factory provided molds.

100.3.10.4 Installation

(1) Deliver grounding materials in factory–sealed containers and with conductors wound on National Electrical Manufacturers Association (NEMA) wire and cable reels.

(2) Store grounding materials in a clean dry space in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.

(3) Supplement the grounded neutral of the secondary distribution system with an equipment grounding system to properly safeguard equipment and personnel. The system shall, as a minimum, comply with NFPA 70.

(4) Provide the equipment grounding system such that all metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, frames, portable equipment, and other conductive items in close proximity with electrical circuits operate continuously at ground potential and provide a low impedance path for possible ground fault currents.

(5) In bus installations other than UL listed assemblies, provide where indicated, a bare copper ground bus spaced 1 inch from the wall and not more than 6 inches above the finished floor in each electrical equipment area. The required length of the ground bus shall be as shown in the Contract Documents. Connect the ground bus by utilizing hard–drawn copper conductors and make connections between the conductors and the ground bus with connectors UL listed for the application.

(6) Drive electrical system ground rods until the top is six inches below the final grade.

(7) Interconnect the electrical system ground rods with bare copper grounding electrode conductors buried at least 24 inches below grade.

(8) Size all required equipment grounding and grounding electrode conductors and straps in compliance with NFPA 70. Provide insulated equipment grounding and grounding electrode conductors of the same type and class for the associated phase and neutral conductors of the secondary distribution system.

(9) Provide the proper number and size of pressure connectors required for all equipment grounding bars in panel boards and other electrical equipment for the termination of equipment grounding conductors. Provide pressure connectors for all active and spare circuits.

(10) Where metallic conduits terminate at a metallic housing without mechanical connection, such as locknuts and bushings, provide each conduit with a ground bushing. Connect each such ground bushings with a bare copper bonding jumper to the ground lug or bus in the electrical equipment. Size the conductor as required by NFPA 70.

(11) Make all ground connections with UL listed products.

(12) Where an insulated ground wire is connected to ground rods below grade or in wet locations, insulate the connection and seal against moisture penetrating under the insulation.

100.3.11 Panelboards

100.3.11.1 General

(1) Contractor shall provide panelboards as indicated on the drawings and in accordance with the following Specifications.

(2) Section Includes:

a. Distribution panelboards.

b. Lighting and appliance branch circuit panelboards.

(3) Section Does Not Include.

a. Switchboards.

b. Service entrance equipment.

100.3.11.2 References

1. National Electrical Manufacturers Association (NEMA). Provide panelboards and switches constructed and configured in accordance with the following:
   a. NEMA AB 1 Molded Case Circuit Breakers and Molded Case Switches
   b. NEMA KS 1 Encloses Switches
   c. NEMA PB 1 Panelboards
2. National Fire Protection Association (NFPA). Conform to the requirements of NFPA 70.
3. Underwriters Laboratories, Inc. (UL): Construct panelboards in accordance with the following UL publications:
   a. UL 50 Cabinets and Boxes
   b. UL 67 Panelboards
   c. UL 310 Electrical Quick–Correct Terminals
   d. UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors
   e. UL 489 Molded–Case Circuit Breakers and Circuit–Breaker Enclosures
   f. UL 943 Ground–Fault Circuit Interrupters
   g. UL 1053 Ground–Fault Sensing and Relaying Equipment

100.3.11.3. Products

100.3.11.3.1 Distribution Panelboards

(1) Provide panelboards with buses constructed of solid copper, minimum conductivity 98 percent and rectangular shape.

a. Mechanically mount and brace buses in conformance with UL 67.

b. Provide solderless lugs for copper cable.

c. Provide ampacity as indicated on the drawings.

(2) Provide bare, uninsulated copper, factory installed grounding bus with ampacity equal to the main bus. Provide copper pressure connected terminations.

(3) Provide bus bar connections to branch circuits of the sequenced phased type.

a. Mount in accordance with UL 67.

b. Provide numbered terminals.

c. Provide pressure connectors for copper.

(4) Where words similar to "space", "space only", "future space", or similar wording are used on the drawings and panel schedules, provide bus space for future overcurrent devices.
    a. Extend buses full size.
    b. Brace and insulate bus in accordance with UL 67.
    c. Provide bolted connections for future overcurrent devices.

(5) Construct enclosures in accordance with UL 50 except modify as hereinafter specified.
    a. Construct of minimum 16–gauge galvanized steel NEMA 1, unless indicated otherwise in the Contract Documents.
    b. Conform to UL 67 for additional enclosure requirements.
    c. Provide inner and outer door with hinged trim.
    d. Panelboard, back–box and front plate shall be the product of one manufacturer. Factory fit components before shipment.
    e. Provide enclosure type in conformance with UL 50 and NEMA PB 1.
    f. Provide removable front plates of the dead–front type with removable, and flush hinged enclosure door.
    g. Provide a keyed lock for circuit breaker access cover.

(6) Provide multiple knockouts not fewer than 1.5 times the number of bus circuits.

(7) In addition to the priming coat, all inside and outside surfaces of trim and doors shall be given a factory finish coat of gray paint. Recessed boxes, and surface boxes in vaults, switchgear rooms and electrical equipment enclosures shall be painted as previously described.

(8) Provide factory printed directories with a clear plastic directory cover and metal frame attached to the panel door.

(9) Provide Wiring Space that conforms to the requirements of UL 67. Feed–through gutters not permitted.
    a. Conform to NFPA 70 for maximum gutter fill.
    b. Conform to UL 67 for minimum width of gutter and wire bending space.

(10) Breakers shall have inverse time automatic tripping.

(11) Provide adjustable trip circuit breakers as noted in the Contract Documents.

(12) Circuit breakers shall be bolt–in type, factory assembled, except breakers 225 amperes frame size and larger may be plug–in type if held in place by positive locking device requiring mechanical release for removal.

(13) Integrally fused circuit breakers with inverse time automatic tripping, and fuses shall conform to UL 198B, 198C, 198D, 198E, 198F, 198G, 198H, 198L, and 198M.

(14) Provide breakers as indicated in the Contract Documents with current interrupting ratings, in RMS symmetrical amps.

100.3.11.3.2 Lighting and Appliance Branch Circuit Panelboards

(1) Provide enclosures, bus systems, spacing and knockouts same as for distribution panelboards.

(2) Provide interrupting ratings, circuit arrangements, and trip settings as noted in the Contract Documents.

(3) Provide common trip mechanisms for multi–pole breakers.

(4) Provide instantaneous automatic trips conforming to NEMA AB 1.

(5) Breakers shall be bolt–on type, factory assembled.

(6) Stab–in circuit breaker types are not acceptable.

(7) Provide quick–make and quick–break mechanism.

100.3.11.4 Installation

(1) Install panelboards in conformance with NEMA PB 1 and NFPA 70.

(2) Torque lug screws in accordance with UL 486A for copper conductors and UL 486B for aluminum conductors. Install connectors, lugs, neutral bus and other field installed components in accordance with manufacturer's published literature.

(3) Verify gutter size conforms to wire bending space requirements of NFPA 70 and UL 67.

(4) Wire wrap branch circuits in gutters after installation. Use approved wire ties.

(5) Verify maximum gutter fill to conform with NFPA 70 and UL 67.

(6) Verify bolted circuit breaker connection lugs conforming to shop drawings.

(7) Verify breaker size, trip setting, and breaker type in conformance with Contract Documents.

(8) Complete typewritten panelboard circuit directory prior to project acceptance.

(9) Only wires made of the conductor material for which the panelboard terminals have been marked shall be used.

(10) Adjustable Trip Settings. Install lugs and ground connectors in conformance with UL 486A and UL 486B. Verify factory settings for adjustable trip breakers. Field adjust in conformance with manufacturer's recommendations, if necessary.

100.3.12 Overcurrent Protective Devices

100.3.12.1 General

(1) Contractor shall provide overcurrent protective device as indicated on the drawings and in accordance with these specifications.

(2) Section Includes.

a. Molded case circuit breakers.

b. Heavy duty safety switches.

c. Combination molded case circuit breakers and current–limiting fuses.

(3) Section Does Not Include.

a. Main service switches.

100.3.12.2 References

1. National Electrical Manufacturers Association (NEMA). Provide and install fuses and circuit breakers conforming to NEMA, including:
   a. NEMA AB–1 Molded Case Circuit Breakers and Molded Case Switches.
   b. NEMA AB–2 Field Inspection and Performance Verification of Molded Case Circuit. Breakers Used in Commercial and Industrial Applications, Procedures for.
   c. NEMA AB–3 Molded Case Circuit Breakers and Their Application.
   d. NEMA FU–1 Low Voltage Cartridge Fuses.
2. National Fire Protection Association (NFPA). Comply with NFPA 70, "National Electrical Code" requirements as applicable to construction and installation of overcurrent devices.
3. Underwriters Laboratories, Inc. (UL): Provide overcurrent protective devices that are UL–listed and labeled. Provide fuses and circuit breakers conforming to UL including:
   a. UL512 Fuseholders
   b. UL198B Class H Fuses
   c. UL198C High–Interrupting–Capacity Fuses, Current–Limiting Types
   d. UL198D Class K Fuses
   e. UL198E Class R Fuses
   f. UL198G Fuses for Supplementary Overcurrent Protection
   g. UL198H Class T Fuses
   h. UL489 Molded–Case Circuit Breakers and Circuit–Breaker Enclosures.

100.3.12.3 Products

(1) Enclosures shall be NEMA 1, unless otherwise indicated in the Contract Documents. Enclosures shall have an externally operable handle with interlock to prevent opening of front cover with the switch in the "ON" position. Handle shall be lockable in the "OFF" position.

(2) Molded Case Circuit Breakers.

a. Circuit breakers shall conform to NEMA AB 1.

b. Circuit breakers shall have trip rating and number of poles as indicated on the Contract Documents.

c. Circuit breakers shall have an interrupting current rating equal to or greater than the available fault current at their location in the electrical system, unless otherwise specified. Provide a minimum rating of 10,000 amperes symmetrical, unless a greater rating is shown on the Contract Documents.

d. All circuit breakers shall be of the same manufacturer.

e. Provide circuit breakers with a quick–made and quick–break toggle mechanism with inverse–time trip characteristics.

f. Automatic release is to be secured by a bimetallic thermal element releasing the mechanism latch.

g. A magnetic armature shall be provided to trip the breaker instantaneously for short–circuit currents above the overload range.

h. Automatic tripping shall be indicated by a handle position between the manual OFF and ON position.

i. Provide adjustable magnetic trip devices adjusted at the factory to "low" trip setting ampere values.

(3) Heavy Duty Safety Switches.

a. Provide quick make, quick break load interrupter enclosed knife switch assemblies.

b. Provide fuses that conform to UL 198B, 198C, 198D, 198E 198F, 198G, 198H, 198L, and 198M. Provide fuses of the sizes noted on the Contract Documents.

c. Current–limiting fuses shall be installed in lieu of regular fuses where the fault current exceeds 10,000 RMS amperes.

d. Fuses rated over 600 amperes shall be NEMA Class L.

e. Fuses for use with switches rated 600 amperes and less shall be UL Class RK–5 or RK–1 as noted, unless otherwise specified. Class RK–5 and RK–1 fuses shall be dual element type with minimum time–delay of ten seconds at 500 percent of rating.

f. Provide one complete set of fuses installed for all switches requiring fuses. Provide one spare fuse of each size and type installed.

(4) Combination Molded Case Circuit Breaker and Current–Limiting Fuses.

a. Where the short circuit current exceeds the interrupting ratings of molded case circuit breakers, provide high–interrupting capacity integral current limiters on the load side of the circuit breakers.

b. The circuit breaker and limiter combination shall be a coordinated unit meeting the applicable requirements of UL 489, so designed that the normal thermal magnetic overcurrent devices provide coordinated protection against overloads and short circuits up to a predetermined value. The current limiters shall assume the fault–clearing duty and extend short circuit protection up to and including 100,000 RMS amperes.

c. High–interrupting–capacity circuit breakers adequate for the short circuit current available at the particular location in the system may be provided in lieu of the combination current limiting fuse units.

100.3.12.4. Installation

(1) Install overcurrent protective devices as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NFPA 70 and NEMA standards for installation of overcurrent protective devices.

(2) Coordinate with other work, including electrical wiring work, as necessary to interface installation of overcurrent protective devices with other work.

(3) Fasten overcurrent devices without causing mechanical stresses, twisting or misalignment being exerted by clamps, supports, or cabling.

(4) Set field–adjustable circuit breakers for trip settings as indicated, subsequent to installation of units.

(5) Install fuses and package the spare fuses in an orderly fashion.

(6) Inspect circuit–breaker operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.

(7) Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and short–circuits. Correct malfunctioning units, and then demonstrate compliance with requirements.

100.3.13 Method of Measurement and Basis of Payment

(1) Work specified herein shall be measured for payment as part of other Pay Items described in other Specifications. The cost of Work required in this Specification shall be included in the prices bid for Pay Items included in the Schedule of Prices.

END OF SPECIFICATION L100

Specification L101 - Airport Rotating Beacons

101.1 Description

101.1.1 General

(1) This Work shall consist of furnishing and installing airport rotating beacons, including mounting, leveling, wiring, painting, maintaining, and testing the beacon. In addition, this item also includes all materials and incidentals necessary to place the beacon in a serviceable condition (as a completed unit), including a mounting platform if shown on the Plans.

101.2 Equipment and Materials

101.2.1 General

(1) Airport lighting equipment and materials covered by advisory circulars (ACs) must be certified and listed in AC 150/5345-53, Airport Lighting Equipment Certification Program (ALECP) and listed in the ALECP Addendum.

(2) All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification.

(3) Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials that are in accordance with these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed when directed by the Engineer and replaced with materials, which is in compliance with these specifications, at the Contractor's cost.

(4) Provide shop drawings in accordance with 100.2.10.

(5) Provide warranty in accordance with 100.2.18.

101.2.2 Beacon

(1) Beacons shall be the Type and Class beacon indicated by the Pay Item or on the Plans or Special Provisions meeting the requirements of AC 150/5345-12, Specification for Airport and Heliport Beacons.

101.2.3 Beacon Installation

(1) Conform to FAA AC 150/5340-30, Design and Installation Details for Airport Visual Aids, for airport beacon and AC 150/5390-2, Heliport Design for heliport installation details. Provide two lamp sets as spares.

101.2.4 Panel Boards and Breakers

(1) Panel boards and breakers shall conform to the requirements of Federal Specification W-P-115, Panel, Power Distribution.

101.2.5 Weatherproof Cabinets

(1) Weatherproof cabinets shall conform to National Electrical Manufacturers Association Standards (NEMA) and shall be constructed of steel not less than No. 16 United States Standard (USS) gauge.

101.2.6 Electrical Wire

(1) For ratings up to 600 volts, moisture and heat resistant thermoplastic wire conforming to Commercial Item Description A-A-59544A Type THWN-2 shall be used. The wires shall be the type, size, number of conductors, and voltage shown in the Plans or in the proposal.

101.2.7 Conduit

(1) Rigid steel conduit and fittings shall be in accordance with Underwriters Laboratories Standards 6, 514B, and 1242.

101.2.8 Paint

(1) Priming paint for non-galvanized metal surfaces shall be a high solids alkyd primer compatible with the manufacturer's recommendations for the intermediate or topcoat.

(2) Priming paint for galvanized metal surfaces shall be a zinc-rich epoxy primer paint per MIL-DTL-24441/19C, Formula 159, Type III. Use MIL-24441 thinner per paint manufacturer's recommendations.

(3) Orange paint for the body and the finish coats on metal and wood surfaces shall consist of a ready-mixed non-fading paint meeting the requirements of Master Painter's Institute (MPI) Reference #9 (gloss). The color shall be in accordance with Federal Standard 595, International Orange Number 12197.

(4) White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint in accordance with the Master Painter's Institute, Reference #9, Exterior Alkyd, Gloss, volatile organic content (VOC) Range E2.

(5) Priming paint for wood surfaces shall be mixed on the job by thinning the above-specified orange or white paint with 1/2 pint of raw linseed oil to each gallon.

101.3 Construction

101.3.1 Placing the Beacon

(1) The beacon shall be mounted on a beacon tower, platform, or building roof as shown in the Plans.

101.3.2 Hoisting and Mounting

(1) The beacon shall be hoisted to the mounting platform by using suitable slings and hoisting tackle. Before fastening the beacon to the mounting platform, the mounting holes shall be checked for correct spacing. Beacon base or mounting legs shall not be strained or forced out of position to fit incorrect spacing of mounting holes. The beacon base shall be raised first, set in position, and bolted in place. The drum shall then be raised and assembled to the base.

101.3.3 Leveling

(1) After the beacon has been mounted, it shall be accurately leveled following the manufacturer's instructions. The leveling shall be checked in the presence of the Engineer and shall be to the Engineer's satisfaction.

101.3.4 Servicing

(1) Before placing the beacon in operation, the Contractor shall check the manufacturer's manual for proper servicing requirements. Follow the manufacturer's servicing instructions for each size of beacon.

101.3.5 Beam Adjustment

(1) After the beacon has been mounted and leveled, the elevation of the beam shall be adjusted. The final beam adjustments shall be made at night so that results can be readily observed. The beams shall be adjusted to the elevation directed by the Engineer or as shown in the. See AC 150/5340-30 requirements for additional information about airport beacon beam adjustment.

101.3.6 Beacon Mounting Platform

(1) Where the beacon is to be mounted at a location other than the beacon tower and where a special mounting platform is required, the construction of the mounting platform and lightning protection equipment shall be in accordance with the details shown in the Plans.

101.3.7 Wiring

(1) Contractor shall furnish all necessary labor and materials and shall make complete above ground electrical connections in accordance with the wiring diagram furnished with the project Plans. The electrical installation shall conform to the requirements of the latest edition of National Fire Protection Association, NFPA-70, and National Electrical Code (NEC).

(2) If underground cable for the power feed from the transformer vault to the beacon site and duct for this cable installation is required, the cable, ground rods and duct shall be installed as shown on the plans.

(3) If shown on the plans, the Contractor shall connect the tell-tale relay mechanism in the beacon to energize the tower obstruction light circuit when failure of the beacon service (primary) lamp occurs.

(4) If lightning protection is specified in the Plans or proposal as a part of this item, it shall be installed in accordance with 103.2.3 in L103, Airport Beacon Towers.

101.3.8 Panel and Cabinet

(1) Unless otherwise specified, Contractor shall furnish and install at the top of the beacon tower or mounting platform a circuit-breaker panel consisting of four 15-ampere breakers mounted in a weather-proof cabinet to provide separate protection for the circuits to the beacon lamps, motor, obstruction lights, and other equipment. The cabinet shall be located on the side of the beacon platform, as directed by the Engineer.

101.3.9 Conduit

(1) All exposed wiring shall be run in not less than 3/4 inch galvanized rigid steel conduit. Outdoor rated, liquid-tight, flexible metal conduit may be used for final connection at the beacon equipment. No conduit shall be installed on top of a beacon platform floor. All conduits shall be installed to provide for drainage. If mounted on a steel beacon tower, the conduit shall be fastened to the tower members with Wraplock® straps (or equivalent), clamps, or approved fasteners, spaced approximately five feet apart. The conduit shall be fastened to wooden structures with galvanized pipe straps and with galvanized wood screws not less than No. 8 or less than 1-1/4 inches long. There shall be at least two fastenings for each ten feet length.

101.3.10 Booster Transformer

(1) The installation shall be as indicated plans and described in the specifications.

101.3.11 Photoelectric Control

(1) If shown in the Plans or Special Provisions, Contractor shall furnish and install an automatic control switch at the location indicated in the Plans. The switch shall be a photoelectric type. It shall be a standard commercially available unit that will energize when the illumination on a vertical surface facing North decreases to 25 to 35 foot-candles. The photoelectric switch should de-energize when the illumination rises to 50 to 60 foot-candles. The photoelectronic switch shall be installed, connected, and adjusted in accordance with the manufacturer's instructions.

101.3.12 Obstruction lights

(1) Unless otherwise specified, the Contractor shall install on the top of the beacon tower or mounting platform two L-810 obstruction lights on opposite corners. These lights shall be mounted on conduit extensions to a height of not less than four inches above the top of the beacon.

101.3.13 Painting

(1) If construction of a wooden mounting platform is stipulated in the proposal as part of this Work, all wooden parts of the platform shall be given one priming coat of white or aviation-orange paint after fabrication but before erection and one body and one finish coat of international-orange paint after erection. Steel mounting platforms shall be given one priming coat of corrosion-inhibiting primer before erection and one body and one finish coat of international orange paint after erection. All equipment installed under this contract and exposed to the weather shall be given one body and one finish coat of international-.orange (in accordance with Federal Standard 595, Number 12197) or white paint as required. This shall include the beacon (except glass surfaces), beacon base, breaker cabinet, all conduit, and transformer cases. It shall not include lightning protection system air terminals or obstruction light globes.

(2) Apply the paint uniformly at the proper consistency. The finished paint shall be free from sags, holidays, and smears. Each coat of paint shall be given ample time to dry and harden before the next coat of paint is applied. A minimum of three days shall be allowed for drying on wood surfaces, and a minimum of four days shall be allowed for drying on metal surfaces. Painting shall not be performed in cold, damp, foggy, dusty, or frosty atmospheres, or when the air temperature is below 40°F, nor started when the weather forecast indicates such conditions for the day.

(3) All surfaces shall be cleaned before painting. The surfaces shall be dry and free from scale, grease, rust, dust, and dirt. All knots in wood surfaces shall be covered with shellac immediately before applying the priming coat of paint. Nail holes and permissible imperfections shall be filled with putty. The ready-mixed paint shall be thinned for the priming and body coats in accordance with the manufacturer's recommendations. In the absence of such recommendations, the following shall apply:

   a. Body coats (for both wood and steel surfaces) - add 1/2 pint of turpentine to each gallon of ready-mixed paint for body coats.
   b. Finish coats (for both wood and steel surfaces) the ready-mixed paint shall be used as it comes from the container for finish coats.

101.3.14 Testing

(1) The beacon installation shall be fully tested as a completed unit prior to acceptance. These tests shall include operation of the lamp-changer and performing insulation resistance and voltage readings. The insulation resistance to ground of the beacon power supply circuit shall be not less than 100 megohms when measured ungrounded. Contractor must furnish testing equipment. Tests shall be conducted in the presence of the Engineer and shall be to the Engineer's satisfaction.

101.4 Measurement

101.4.1 General

(1) Airport Rotating Beacons shall be measured as completed unit install in place, accepted, and tested per lump sum.

101.5 Payment

101.5.1 General

(1) Payment will be made at the Contract unit price for each unit completed and accepted per lump sum. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, testing, and incidentals necessary to complete this item.

(2) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

101.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
L101.010 through L101.019	Airport Rotating Beacon (type) (class)	Lump Sum (LS)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5345-7	Specification for L-824 Underground Cable for Airport Lighting Circuits
AC 150/5345-12	Specification for Airport and Heliport Beacons
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-53	Airport Lighting Equipment Certification Program
AC 150/5390-2	Heliport Design

Commercial Item Description

A-A-59544A	Cable and Wire, Electrical (Power, Fixed Installation)

Federal Specification (FED SPEC)FED SPEC W-P-115 Panel, Power Distribution

Federal Standard (FED STD)

FED STD 595	Colors Used in Government Procurement

Master Painter Institute MPI)

MPI Reference #9	Alkyd, Exterior, Gloss (MPI Gloss Level 6)

Military Specification

MIL-DTL-24441C/19C	Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III

National Fire Protection Association (NFPA)

NFPA-70	National Electric Code (NEC)
NFPA-780	Standard for the Installation of Lightning Protection Systems

Underwriters Laboratories (UL)

UL Standard 6	Electrical Rigid Metal Conduit – Steel
UL Standard 514B	Conduit, Tubing, and Cable Fittings
UL Standard 1242	Electrical Intermediate Metal Conduit - Steel

END OF SPECIFICATION L101

Specification L103 - Airport Beacon Towers

103.1 Description

103.1.1 General

(1) This Work shall consist of furnishing and installing an airport beacon tower of the type shown in the Plans, in accordance with these Specifications; including clearing of the site, erection of the tower, installation of lightning protection, painting, and all incidentals necessary to place it in operating condition as a completed unit. Conform to FAA advisory circular (AC) 150/5340-30 for installation of airport beacon towers.

103.2 Equipment and Materials

103.2.1 General

(1) All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification.

(2) Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials in accordance these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed and replaced with materials, which conform to these specifications, at the Contractor's cost.

(3) Provide shop drawings in accordance with 100.2.10.

(4) Provide warranty in accordance with 100.2.18.

103.2.2 Tower

(1) The beacon tower shall comply to FAA AC 150/5340-30, Design and Installation Details for Airport Visual Aids, Chapter 6.

103.2.3 Lightning Protection

(1) Lightning protection shall comply with NFPA-780, Standard for the Installation of Lightning Protection Systems. All materials shall comply with NFPA-780 Class II material requirements regardless of the tower height. Ground rods and underground cables shall be installed in accordance with and paid as described in L108, Underground Power Cable for Airports.

103.2.4 Paint

(1) Priming paint for galvanized steel towers shall be zinc dust-zinc oxide primer paint in accordance with MIL-DTL-24441C/19B. Use MIL-24441 thinner in accordance with paint manufacturer's recommendations.

(2) Priming paint for non-galvanized steel towers shall be a high solids alkyd primer in accordance with the Master Painter's Institute (MPI), Reference #9, Exterior Alkyd, Gloss.

(3) Orange paint for the body and the finish coats on metal and wood surfaces shall consist of a ready-mixed non-fading paint MPI Reference #9 (gloss). The color shall be in accordance with Federal Standards 595, International Orange Number 12197.

(4) White paint for a steel tower shall be ready-mixed paint in accordance with MPI #8.

103.3 Construction

103.3.1 Clearing and Grading

(1) The site on which the beacon tower is to be erected shall be cleared and leveled. All trees and brush shall be removed from the area within a distance of 25 feet from the tower or as called for in the Plans. Stumps shall be removed to a depth of 18 inches below finished grade and the excavation filled with earth and tamped. If a transformer vault or other structure is included as part of the installation, the area shall be cleared to a distance of 25 feet from these structures. The ground near the tower shall be leveled to permit the operation of mowing machines. The leveling shall extend at least two feet outside the tower legs. All debris removed from the tower site shall be disposed of by the Contractor to the satisfaction of the Engineer and in accordance with Federal, state, or local regulations.

103.3.2 Excavation and Fill

(1) Excavation for the tower footings shall be carried to a minimum of four inches below the footing depth. The excess excavation below the footing depth shall then be backfilled with gravel or crushed stone and compacted to the required level. The footing plates shall be installed, and a thickness of not less than 18-inches of the same gravel or crushed stone shall be placed immediately above the footing plates in layers of not over six inches. Each layer above the footing plates shall be thoroughly tamped in place.

The remainder of the backfill may be of excavated earth placed in layers not to exceed 6 inches. Each layer shall be thoroughly compacted by tamping.

(2) Where solid rock is encountered, which prevents the carrying of the foundation legs to the required depth but which is of sufficient strength to use hold-down bolts, the tower anchor posts shall be cut off at the required length and the hold-down bolts shall be installed as indicated in the Plans with the approval of the Engineer. Each tower leg shall be anchored to the rock by means of two 7/8 inch diameter by three feet long expansion or split bolts and shall be grouted with neat Portland cement into holes drilled into the natural rock. Except as required for rock foundations, the footing members shall not be cut off or shortened. If excavated material is of such consistency that it will not readily compact when backfilled, the Engineer may order the excavation backfilled with concrete or other suitable material.

(3) The concrete footing for tubular beacon towers shall be installed in accordance with the manufacturer's recommendations. Portions of the footing in the topsoil layer shall not be included in the footing height.

103.3.3 Erection

(1) Detailed erection drawings furnished by the manufacturer shall be strictly followed during construction. All towers shall be erected in sections from the ground up unless otherwise specified. For final assembly, all bolts and fastenings shall be installed, and the structure shall be plumb, true, square, and level. Nuts shall be taken up to a firm bearing after which the bolts shall, if necessary, be cut to proper length to protrude three full threads. Approved locknuts shall be placed on each bolt over the regular nut. Ladder bolts shall be inserted with the head to the outer face of the tower. Diagonal, leg, and handrail bolts shall be installed with nuts on the outer face of the tower, unless otherwise specified. Bent parts shall be straightened before erection without damage to the protective coating. Surfaces abraded or bared of protective coating shall be painted with the proper priming paint in accordance with these specifications.

(2) Contractor shall install the ladder on the side of the tower adjacent to the driveway or most accessible approach to the tower. Tubular beacon towers shall be erected in accordance with the manufacturer's recommendations. The safety cable shall be located on the side of the tower adjacent to the driveway or most accessible approach to the tower.

103.3.4 Lightning Protection

(1) Lightning protection shall be in accordance with NFPA-780, Standard for the Installation of Lightning Protection Systems. All materials shall comply with Class II requirements regardless of tower height. Ground rods and underground cables shall be installed in accordance with and paid as described in Specification L108, Underground Power Cable for Airports.

(2) The Contractor shall furnish and install a Class II lightning protection system in accordance with NFPA 780.

(3) Securely fasten down-conductor cables to the surface of the tower leg at five foot intervals with suitable bronze fasteners having bronze or noncorrosive metal bolts. Sharp turns or bends in the down conductor will not be permitted.

(4) All connections of cable to cable, cable to air terminals, and cable to ground plates or rods shall be made with solder-less connectors or noncorrosive metal approved by the Engineer and shall be of substantial construction.

(5) The down-conductor cable shall be securely attached to ground rods or plates placed at least two feet away from the tower foundations. The ground rod shall be driven into the ground so that the top is at least six inches below grade. The down-conductor shall be firmly attached to the ground plate or rod by means of an exothermic weld only. Plates shall be embedded in an area of permanent moisture.

(6) The complete lightning protection installation shall be accomplished to the satisfaction of the Engineer. The resistance to ground of parts of the lightning protection system shall not exceed 25 ohms. If a single rod grounding electrode has a resistance to earth of over 25 ohms, then install one supplemental rod not less than ten feet from the first rod. If desired resistance to ground levels are still not achieved, see FAA-STD-019 for guidance.

103.3.5 Painting

(1) Contractor shall furnish all materials and labor for painting the beacon tower. The color scheme for the steel tower shall be as shown in the Plans.

103.3.5.1 Parts to be Painted

(1) Tower parts (except those parts to be exposed to earth) shall not be treated or primed before erection. All tower parts placed below ground level or within 12 inches above ground level shall be given two coats of approved asphalt paint.

(2) Apply the proper consistency of paint uniformly. The finished paint shall be free from sags, holidays, and smears. Division lines between colors shall be sharply defined. Each coat of paint shall be given ample time to dry and harden before the next coat is applied. A minimum of four days shall be allowed for drying on metal surfaces. Painting shall not be done in cold, damp, foggy, or dusty atmospheres, or when air temperature is below 40°F, nor started when the weather forecast indicates such conditions for the day.

(3) All surfaces shall be cleaned before painting. The surfaces shall be dry and free from scale, grease, rust, dust, and dirt when paint is applied.

(4) The number of coats of paint applied shall be in accordance with the following instructions.

103.3.5.2 Steel Towers - Galvanized

(1) One priming coat of zinc dust-zinc oxide primer after erection and one body and one finish of white or orange paint (as required by the color scheme) shall be applied after erection.

103.3.5.3 Steel Towers - Not Galvanized

(1) One priming coat of corrosion-inhibiting primer and one body and one finish coat of white or orange paint (as required by the color scheme) shall be applied after erection. The specified orange and white ready-mixed paints shall be thinned for the body coats in accordance with the manufacturer's recommendations. In the absence of such recommendations, the following shall apply:

a. Body coats. Add not more than 1/2 pint of turpentine to each gallon of ready-mixed paint for body coats.

b. Finish coats. The ready-mixed paint shall be used as it comes from the container for finish coats.

103.4 Measurement
103.4.1 General

(1) Airport Beacon Towers shall be measured as a completed units in place, per lump sum, accepted, and ready for operation.

103.5 Payment
103.5.1 General

(1) Payment will be made at the Contract unit price for each unit completed and accepted per Lump Sum. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, testing, and incidentals necessary to complete this work in accordance with the details shown on the Plans.

(2) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

103.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
L103.010 through L103.049	Airport Beacon Tower (type)	Lump Sum (LS)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
Advisory Circulars (AC)

AC 150/5340-30 Installation and Design Details for Airport Visual Aids

Master Painter's Institute (MPI)

MPI Reference #8 Alkyd, Exterior, Flat (MPI Gloss Level 1)

MPI Reference #9 Alkyd, Exterior, Gloss (MPI Gloss Level 6)

Federal Standard (FED STD)

FED STD 595	Colors Used in Government Procurement

Military Specification (MIL)

MIL-DTL.24441C/19B	Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III

National Fire Protection Association (NFPA)

NFPA-780	Standard for the Installation of Lightning Protection Systems

END OF SPECIFICATION L103

Specification L107 - Airport Wind Cones

107.1 Description

107.1.1 General

(1) This Work shall consist of furnishing and installing Airport Wind Cones in accordance with these specifications and the dimensions, design, and details shown in the Plans.

(2) The Work shall include furnishing and installing a support for mounting the wind cone, interconnecting wire, and a concrete foundation; including all cable connections, conduit and conduit fittings, furnishing and installing lamps, ground rod; ground connections, testing of the installation, and incidentals necessary to place the wind cone in operation, (as a completed unit) to the satisfaction of Engineer.

107.2 Equipment and Materials

107.2.1 General

(1) Airport lighting equipment and materials shall be certified and listed in FAA AC 150/5345-53, Airport Lighting Equipment Certification Program (ALECP) and listed in the ALECP Addendum.

(2) All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification.

(3) Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials in accordance with these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed and replaced with materials that comply with these specifications, at the Contractor's cost.

(4) Provide shop drawings in accordance with 100.2.10.

(5) Provide warranty in accordance with 100.2.18.

107.2.2 Wind Cones

(1) The wind cone assembly shall be Type, Style, and Size as indicated by the Pay Item or on the Plans or Special Provisions meeting the requirements of FAA AC 150/5345-27, Specification for Wind Cone Assemblies.

107.2.3 Electrical Wire and Cable

(1) Cable rated up to 5,000 volts in conduit shall conform to AC 150/5345-7, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits. For ratings up to 600 volts, moisture and heat resistant thermoplastic wire conforming to Commercial Item Description A-A-59544A Type THWN-2 shall be used. The wires shall be of the type, size, number of conductors, and voltage shown in the Plans or in the proposal.

107.2.4 Conduit

(1) Rigid steel conduit and fittings shall conform to the requirements of Underwriters Laboratories Standards 6, 514B, and 1242.

107.2.5 Plastic Conduit

(1) Plastic conduit and fittings (for use below grade only) shall be in accordance with the following:

a. UL 514B covers W-C-1094 - Conduit fittings all types, Classes 1 thru 3 and 6 thru 10
b. UL 514C covers W-C-1094 - all types, Class 5 junction box and cover in plastic (polyvinyl chloride (PVC))
c. UL 651 covers W-C-1094 - Rigid PVC Conduit, types I and II, Class 4
d. UL 651A covers W-C-1094 - Rigid PVC Conduit and high density polyethylene (HDPE) Conduit type III and Class 4

(2) Underwriters Laboratories Standard UL.651 shall be one of the following, as shown in the Plans:

a. Type I–Schedule 40 PVC suitable for underground use either direct-buried or encased in concrete.
b. Type II–Schedule 40 PVC suitable for either above ground or underground use.

(3) Plastic conduit adhesive shall be a solvent cement manufactured specifically for the purpose of gluing the type of plastic conduit and fitting.

107.2.6 Concrete

(1) The concrete for foundations shall be proportioned, placed, and cured in accordance with P610, Structural Portland Cement Concrete or SHS 501 Concrete.

107.2.7 Paint

(1) Priming paint for non-galvanized metal surfaces shall be a high solids alkyd primer compatible with the manufacturer's recommendations for the intermediate or topcoat.

(2) Priming paint for galvanized metal surfaces shall be zinc dust-zinc oxide primer paint conforming to MIL-DTL-24441C/19B. Use MIL-24441 thinner in accordance with paint manufacturer's recommendations.

(3) Orange paint for the body and the finish coats on metal and wood surfaces shall consist of a ready-mixed non-fading paint in accordance with Master Painter's Institute (MPI) Reference #9 (gloss). The color shall be in accordance with Federal Standards 595, International Orange, Number 12197.

(4) White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to the MPI, Reference #9, Exterior Alkyd, Gloss.

(5) Priming paint for wood surfaces shall be mixed on the job by thinning the above specified aviation-orange or white paint by adding 1/2 pint (0.24 liter) of raw linseed oil to each gallon (liter).

107.3 Construction

107.3.1 Installation

(1) The hinged support or hinged pole shall be installed on a concrete foundation in accordance with the Plans.

107.3.2 Support Pole Erection

(1) Contractor shall erect the pole on the foundation following the manufacturer's requirements and erection details. The pole shall be level and secure.

107.3.3 Electrical Connection

(1) Contractor shall furnish all labor and materials and shall make complete electrical connections in accordance with the wiring diagram furnished with the project plans. The electrical installation shall conform to the requirements of the latest edition of National Fire Protection Association, NFPA-70, National Electric Code (NEC).

(2) If underground cable from the transformer vault to the wind cone site and duct for this cable installation is required, the cable and duct shall be installed in accordance with and paid for as described in L108, Underground Power Cables for Airports, and L110, Airport Underground Electrical Duct Banks and Conduits.

107.3.4 Booster Transformer

(1) The booster transformer shall be installed as indicated in the Plans and described in the proposal. This work shall be incidental and the cost included in the price bid for wind cones.

107.3.5 Ground Connection and Ground Rod

(1) Contractor shall furnish and install a ground rod, grounding cable, and ground clamps for grounding the "A" frame of the 12-foot assembly or pipe support of the 8-foot support near the base. The ground rod shall be of the type, diameter and length specified in L108, Underground Power Cable for Airports. The ground rod shall be driven into the ground adjacent to the concrete foundation (minimum distance from foundation of two feet) so that the top is at least six inches below grade. The grounding cable shall consist of No. 6 (or as shown on Plan) American wire gauge (AWG) minimum stranded copper wire or larger and shall be firmly attached to the ground rod by exothermic welding. If an exothermic weld is not possible, connections to the grounding bus shall be made by using connectors approved for direct burial in soil or concrete in accordance with UL 467. The other end of the grounding cable shall be securely attached to a leg of the frame or to the base of the pipe support with non-corrosive metal and shall be of substantial construction. The resistance to ground shall not exceed 25 ohms. If a single rod grounding electrode has a resistance to earth of over 25 ohms, then install one supplemental rod not less than ten feet from the first rod. If desired resistance to ground levels are still not achieved, see FAA-STD-019 for guidance.

107.3.6 Painting

(1) Three coats of paint shall be applied (one prime, one body, and one finish) to all exposed material installed under this item except the fabric cone, obstruction light globe, and lamp reflectors. The wind cone assembly, if already painted upon receipt, shall be given one finish coat of paint in lieu of the three coats specified above. The paint shall be in accordance with MPI Reference #9 (gloss). The color shall be in accordance with Federal Standard 595, International Orange, Number 12197.

107.3.7 Light Sources

(1) Contractor shall furnish and install lamps in accordance with the manufacturer's instruction book.

107.3.8 Chain and Padlock

(1) Furnish and install a suitable operating chain for lowering and raising the hinged top section. The chain shall be attached to the pole support in a manner to prevent the light fixture assembly from striking the ground in the lowered position.

(2) A padlock shall also be furnished by the Contractor on the 8-foot wind cone for securing the hinged top section to the fixed lower section. Keys for the padlock shall be delivered to the Engineer.

107.3.9 Segmented Circle

(1) The segmented circle shall be constructed in accordance with FAA AC 150/5340-5, Segmented Circle Airport Marker System, and the details in the Plans.

107.4 Measurement

107.4.1 General

(1) Wind cones shall be measured as completed units in place per each, accepted, and ready for operation.

(2) Segmented circle marker systems shall be measured as completed units in place, per each.

107.5 Payment

107.5.1 General

(1) Payment will be made at the Contract unit price for each completed Wind Cone and Segmented Circle Marker System, this price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, power adapters when required, testing and incidentals necessary to complete this Work.

(2) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

107.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
L107.010 through L107.039	Airport Wind Cone (type) (style) (size) (location)	Each (EA)
L107.040 through L107.049	Segmented Circle Mark System (location)	Each (EA)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5340-5	Segmented Circle Airport Marker System
AC 150/5340-30	Design and Installation Details for airport Visual Aids
AC 150/5345-7	Specification for L.824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-27	Specification for Wind Cone Assemblies
AC 150/5345-53	Airport Lighting Equipment Certification Program

Commercial Item Description

A-A-59544	Cable and Wire, Electrical (Power, Fixed Installation)

Federal Standard (FED STD)

FED STD 595	Colors Used in Government Procurement

Master Painter's Institute (MPI)

MPI Reference #9	Alkyd, Exterior, Gloss (MPI Gloss Level 6)

Military Standard (MIL)

MIL-DTL-24441C/19B	Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III

Underwriters Laboratories (UL)

UL Standard 6	Electrical Rigid Metal Conduit – Steel
UL Standard 514B	Conduit, Tubing, and Cable Fittings
UL Standard 514C	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL Standard 651	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL Standard 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit
UL Standard 1242	Electrical Intermediate Metal Conduit - Steel

National Fire Protection Association (NFPA)

NFPA-70	National Electric Code (NEC)

END OF SPECIFICATION L107

Specification L108 - Underground Power Cable for Airports

108.1 Description

108.1.1 General

(1) This Work shall consist of furnishing and installing power cables that are direct buried and furnishing and installing power cables within properly rated flexible polyethylene duct, conduit, or duct banks in accordance with these Specifications at the locations shown on the Plans. It includes excavation and backfill of trench for direct-buried cables. Also included are the installation of counterpoise wires, ground wires, ground rods and connections, cable splicing, cable marking, cable testing, flexible polyethylene duct, and all incidentals necessary to place the cable in operating condition as a completed unit to the satisfaction of the Engineer.

(2) This Work shall not include the installation of duct banks, conduit, trenching and backfilling for duct banks or conduit, or furnishing or installation of cable for FAA owned/operated facilities. Requirements and payment for trenching and backfilling for the installation of underground conduit and duct banks is in L110, Airport Underground Electrical Duct Banks and Conduits.

(3) Construct flexible polyethylene duct at locations shown on the Plans. Install single cables in 1-inch duct and multiple cables (as shown on the Plans) in 1 ½-inch duct.

108.2 Equipment and Materials

108.2.1 General

(1) Airport lighting equipment and materials covered by advisory circulars (AC) shall be approved under the Airport Lighting Equipment Certification Program in accordance with AC 150/5345-53, current version.

(2) All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification, when requested by the Engineer.

(3) Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials in accordance with these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the Engineer) and replaced with materials that comply with these specifications at the Contractor's cost.

(4) Provide shop drawings in accordance with 100.2.10.

(5) Provide warranty in accordance with 100.2.18.

(6) The Contractor shall be responsible to maintain a minimum insulation resistance in accordance with AC 150/5340-26, Maintenance Airport Visual aid Facilities, Table 5.1 and paragraph 5.1.3.1, with isolation transformers connected in new circuits and new segments of existing circuits through the end of the contract warranty period when tested in accordance with AC 150/5340-26, *Maintenance Airport Visual Aid Facilities*, paragraph 5.1.3.1, Insulation Resistance Test.

108.2.2 Cable

(1) Underground cable for airfield lighting facilities (runway and taxiway lights and signs) shall conform to the requirements of AC 150/5345-7, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits latest edition. Conductors for use on 6.6 ampere primary airfield lighting series circuits shall be single conductor, seven strand, #8 American wire gauge AWG, L-824, Type C, 5,000 volts, non-shielded, with, cross-linked polyethylene insulation. Conductors for use on 20 ampere primary airfield lighting series circuits shall be single conductor, seven strand, #6 AWG, L-824, Type C, 5,000 volts, non-shielded, with, cross-linked polyethylene insulation. L-824 conductors for use on the L-830 secondary of airfield lighting series circuits shall be sized in accordance with the manufacturer's recommendations. All other conductors shall comply with FAA and National Electric Code (NEC) requirements. Conductor sizes noted above shall not apply to leads furnished by manufacturers on airfield lighting transformers and fixtures.

(2) Wire for electrical circuits up to 600 volts shall comply with Specification L-824 and/or Commercial Item Description A-A-59544A and shall be type THWN-2, 75°C. Conductors for parallel (voltage) circuits shall be sized and installed in accordance with NFPA-70, National Electrical Code.

(3) Unless noted otherwise, all 600 volt and less non-airfield lighting conductor sizes are based on a 75°C, THWN-2, 600 volt insulation, copper conductors, not more than three single insulated conductors, in raceway, in free air. The conduit/duct sizes are based on the use of THWN-2, 600 volt insulated conductors. The Contractor shall make the necessary increase in conduit/duct sizes for other types of

wire insulation. In no case shall the conduit/duct size be reduced. The minimum power circuit wire size shall be #12 AWG.

(4) Conductor sizes may have been adjusted due to voltage drop or other engineering considerations. Equipment provided by the Contractor shall be capable of accepting the quantity and sizes of conductors shown in the Contract Documents. All conductors, pigtails, cable step-down adapters, cable step-up adapters, terminal blocks and splicing materials necessary to complete the cable termination/splice shall be considered incidental to the respective pay items provided.

(5) Cable type, size, number of conductors, strand and service voltage shall be as specified in the Contract Document.

108.2.3 Bare Copper Wire (Counterpoise, Bare Copper Wire Ground and Ground Rods)

(1) Wire for counterpoise or ground installations for airfield lighting systems shall be No. 6 AWG bare solid copper wire for counterpoise and/or No. 6 AWG insulated stranded for grounding bond wire per ASTM B3 and ASTM B8, and shall be bare copper wire or tinned copper wire per ASTM B33

(2) For voltage powered circuits, the equipment grounding conductor shall comply with NEC Article 250.

(3) Ground rods shall be copper or copper-clad steel. The ground rods shall be of the length and diameter specified on the Plans, but in no case be less than 10-feet long and 3/4 inch in diameter.

108.2.4 Cable Connections

(1) In-line connections or splices of underground primary cables shall be of the type called for on the Plans, and shall be one of the following types. No separate payment will be made for cable connections.

a. **Cast Splice.** A cast splice, employing a plastic mold and using epoxy resin equivalent to that manufactured by 3M™ Company, “Scotchcast” Kit No. 82-B, or an approved equivalent, used for potting the splice is acceptable.

b. **Field-Attached Plug-In Splice.** Field attached plug-in splices shall be installed as shown on the plans. The Contractor shall determine the outside diameter of the cable to be spliced and furnish appropriately sized connector kits and/or adapters. Tape or heat shrink tubing with integral sealant shall be in accordance with the manufacturer’s requirements. Primary Connector Kits manufactured by Amerace, "Super Kit", Integro "Complete Kit", or approved equal is acceptable.

c. **Factory-Molded Plug-In Splice.** Specification for L-823 Connectors, Factory-Molded to Individual Conductors, is acceptable.

d. **Taped or Heat-Shrink Splice.** Taped splices employing field-applied rubber, or synthetic rubber tape covered with plastic tape is acceptable. The rubber tape should meet the requirements of ASTM D4388 and the plastic tape should comply with Military Specification MIL-I-24391 or Commercial Item Description A-A-55809. Heat shrinkable tubing shall be heavy-wall, self-sealing tubing rated for the voltage of the wire being spliced and suitable for direct-buried installations. The tubing shall be factory coated with a thermoplastic adhesive-sealant that will adhere to the insulation of the wire being spliced forming a moisture and dirt proof seal. Additionally, heat shrinkable tubing for multi-conductor cables, shielded cables, and armored cables shall be factory kits that are designed for the application. Heat shrinkable tubing and tubing kits shall be manufactured by Tyco Electronics/ Raychem Corporation, Energy Division, or approved equivalent.

(2) In all the previously listed cases, connections of cable conductors shall be made using crimp connectors using a crimping tool designed to make a complete crimp before the tool can be removed. All L-823/L-824 splices and terminations shall be made in accordance with the manufacturer’s recommendations and listings.

(3) All connections of counterpoise, grounding conductors and ground rods shall be made by the exothermic process or approved equivalent, except that a light base ground clamp connector shall be used for attachment to the light base. All exothermic connections shall be made per the manufacturer’s recommendations and listings.

108.2.5 Splicer Qualifications

(1) Every airfield lighting cable splicer shall be qualified in making cable splices and terminations on cables rated at or above 5,000 volts AC. Contractor shall submit to Engineer written proof of the qualifications of each proposed cable splicer for the airport cable type and voltage level to be worked on. Cable splicing/terminating personnel shall have a minimum of three years continuous experience in terminating/splicing medium voltage cable.

108.2.6 Concrete

(1) Concrete for cable markers shall be proportioned, placed, and cured per Item P-610, in accordance with P610, Structural Portland Cement Concrete or SHS 501 Concrete.

108.2.7 Granular Backfill

(1) Granular material used to backfill trenches for power cable trenches shall conform to the requirements of P203.

108.2.8 Cable Identification Tags

(1) Cable identification tags shall be made from a non-corrosive material with the circuit identification stamped or etched onto the tag. The tags shall be of the type as detailed on the Plans.

108.2.9 Tape

(1) Electrical tapes shall be Scotch™ Electrical Tapes –Scotch™ 88 (1-1/2 inch wide) and Scotch™ 130C® linerless rubber splicing tape (2-inch wide), as manufactured by the Minnesota Mining and Manufacturing Company (3M™), or an approved equivalent.

108.2.10 Electrical Coating

(1) Electrical coating shall be Scotchkote™ as manufactured by 3M™, or an approved equivalent.

108.2.11 Existing Circuits

(1) Whenever the scope of work requires connection to an existing circuit, the circuit's insulation resistance shall be tested, in the presence of the Engineer. The test shall be performed in accordance with this Specification and prior to any activity that will affect the respective circuit. The Contractor shall record the results on forms acceptable to the Engineer. When the work affecting the circuit is complete, the circuit's insulation resistance shall be checked again, in the presence of the Engineer. Contractor shall record the results on forms acceptable to the Engineer. The second reading shall be equal to or greater than the first reading or the Contractor shall make the necessary repairs to the circuit to bring the second reading above the first reading. All repair costs including a complete replacement of the L-823 connectors, L-830 transformers and L-824 cable, if necessary, shall be borne by the Contractor. All test results shall be submitted in the Operation and Maintenance (O&M) Manual.

108.2.12 Detectable Warning Tape

(1) Plastic, detectable, American Public Works Association (APWA) Red (electrical power lines, cables, conduit and lighting cable) with continuous legend magnetic tape shall be polyethylene film with a metalized foil core and shall be three to six inches wide. Detectable tape is incidental to the respective Pay Item. Detectable warning tape for communication cables shall be orange. Detectable warning tape color code shall comply with the APWA Uniform Color Code.

108.2.13 Flexible Polyethylene Duct

(1) Provide flexible polyethylene duct in accordance with NEMA Standards Publication TC 7.

108.3 Construction

108.3.1 General

(1) Contractor shall install the specified cable at the approximate locations indicated on the Plans. Unless otherwise shown on the Plans, all cable required to cross under pavements expected to carry aircraft loads shall be installed in concrete encased duct banks. Cable shall be run without splices, from fixture to fixture.

(2) Cable connections between lights will be permitted only at the light locations for connecting the underground cable to the primary leads of the individual isolation transformers. Contractor shall be responsible for providing cable in continuous lengths for home runs or other long cable runs without connections unless otherwise authorized in writing by the Engineer or shown on the Plans.

(3) In addition to connectors being installed at individual isolation transformers, L-823 cable connectors for maintenance and test points shall be installed at locations shown on the Plans. Cable circuit identification markers shall be installed on both sides of the L-823 connectors installed and on both sides of slack loops where a future connector would be installed.

(4) Provide not less than three feet of cable slack on each side of all connections, isolation transformers, light units, and at points where cable is connected to field equipment. Where provisions must be made for testing or for future above grade connections, provide enough slack to allow the cable to be extended at least one foot vertically above the top of the access structure. This requirement also applies where primary cable passes through empty light bases, junction boxes, and access structures to allow for future connections, or as designated by the Engineer.

(5) Primary airfield lighting cables installed shall have cable circuit identification markers attached on both sides of each L-823 connector and on each airport lighting cable entering or leaving cable access points, such as manholes, hand holes, pull boxes, and junction boxes. Markers shall be of sufficient length for

imprinting the cable circuit identification legend on one line, using letters not less than 1/4 inch in size. The cable circuit identification shall match the circuits noted on the construction plans.

108.3.2 Installation In Duct Banks or Conduits

(1) This Work includes the installation of the cable in duct banks or conduit in accordance with the following paragraphs. The maximum number and voltage ratings of cables installed in each single duct or conduit, and the current-carrying capacity of each cable shall be in accordance with the latest version of the National Electric Code, or the code of the local agency or authority having jurisdiction.

(2) Contractor shall make no connections or splices in cables installed in conduits or duct banks.

(3) Unless otherwise designated in the Plans, where ducts are in tiers, use the lowest ducts to receive the cable first, with spare ducts left in the upper levels. Check duct routes prior to construction to obtain assurance that the shortest routes are selected and that potential interference is avoided.

(4) Duct banks or conduits shall be installed as a separate item in accordance with L110, Airport Underground Electrical Duct Banks and Conduit. Run a mandrel through duct banks or conduit prior to installation of cable to ensure that the duct bank or conduit is open, continuous and clear of debris. The mandrel size shall be compatible with the conduit size. Swab out all conduits/ducts and clean light base, manhole interiors immediately prior to pulling cable. Once cleaned and swabbed, the light bases and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning ducts, light bases, and manholes is incidental to the Pay Item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be re-cleaned at the Contractor's expense. Verify existing ducts proposed for use in this project as clear and open. Notify the Engineer of blockage in the existing ducts.

(5) The cable shall be installed in a manner that prevents harmful stretching of the conductor, damage to the insulation, or damage to the outer protective covering. The ends of all cables shall be sealed with moisture-seal tape providing moisture-tight mechanical protection with minimum bulk, or alternately, heat shrinkable tubing before pulling into the conduit and it shall be left sealed until connections are made. Where more than one cable is to be installed in a conduit, all cable shall be pulled in the conduit at the same time. The pulling of a cable through duct banks or conduits may be accomplished by hand winch or power winch with the use of cable grips or pulling eyes. Maximum pulling tensions shall not exceed the cable manufacturer's recommendations. A non-hardening cable-pulling lubricant recommended for the type of cable being installed shall be used where required.

(6) The Contractor shall submit the recommended pulling tension values to the Engineer prior to cable installation. If required by the Engineer, pulling tension values for cable pulls shall be monitored by a dynamometer in the presence of the Engineer. Cable pull tensions shall be recorded by the Contractor and reviewed by the Engineer. Cables exceeding the maximum allowable pulling tension values shall be removed and replaced by the Contractor at the Contractor's expense.

(7) The manufacturer's minimum bend radius or NEC requirements (whichever is more restrictive) shall apply. Cable installation, handling and storage shall be in accordance with manufacturer's recommendations. During cold weather, particular attention shall be paid to the manufacturer's minimum installation temperature. Cable shall not be installed when the temperature is at or below the manufacturer's minimum installation temperature. At the Contractor's option, the Contractor may submit a plan, for review by the Engineer, for heated storage of the cable and maintenance of an acceptable cable temperature during installation when temperatures are below the manufacturer's minimum cable installation temperature.

(8) Cable shall not be dragged across base can or manhole edges, pavement or earth. When cable must be coiled, lay cable out on a canvas tarp or use other appropriate means to prevent abrasion to the cable jacket.

108.3.3 Installation of Direct-Buried Cable in Trenches

(1) Unless otherwise specified, the Contractor shall not use a cable plow for installing the cable. Cable shall be unreeled uniformly in place alongside or in the trench and shall be carefully placed along the bottom of the trench. The cable shall not be unreeled and pulled into the trench from one end. Slack cable sufficient to provide strain relief shall be placed in the trench in a series of S curves. Sharp bends or kinks in the cable shall not be permitted.

(2) Where cables must cross over each other, a minimum of three inches vertical displacement shall be provided with the topmost cable depth at or below the minimum required depth below finished grade.

108.3.3.1 Trenching

(1) Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored. Trenches for cables may be excavated manually or with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of surface is disturbed. Graders shall not be used to excavate the trench with their blades. The bottom surface of trenches shall be essentially smooth and free from coarse aggregate. Unless otherwise specified, cable trenches shall be excavated to a minimum depth of 18 inches below finished grade in accordance with NEC Table 300.5, except as follows:

   a. When off the airport or crossing under a roadway or driveway, the minimum depth shall be 36 inches unless otherwise specified.

   b. Minimum cable depth when crossing under a railroad track, shall be 42 inches unless otherwise specified.

(2) Dewatering necessary for cable installation, erosion and turbidity control, in accordance with Federal, state, and local requirements is incidental to its respective Pay Items as part of L108. The cost of all excavation regardless of type of material encountered, shall be included in the unit price bid for the L108 Pay Item.

(3) Contractor shall excavate all cable trenches to a width not less than six inches. Unless otherwise specified on the Plans, all cables in the same location and running in the same general direction shall be installed in the same trench.

(4) When rock is encountered, the rock shall be removed to a depth of at least three inches below the required cable depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4 inch sieve. Contractor shall ascertain the type of soil or rock to be excavated before bidding. All such rock removal shall be performed and paid for under P152.

(5) Duct bank or conduit markers temporarily removed for trench excavations shall be replaced as required.

(6) It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Where existing active cables cross proposed installations, the Contractor shall ensure that these cables are adequately protected. Where crossings are unavoidable, no splices will be allowed in the existing cables, except as specified on the Plans. Installation of new cable where such crossings must occur shall proceed as follows:

   a. Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely no damage has occurred.

   b. Construction in cable areas shall then proceed, with approval of the Engineer, with care taken to minimize possible damage or disruption of existing cable, including careful backfilling in area of cable.

(7) In the event that previously identified cable is damaged during the course of construction, the Contractor shall be responsible for the complete and timely repair or replacement.

108.3.3.2 Backfilling

(1) After the cable has been installed, the trench shall be backfilled. The first layer of backfill in the trench shall be three inches deep, loose measurement, and shall be either earth or sand containing no mineral aggregate particles that would be retained on a one-quarter inch sieve. This layer shall not be compacted. The second layer shall be five inches deep, loose measurement, and shall contain no particles that would be retained on a one inch sieve. The remaining third and subsequent layers of backfill shall not exceed eight inches of loose measurement and be excavated or imported material and shall not contain stone or aggregate larger than four inches maximum diameter.

(2) The second and subsequent layers shall be thoroughly tamped and compacted to at least the density of the adjacent undisturbed soil. If necessary to obtain the desired compaction, the backfill material shall be moistened or aerated as required.

(3) If the cable is to be installed in locations or areas where other compaction requirements are specified (under pavements, embankments) the compaction requirements in accordance with P152 for that area shall be followed.

(4) Trenches shall not contain pools of water during backfilling operations. The trench shall be completely backfilled and tamped level with the adjacent surface, except that when turf is to be established over the trench, the backfilling shall be stopped at an appropriate depth consistent with the type of turfing operation to be accommodated. A proper allowance for settlement shall also be provided. Excess excavated material shall be removed and disposed of in accordance with the Plans and Specifications.

(5) Underground electrical warning (caution) tape shall be installed in the trench above all direct-buried cable. Contractor shall submit a sample of the proposed warning tape for acceptance by the Engineer.

If not shown on the Plans, the warning tape shall be located six inches above the direct-buried cable or the counterpoise wire if present. A four to six inch wide polyethylene film detectable tape, with a metalized foil core, shall be installed above all direct buried cable or counterpoise. The tape shall be of the color and have a continuous legend as indicated on the Plans. The tape shall be installed 8 inch minimum below finished grade.

108.3.3.3 Restoration

(1) Following restoration of all trenching near airport movement surfaces, the Contractor shall visually inspect the area for foreign object debris (FOD) and remove all that is found. Where soil and sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by work shall be restored to its original condition. The restoration shall include the topsoiling, fertilizing, seeding, and mulching in accordance with the Specifications and shown on the Plans. Contractor is responsible for maintaining all disturbed surfaces and replacements until final acceptance. When trenching is through paved areas, restoration shall be equal to existing conditions and compaction shall meet the requirements of P152. Restoration shall be considered incidental to the Pay Item of which it is a component part.

108.3.4 Plowing

(1) Plowing equipment shall be of the vibratory type. The plow blade shall be of sufficient length to facilitate installation of the cable conductors or non-metallic conduit at the specified depth. Size the shoe throat for the cable size and the number of cable conductors or non-metallic conduit specified. Cable ways and guides shall be smooth, free of obstructions and sharp edges, and shall not cause bending of the cable conductors or non-metallic conduit at shorter than six times their radius. It also shall not cause excessive cable strain which may damage cable insulation or stretch the conductor. Maintain adequate cable on the reel to avoid splices.

(2) For ground rods, dig a hole along the cable route at each ground rod location. The diameter of this hole shall be as necessary and the depth shall be ten inches deeper than the cable. There shall be adequate length of cable at each ground rod to perform the connection process and accommodate movement caused by frost heaving.

(3) At the light hole and duct hole, stop the plow (movement and vibration), raise it and hand pull the required amount of slack. Take care during this operation that the cable at the entrance into the light hole is not pulled from the specified depth.

(4) The cable may be unreeled along the proposed cable route before plowing or the cable reels may be mounted on the tractor. In the latter case, unreeling of the cable shall not cause excessive tension in the cable.

(5) After the tractor and the plow are positioned at the beginning of the run, sufficient cable conductor or non-metallic conduit slack shall be pulled through the throats. Then lower the plow into the hole and hand hold the cable for the start of plowing. Do not back the plow onto the cable or conductors.

(6) When underground obstructions are encountered, lift the plow out of the ground. After the obstruction has been removed, dig an opening around the cable down to the depth of the cable and large enough to lower the plow. Then lower the plow into the opening. While this is being done, pull the cable back into the throat by hand to prevent kinks or sharp bends. Do not bend cable sharper than six times the radius of the cable, conductor, or non-metallic conduit.

(7) After installation by plowing, level the disturbed earth at the surface and if necessary, compact it to the density of the adjacent undisturbed earth. Mark the location of each underground cable splice in a handhole by a marker placed above the handhole. Impress the word “splice” on each slab.

108.3.5 Cable Markers for Direct-Buried Cable

(1) The location of buried circuits shall be marked by a concrete slab marker, two feet square and four to six inches thick, extending approximately one inch above the surface. Each cable run from a line of lights and signs to the equipment vault shall be marked at approximately every 200 feet along the cable run, with an additional marker at each change of direction of cable run. All other direct-buried cable or flexible non-metallic conduit shall be marked in the same manner. Cable markers shall be installed directly above the cable. Contractor shall impress the word “CABLE” and directional arrows on each cable marking slab. The letters shall be approximately four inches high and three inches wide, with width of stroke 1/2 inch and 1/4 inch deep Stencils shall be used for cable marker lettering; no hand lettering shall be permitted.

(2) At the location of each underground cable connection, except at lighting units, or isolation transformers, a concrete marker slab must mark adapters placed above the connection. The Contractor shall impress

the word “SPLICE” on each slab. Contractor also shall impress additional circuit identification symbols on each slab as directed by the Engineer. All cable markers and splice markers shall be painted international orange. Paint shall be specifically manufactured for uncured exterior concrete. After placement, all cable or splice markers shall be given one coat of high-visibility aviation orange paint. Furnishing and installation of cable markers is incidental to the respective cable pay item.

108.3.6 Splicing

(1) Connections of the type shown on the Plans shall be made by experienced personnel regularly engaged in this type of work and shall be made as follows.

108.3.6.1 Cast Splices

(1) These shall be made by using crimp connectors for jointing conductors. Molds shall be assembled, and the compound shall be mixed and poured in accordance with the manufacturer’s instructions and to the satisfaction of the Engineer.

108.3.6.2 Field-Attached Plug-In Splices

(1) These shall be assembled in accordance with the manufacturer’s instructions. These splices shall be made by plugging directly into mating connectors. The joint where the connectors come together shall be finished by one of the following methods: (1) wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches on each side of the joint (2) Covered with heat shrinkable tubing with integral sealant extending at least 1-1/2 inches on each side of the joint or (3) On connector kits equipped with water seal flap; roll-over water seal flap to sealing position on mating connector.

108.3.6.3 Factory-Molded Plug-In Splices

(1) These shall be made by plugging directly into mating connectors. The joint where the connectors come together shall be finished by one of the following methods: (1) Wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches on each side of the joint. (2) Covered with heat shrinkable tubing with integral sealant extending at least 1-1/2 inches (38 mm) on each side of the joint. or (3) On connector kits so equipped with water seal flap; roll-over water seal flap to sealing position on mating connector.

108.3.6.4 Taped or Heat-Shrink Splices

(1) A taped splice shall be made in the following manner:

a. Bring the cables to their final position and cut so that the conductors will butt. Remove insulation and jacket allowing for bare conductor of proper length to fit compression sleeve connector with 1/4 inch of bare conductor on each side of the connector. Prior to splicing, the two ends of the cable insulation shall be penciled using a tool designed specifically for this purpose and for cable size and type. Do not use emery paper on splicing operation since it contains metallic particles. The copper conductors shall be thoroughly cleaned. Join the conductors by inserting them equidistant into the compression connection sleeve. Crimp conductors firmly in place with crimping tool that requires a complete crimp before tool can be removed. Test the crimped connection by pulling on the cable. Scrape the insulation to assure that the entire surface over which the tape will be applied (plus 3 inches on each end) is clean. After scraping wipe the entire area with a clean lint-free cloth. Do not use solvents.

b. Apply high-voltage rubber tape one-half lapped over bare conductor. This tape should be tensioned as recommended by the manufacturer. Voids in the connector area may be eliminated by highly elongating the tape, stretching it just short of its breaking point. Throughout the rest of the splice less tension should be used. Always attempt to exactly half-lap to produce a uniform buildup. Continue buildup to 1-1/2 times cable diameter over the body of the splice with ends tapered a distance of approximately one inch over the original jacket. Cover rubber tape with two layers of vinyl pressure-sensitive tape one-half lapped. Do not use glyptol or lacquer over vinyl tape as they react as solvents to the tape. No further cable covering or splice boxes are required.

c. Heat shrinkable tubing shall be installed following manufacturer’s instructions. Direct flame heating shall not be permitted unless recommended by the manufacturer. Cable surfaces within the limits of the heat-shrink application shall be clean and free of contaminates prior to application.

108.3.6.5 Assembly

(1) Surfaces of equipment or conductors being terminated or connected shall be prepared in accordance with industry standard practice and manufacturer’s recommendations. All surfaces to be connected shall be thoroughly cleaned to remove all dirt, grease, oxides, nonconductive films, or other foreign material. Paints and other nonconductive coatings shall be removed to expose base metal. Clean all surfaces at least 1/4 inch beyond all sides of the larger bonded area on all mating surfaces. Use a joint compound suitable for the materials used in the connection. Repair painted/coated surface to original condition after completing the connection.

108.3.7 Bare Counterpoise Wire Installation for Lightning Protection and Grounding

(1) If shown on the plans or included in the job specifications, bare solid #6 AWG copper counterpoise wire shall be installed for lightning protection of the underground cables.

108.3.7.1 Equipotential

(1) Equipotential lighting protection shall be used as an alternative to isolation lightning protection when shown on the Plans and required in the Special Provisions.

108.3.7.2 Isolation.

(1) Counterpoise size is as shown on the Plans. The isolation method is used with edge lights installed in turf and stabilized soils and raceways installed parallel to and adjacent to the edge of the pavement. NFPA 780 uses 15 feet to define “adjacent to”.

(2) Counterpoise conductor shall be installed as shown on the Plans, or if not shown, halfway between the pavement edge and the light base, mounting stake, raceway, or cable being protected.

(3) Counterpoise conductor shall be installed 8 inches minimum below grade. The counterpoise is not connected to the light base or mounting stake. An additional grounding electrode is required at each light base or mounting stake. The grounding electrode is bonded to the light base or mounting stake with a 6 AWG solid copper conductor.

(4) See AC 150/5340-30, Design and Installation Details for Airport Visual Aids and NFPA 780, Standard for the Installation of Lightning Protection Systems, Chapter 11, for a detailed description of the Isolation Method of lightning protection.

108.3.7.3 Common Installation Requirements

(1) When a metallic light base is used, the grounding electrode shall be bonded to the metallic light base or mounting stake with a No. 6 AWG bare, annealed or soft drawn, solid copper conductor.

(2) When a nonmetallic light base is used, the grounding electrode shall be bonded to the metallic light fixture or metallic base plate with a No. 6 AWG bare, annealed or soft drawn, solid copper conductor.

(3) Grounding electrodes may be rods, ground dissipation plates, radials, or other electrodes listed in the NFPA 70 (NEC) or NFPA 780, and shall be as shown on Plans.

(4) Where raceway is installed by the directional bore, jack and bore, or other drilling method, the counterpoise conductor shall be permitted to be installed concurrently with the directional bore, jack and bore, or other drilling method raceway, external to the raceway or sleeve.

(5) The counterpoise wire shall also be exothermically welded to ground rods installed as shown on the plans but not more than 500 feet (150 m) apart around the entire circuit. The counterpoise system shall be continuous and terminate at the transformer vault or at the power source. It shall be securely attached to the vault or equipment external ground ring or other made electrode-grounding system. The connections shall be made as shown on the plans and in the specifications.

(6) Where an existing airfield lighting system is being extended or modified, the new counterpoise conductors shall be interconnected to existing counterpoise conductors at each intersection of the new and existing airfield lighting counterpoise systems.

108.3.7.4 Parallel Voltage Systems.

(1) Provide grounding and bonding in accordance with NFPA 70, National Electrical Code.

108.3.8 Counterpoise Installation above Multiple Conduits and Duct Banks

(1) Counterpoise wires shall be installed above multiple conduits/duct banks for airfield lighting cables, with the intent being to provide a complete area of protection over the airfield lighting cables. When multiple conduits and/or duct banks for airfield cable are installed in the same trench, the number and location of counterpoise wires above the conduits shall be adequate to provide a complete cone of protection measured 22-1/2 degrees each side of vertical.

(2) Where duct banks pass under pavement to be constructed in the project, the counterpoise shall be placed above the duct bank. Refer to details on the construction plans.

108.3.9 Counterpoise Installation at Existing Duct Banks

(1) When airfield lighting cables are indicated on the Plans to be routed through existing duct banks, the new counterpoise wiring shall be terminated at ground rods at each end of the existing duct bank where the cables being protected enter and exit the duct bank. The new counterpoise conductor shall be bonded to the existing counterpoise system.

108.3.10 Exothermic Bonding

(1) Bonding of counterpoise wire shall be by the exothermic welding process. Only personnel experienced in and regularly engaged in this type of work shall make these connections.

(2) Contractor shall demonstrate to the satisfaction of the Engineer, the welding kits, materials and procedures to be used for welded connections prior to any installations in the field. The installations shall comply with the manufacturer's recommendations and the following:

a. All slag shall be removed from welds.

b. Using an exothermic weld to bond the counterpoise to a lug on a galvanized light base is not recommended unless the base has been specially modified. Consult the manufacturer's installation directions for proper methods of bonding copper wire to the light base. See also AC 150/5340-30 for galvanized light base exception.

c. If called for in the Plans, all buried copper and weld material at weld connections shall be thoroughly coated with 6 mm of 3M™ Scotchkote™, or approved equivalent, or coated with coal tar Bitumastic® material to prevent surface exposure to corrosive soil or moisture.

108.3.11 Test, Locate and Protect Existing Circuits

(1) Work includes the testing and location of all power and control circuits that are located within the construction area or haul routes; providing temporary connection/cable runs to enable operation as required by construction staging of airport lighting systems during darkness, weekends, holidays and instrument conditions; prompt repair or replacement of electrical cables or equipment damaged during construction operations; careful handling of FAA installed cables or equipment encountered during construction; and removal/reinstallation of existing cables. Protect new circuits installed under this Contract.

(2) Immediately prior to construction, obtain insulation resistance to ground (megger) test readings of all airport circuits that will be encountered during construction, including those crossed by haul routes or access roads. Take tests in the presence of the Sponsor and the Engineer. If the Contractor notes problems in the existing circuits prior to starting Work, these circuits may be repaired by the Sponsor or noted to the mutual satisfaction of the Contractor and the Sponsor as not being the responsibility of the Contractor. Test circuits repaired by the Sponsor once again prior to construction.

(3) Upon completion of construction, in the presence of the Sponsor and the Engineer, perform insulation resistance testing of all airport circuits encountered during construction. Repair all portions of circuits that have been damaged during construction.

(4) Excavation, cutting, pulling-out and reinstallation of existing cables as required in the Contract Documents shall be incidental to this Pay Item. Provide temporary above-ground connections in protective conduit, as shown on Contract Documents or as conditions and environment warrant. All temporary connections shall use L-823 cable connectors, taped and waterproofed as shown on the Contract Documents. Contractor's superintendent or on-site representative must remain in communication with the Engineer until such repairs are completed and the lighting system has been checked for operation and accepted by the Sponsor.

108.3.12 Final Acceptance and Testing

(1) Contractor shall furnish all necessary equipment and appliances for testing the airport electrical systems and underground cable circuits before and after installation in accordance with this Specification and 100.2.13. Contractor shall perform all tests in the presence of the Engineer. Contractor shall demonstrate the electrical characteristics to the satisfaction of the Engineer. All costs for testing are incidental to the respective item being tested. For phased projects, the tests must be completed by phase. Contractor must maintain the test results throughout the entire project as well as during the warranty period that meet the following:

a. Earth resistance testing methods shall be submitted to the Engineer for approval. Earth resistance testing results shall be recorded on an approved form and testing shall be performed in the presence of the Engineer. All such testing shall be at the sole expense of the Contractor.

b. Should the counterpoise or ground grid conductors be damaged or suspected of being damaged by construction activities the Contractor shall test the conductors for continuity with a low resistance ohmmeter. The conductors shall be isolated such that no parallel path exists and tested for continuity. The Engineer shall approve of the test method selected. All such testing shall be at the sole expense of the Contractor.

(2) After installation, the Contractor shall test and demonstrate to the satisfaction of the Engineer the following:

a. Affected lighting power and control circuits (existing and new) are continuous and free from short circuits.

b. Affected circuits (existing and new) are free from unspecified grounds.

c. That the insulation resistance to ground of all new non-grounded high voltage series circuits or cable segments is not less than 500 megohms. Verify continuity of all series airfield lighting circuits prior to energization.

d. Insulation resistance to ground of all new non-grounded conductors of new multiple circuits or circuit segments is not less than 100 megohms and meets the requirements of 100.3.3.8.

e. Affected circuits (existing and new) are properly connected in accordance with applicable wiring diagrams.

f. Affected circuits (existing and new) are operable. Tests shall be conducted that include operating each control not less than ten times and the continuous operation of each lighting and power circuit for not less than 1/2 hour.

g. Impedance to ground of each ground rod does not exceed 25 ohms prior to establishing connections to other ground electrodes. The fall-of-potential ground impedance test shall be used, as described by American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81, to verify this requirement. As an alternate, clamp-on style ground impedance test meters may be used to satisfy the impedance testing requirement. Test equipment and its calibration sheets shall be submitted for review and approval by the Engineer prior to performing the testing.

(3) Two copies of tabulated results of all cable tests performed shall be supplied by the Contractor to the Engineer. Where connecting new cable to existing cable, ground resistance tests shall be performed on the new cable prior to connection to the existing circuit.

(4) There are no approved “repair” procedures for components that have failed testing. Replace components that fail tests, at Contractor’s expense.

108.4 Measurement

108.4.1 Locate and Protect Existing Circuits

(1) Locate and Protect Existing Circuits will be measured for payment as a complete unit per lump sum.

108.4.2 Plow

(1) Plow will be measured for payment on a unit price basis per linear foot. Measurement will be made in straight horizontal lines between lights, signs, and angle points shown on the Plans.

108.4.3 Trench

(1) Trench of the various sizes indicated will be measured for payment on a unit price basis per linear foot. Measurement will be made in straight horizontal lines along the centerline of trench constructed and accepted for payment. Trench will only be measured for payment when Trenches of the various sizes required are designated on the Drawings and corresponding Pay Items are included in the Schedule of Prices; otherwise, all cable trenches and length of plowing will be measured as Trench or Plow. If the Pay Item for Trench or Plow and the Pay Item for various sizes of trench are included in the Contract Documents, only portions of trench specifically designated on the Plan to be measured for payment as Trench will be measured as such; otherwise, trench will be included in the measurement for Trench or Plow.

108.4.4 Trench or Plow

(1) Trench or Plow will be measured for payment on a unit price basis per linear foot. Measurement will be made along the centerline of the various sizes of trench and lengths of plowed cables or non-metallic flexible conduit. Measurement will be made in straight horizontal lines between lights, signs, and angle points shown on the Plans. Trench of various sizes will not be measured separately for payment when this Pay Item is included in the Schedule of Prices. The depth of trench and plowing will be incidental.

108.4.5 Counterpoise Trench or Plow

(1) Counterpoise Trench or Plow will be measured for payment on a unit price basis per linear foot. Measurement will be made along the centerline of the trench and lengths of plowed counterpoise. Measurement will be made in straight horizontal lines between angle points shown on the Plans. The depth of trench and plowing will be incidental.

108.4.6 Cable

(1) Cable of the various sizes and types indicated will be measured on a unit price basis per linear foot of cable, furnished, installed and accepted. Measurement for payment will be determined based upon the straight line measurement of the associated duct, trench, or plow lengths, multiplied by the numbers of cables installed in each length. The three feet of cable length required for each isolation transformers, handhole, manhole, and pull box will be added to the length measured for payment.

108.4.7 Flexible Polyethylene Duct

(1) Flexible Polyethylene Duct will be measured on a unit price basis per linear foot of duct, furnished, installed and accepted. Measurement for payment will be determined based upon the straight line measurement along the centerline of the duct installed.

108.4.8 Counterpoise.

(1) Counterpoise of the various sizes indicated will be measured on a unit price basis per linear foot of counterpoise, furnished, installed and accepted. Measurement for payment will be determined based upon the straight line measurement of the associated trench or plow lengths.

108.4.9 Counterpoise Ground Rods.

(1) Counterpoise Ground Rods will be measured for payment on a unit price basis for each.

108.4.10 Cable and Splice Markers.

(1) Cable and Splice Markers will be measured for payment on a unit price basis per each. Splice markers will be measured as Cable Markers.

108.4.11 Turf Restoration.

(1) Turf Restoration will be measured for payment on a unit price basis per linear foot or per lump sum. Measurement per lineal foot will be made in a straight horizontal line, between angle points along trenches or plowed cable, outside of the grading limits shown on the Plans.

108.5 Payment

108.5.1 Locate and Protect Existing Circuits

(1) Payment will be made at the Contract Lump Sum price for Locate and Protect Existing Circuits and will be full compensation for furnishing all materials for locating, protecting, and testing existing circuits and for all labor, equipment, tools, and incidentals necessary to complete this Pay Item as required in the Contract Documents.

108.5.2 Plow

(1) Payment will be made at the Contract unit price per linear foot for Plow. This Pay Item will include plowing operations for the installation of the various sizes and types of cable, and flexible polyethylene duct required in the Contract Documents. Amounts paid for this Pay Item will be full compensation for furnishing all materials required for a complete installation and not specifically paid for under other Pay Items, repair of cable damaged by construction operations, preparation for the installation of these materials, and the plowing operation; including all labor, equipment, tools, and incidentals necessary to compete the Work.

108.5.3 Trench

(1) Payment will be made at the Contract unit price per linear foot for the various sizes of Trench. These Pay Items will include construction of trenches for the installation of the various sizes and types of conductor cable, and flexible polyethylene non-metallic duct required in the Contract Documents. Amounts paid for these Pay Items will be full compensation for furnishing all materials required for a complete installation and not specifically paid for under other Pay Items, repair of cable damaged by construction operations, preparation for the installation of these trench construction and backfill and plowing operations, including all labor, equipment, tools, and incidentals necessary to complete the Work.

108.5.4 Trench or Plow

(1) Payment will be made at the Contract unit price per linear foot for Trench or Plow. This Pay Item will include construction of the various sizes of trench or plowing operations required for the installation of the various sizes and types of cable and flexible polyethylene duct shown in the Contract Documents. Amounts paid will be full compensation for furnishing all materials required for a complete installation, including repair of cable damaged by construction operations. The amount paid shall also include site preparation, installation by trench construction or plowing, backfilling and testing; including all labor, equipment, tools, and incidentals necessary to complete the Work.

108.5.5 Counterpoise Trench or Plow

(1) Payment will be made at the Contract unit price per linear foot for Counterpoise Trench or Plow. This Pay Item will include construction of the trench or plowing operations for the installation of the various sizes of counterpoise required in the Contract Documents. Amounts paid will be full compensation for furnishing all materials required for a complete installation and not specifically paid for under other Pay Items, repair of cable damaged by construction operations, preparation for the installation of materials,

and trench construction and backfill and plowing operations; including all labor, equipment, tools, and incidentals necessary to complete the Work.

108.5.6 Cable

(1) Payment will be made at the Contract unit price per linear foot for the various sizes and types of cable and connections furnished and installed in duct, trench, or plow in accordance with the Contract Documents. These prices will be full compensation for furnishing all materials and for delivery, preparation, and installation of these materials, including all labor, equipment, tools, testing, and incidentals necessary to complete the Work;, except the cost of flexible polyethylene duct (on projects where flexible polyethylene duct is required), and trenching, plowing, or trench and plow, which will be included in separate Pay Items.

108.5.7 Flexible Polyethylene Duct

(1) Payment will be made at the Contract unit price per linear foot for Flexible Polyethylene Duct furnished and installed in accordance with the Contract Documents. These prices will be full compensation for furnishing all materials and for delivery, preparation, and installation of these materials, including all labor, equipment, tools, testing, and incidentals necessary to complete the Work, except the cost of trenching, plowing, or trench and plow, which will be included in separate Pay Items.

108.5.8 Counterpoise

(1) Payment will be made at the Contract unit price per linear foot for the various sizes of counterpoise furnished and installed in accordance with the Contract Documents. These prices will be full compensation for furnishing all materials and for delivery, preparation, and installation of materials, including all labor, equipment, tools, testing, and incidentals necessary to complete the Work, except the cost of trenching, plowing, or trench and plow, which will be included in a separate Pay Item.

108.5.9 Counterpoise Ground Rods

(1) Payments will be made at the Contract unit price per each for Counterpoise Ground Rods constructed and accepted. This price will be full compensation for furnishing materials and for preparation and installation, including labor, equipment, tools, testing, and incidentals necessary to complete the Work.

108.5.10 Cable and Splice Markers

(1) Payment will be made at the Contract unit price per each for Cable Markers constructed and accepted. This price will be full compensation for furnishing materials and for preparation and installation, including labor, equipment, tools, and incidentals necessary to complete the Work. Splice markers will be paid as cable markers.

108.5.11 Surface Restoration for Trench or Plow

108.5.11.1 Turf Restoration for Trench or Plow

(1) Payment for restoration of turf and other surface features disturbed by trenching, plowing, cable laying, storage of materials, and other Contractor operations required for installation of cable, conductors, duct, and appurtenant Work, shall be as follows:

a. When the Contract contains grading for Airport Improvements and includes Pay Items for Topsoil or Salvaged Topsoil, Seeding, Fertilizing, and Mulching; turfing shall be completed, measured, and paid as required in Specifications for Work within the grading limits shown on the Plans. The Items for Topsoiling or Salvaged Topsoil, Seeding, Fertilizing, and Mulching will only be measured and paid once for work areas within the grading limits. Coordination of the construction operations for the various parts of the Work to maintain the schedule and to coordinate completion of grading, paving and electrical Work in accordance with the Contract Documents shall be incidental to the other items of the Contract and no separate or additional compensation will be made.

b. When cable or duct are installed by trenching or plowing outside grading limits, turf restoration shall be completed by removing and replacing existing sod or by restoring the turf with topsoil or salvaged topsoil, fertilizer, seeding and mulching in accordance with Specifications T901, T902, T905, and T908. Measurement will be made per linear foot or per lump sum, this price will include furnishing all materials for grading, topsoiling, seeding, mulching, maintenance and replacement of areas that did not "catch", and for preparation and installation including all labor, equipment, tools, and incidentals necessary to complete the Work.

c. When there are no Pay Items for turf restoration contained in the Schedule of Prices, turf restoration will be incidental and the cost included in Pay Items for Trench, or Trench or Plow.

108.5.11.2 Pavement Restoration for Trench

(1) Payment for restoration of pavement and other surface features disturbed by trenching, plowing, cable laying, storage of materials, and other Contractor operations required for installation of cable, conductors, duct, and appurtenant Work, shall be as follows:

a. When cable or duct are installed outside grading limits for new Airport facilities shown on the Plans and are beneath existing pavement which will remain in-place, then pavement restoration shall be completed in accordance with details shown on the Plans. Measurement will be made per linear **foot** or per lump sum, this price will include furnishing all preparation, saw cutting, removal, disposal of materials, base course, compaction, pavement materials and paving, re-marking, clean-up; including all labor, equipment, tools, and incidentals necessary to complete the Work.

b. When there are no Pay Items for pavement restoration contained in the Schedule of Prices, pavement restoration will be incidental and the cost included in Pay Items for Trench, or Trench or Plow.

108.5.12 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
L108.101	Locate and Protect Existing Circuits	Lump Sum (LS)
L108.110	Plow	Linear Foot (LF)
L108.206	Trench 6-Inch	Linear Foot (LF)
L108.209	Trench 9-Inch	Linear Foot (LF)
L108.212	Trench 12-Inch	Linear Foot (LF)
L108.218	Trench 18-Inch	Linear Foot (LF)
L108.221	Trench 21-Inch	Linear Foot (LF)
L108.224	Trench 24-Inch	Linear Foot (LF)
L108.301	Flexible Polyethylene Duct 1-Inch	Linear Foot (LF)
L108.302	Flexible Polyethylene Duct 1 ¼-Inch	Linear Foot (LF)
L108.303	Flexible Polyethylene Duct 1 ½-Inch	Linear Foot (LF)
L108.310	Trench or Plow	Linear Foot (LF)
L108.320	Counterpoise Plow	Linear Foot (LF)
L108.506	5000 Volt Cable No. 6	Linear Foot (LF)
L108.508	5000 Volt Cable No. 8	Linear Foot (LF)
L108.604	600 Volt Cable No. 4	Linear Foot (LF)
L108.606	600 Volt Cable No. 6	Linear Foot (LF)
L108.608	600 Volt Cable No. 8	Linear Foot (LF)
L108.610	600 Volt Cable No. 10	Linear Foot (LF)
L108.706	Bare Counterpoise Wire No. 6	Linear Foot (LF)
L108.708	Bare Counterpoise Wire No. 8	Linear Foot (LF)
L108.810	Counterpoise Ground Rod	Linear Foot (LF)
L108.820	Cable Markers	Each (EA)
L108.830	Turf Restoration for Trench or Plow	Lump Sum (LS)
L108.831	Turf Restoration for Trench or Plow	Linear Foot (LF)
L108.840	Pavement Restoration for Trench	Lump Sum (LS)
L108.841	Pavement Restoration for Trench	Linear Foot (LF)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5340-26	Maintenance of Airport Visual Aid Facilities
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-7	Specification for L.824 Underground Electrical Cable for Airport Lighting Circuits

AC 150/5345-26	Specification for L.823 Plug and Receptacle, Cable Connectors
AC 150/5345-53	Airport Lighting Equipment Certification Program

Commercial Item Description

A-A-59544A	Cable and Wire, Electrical (Power, Fixed Installation)
A-A-55809	Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic

American Society for Testing Materials International (ASTM)

ASTM B3	Standard Specification for Soft or Annealed Copper Wire
ASTM B8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
ASTM D4388	Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes

Military Specification (MIL)

MIL-PRF-23586F	Performance Specification: Sealing Compound (with Accelerator), Silicone Rubber, Electrical
MIL-I-24391	Insulation Tape, Electrical, Plastic, Pressure Sensitive

National Fire Protection Association (NFPA)

NFPA-70	National Electrical Code (NEC)
NFPA-780	Standard for the Installation of Lightning Protection Systems

American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

ANSI/IEEE STD 81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

NEMA Standards Publication (NEMA)

NEMA TC 7	Smooth-Wall Coilable Electrical Polyethylene Conduit

END OF SPECIFICATION L108

Specification L109 - Airport Equipment Enclosure and Equipment

109.1 Description

109.1.1 General

(1) This Work shall consist of constructing an airport transformer vault or a prefabricated metal housing in accordance with these specifications and in accordance with the design and dimensions shown in the Plans. This work shall also include the installation of conduits in the floor and foundation, painting and lighting of the vault or metal housing, and the furnishing of all incidentals that are necessary to produce a completed unit. Included as a separate part under this item or as a separate item where an existing vault is to be used shall be the furnishing of all vault equipment, wiring, electrical buses, cable, conduit, potheads, and grounding systems. This work shall also include the painting of equipment and conduit; the marking and labeling of equipment and the labeling or tagging of wires; the testing of the installation; and the furnishing of all incidentals necessary to place it in operating condition as a completed unit to the satisfaction of the Engineer.

109.2 Equipment and Materials

109.2.1 General.

(1) Airport lighting equipment and materials covered by advisory circulars (AC) shall be certified and listed in AC 150/5345.53, Airport Lighting Equipment Certification Program (ALECP) and listed in the ALECP Addendum.

(2) All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specifications.

(3) Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials in accordance with these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the Engineer) and replaced with materials that comply with these specifications at the Contractor's cost.

(4) All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals shall be in accordance with 100.2.10.

(5) Provide warranty in accordance with 100.2.18.

109.3 Construction of Vault and Prefabricated Metal Housing

109.3.1 Electrical vault building

(1) The electrical vault building must comply with NEC Article 110.31, Enclosure for Electrical Installations, Item (A) Electrical Vaults. Construct the building of materials having adequate structural strength for the conditions and installed location, has a minimum fire rating of two or three hours as determined by the authority having jurisdiction (AHJ), and is bullet resistant to minimum UL 752 Level 4.

109.3.2 Concrete

(1) The concrete for the vault shall be proportioned, placed, and cured in accordance with Item P610, Structural Portland Cement Concrete or SHS 501 Concrete, using 3/4 inch maximum size coarse aggregate.

109.3.3 Precast Concrete Structures

(1) Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another RPR approved third party certification program. Precast concrete structures shall conform to ASTM C478.

109.3.4 Reinforcing Steel

(1) Reinforcing steel bars shall be intermediate or structural grade deformed-type bars and shall be in accordance with ASTM A615.

109.3.5 Brick

(1) Brick shall be in accordance with ASTM C62, Grade SW.

109.3.6 Rigid Steel Conduit

(1) Rigid steel conduit and fittings shall be in accordance with Underwriters Laboratories Standards 6 and 514B.

109.3.7 Plastic Conduit and Fittings

(1) Plastic Conduit and fittings shall conform to the requirements of Federal Specification W-C-1094 and UL-651 and UL-654 schedule 40 polyvinyl chloride (PVC) suitable for use above or below ground.

109.3.8 Lighting

(1) Vault or metal-housing light fixtures shall be of a vapor-proof type.

109.3.9 Receptacles

(1) Convenience receptacles shall be heavy-duty duplex units designed for industrial service.

109.3.10 Switches

(1) Vault or metal-housing light switches shall be single-pole switches.

109.3.11 Paint

(1) Priming paint for non-galvanized metal surfaces shall be a high solids alkyd primer comparable with the manufacturer's recommendations for the intermediate or topcoat.

(2) White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to the Master Painter's Institute (MPI), Reference #9, Exterior Alkyd, Gloss.

(3) Priming paint for wood surfaces shall be mixed on the job by thinning the specified white paint by adding 1/2 pint (0.24 liter) of raw linseed oil to each gallon.

(4) Paint for the floor, ceiling, and inside walls shall be in accordance with Porter Paint Company 69, 71, and 79 or equivalent. Walls and ceiling shall be light gray and the floor shall be medium gray.

(5) The roof coating shall be hot asphalt material in accordance with ASTM D2823. Asbestos-free roof coating in accordance with ASTM D4479 may be substituted if required by local codes.

109.3.12 Ground Bus

(1) Ground bus shall be 1/8 × 3/4 inch minimum copper bus bar.

109.3.13 Square Duct

(1) Duct shall be square similar to that manufactured by the Square D Company (or equivalent), or the Trumbull Electric Manufacturing Company (or equivalent). The entire front of the duct on each section shall consist of hinged or removable cover for ready access to the interior. The cross-section of the duct shall be not less than 4 × 4 inch except where otherwise shown in the Plans.

109.3.14 Ground Rods

(1) Ground rods shall be in accordance with L108.

109.3.15 Vault Prefabricated Metal Housing

(1) The prefabricated metal housing shall be a commercially available unit.

109.3.16 FAA-Approved Equipment

(1) Certain items of airport lighting equipment installed in vaults are covered by individual ACs listed:

AC 150/5345-3	Specification for L-821, Panels for Remote Control of Airport Lighting
AC 150/5345-5	Circuit Selector Switch
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-10	Specification for Constant Current Regulators and Regulator Monitors
AC 150/5345-13	Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits.
AC 150/5345-49	Specification for L-854, Radio Control Equipment
AC 150/5345-56	Specification for L-890 Airport Lighting Control and Monitoring System (ALCMS)

109.3.17 Other Electrical Equipment

(1) Distribution transformers, oil switches, cutouts, relays, terminal blocks, transfer relays, circuit breakers, and all other regularly used commercial items of electrical equipment not covered by FAA equipment specifications and ACs shall conform to the applicable rulings and standards of the Institute of Electrical and Electronic Engineers (IEEE) or the National Electrical Manufacturers Association (NEMA). When specified, test reports from a testing laboratory indicating that the equipment meets the specifications shall be supplied. In all cases, equipment shall be new and a first-grade product. This equipment shall be supplied in the quantities required for the specific project and shall incorporate the electrical and mechanical characteristics specified in the proposal and Plans. Equipment selected and installed by the

Contractor shall maintain the interrupting current rating of the existing systems or specified rating whichever is greater.

109.3.18 Wire

(1) Wire (in conduit) rated up to 5,000 volts shall be in accordance with AC 150/5345-7, Specification for L-824 Underground Electrical Cables for Airport Lighting Circuits. For ratings up to 600 volts, moisture and heat resistant thermoplastic wire conforming to Commercial Item Description A-A-59544A Type THWN.2 shall be used. The wires shall be of the type, size, number of conductors, and voltage shown in the Plans.

109.3.18.1 Control Circuits

(1) Unless otherwise indicated on the Plans, wire shall be not less than No. 12 American wire gauge (AWG) and shall be insulated for 600 volts. If telephone control cable is specified, No. 19 AWG telephone cable in accordance with ANSI/Insulated Cable Engineers Association (ICEA) S.85.625.2007 specifications shall be used.

109.3.18.2 Power Circuits

a. 600 volts maximum-Wire shall be No. 6 AWG or larger and insulated for at least 600 volts.
b. 3,000 volts maximum-Wire shall be No. 6 AWG or larger and insulated for at least 3,000 volts.
c. Over 3,000 volts-Wire shall be No. 6 AWG or larger and insulated for at least the circuit voltage.

109.3.19 Short Circuit/Coordination/Device Evaluation/Arc Flash Analysis

(1) The Contractor shall, based upon the equipment provided, include as a part of the submittal process the electrical system “Short Circuit/Coordination/Device evaluation/Arc Flash Analysis”. The analysis shall be performed by the equipment manufacturer and submitted in a written report. The analysis shall be signed and sealed by a registered professional Engineer from the state in which the project is located. The analysis shall comply with NFPA-70E and IEEE 1584.

(2) The analysis will include: one line diagrams, short circuit analysis, coordination analysis, equipment evaluation, arc flash analysis and arc flash labels containing at a minimum, equipment name, voltage/current rating, available incident energy and flash protection boundary.

(3) The selected firms field service Engineer shall perform data gathering for analysis completion and device settings, perform device setting as recommended by the analysis and will furnish and install the arc flash labels. The components worst case incident energy will be considered the available arc flash energy at that specific point in the system. Submit three written copies and one electronic copy of the report.

109.4 Construction

109.4.1 Construction of Equipment Enclosure and Prefabricated Metal Housing

(1) Contractor shall construct the transformer vault or prefabricated metal housing at the location indicated in the Plans. Vault construction (if shown on Plans) shall be reinforced concrete, concrete masonry, or brick wall as specified. Metal housing construction (if shown on Plans) shall be prefabricated equipment enclosure to be supplied in the size specified. The mounting pad or floor details, installation methods, and equipment placement are shown in the Plans. Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another engineer approved third party certification program.

109.4.1.1 General

(1) Unless otherwise specified, Contractor shall clear, grade, and seed the area around the vault or metal housing for a minimum distance of ten feet on all sides. The slope shall be not less than 1/2 inch per foot away from the vault or metal housing in all directions.

(2) The vault shall provide adequate protection against weather elements, including rain, wind-driven dust, snow, ice and excessive heat. The vault shall have sufficient filtered ventilation, to assure that the interior room temperatures and conditions do not exceed the recommended limits of the electrical equipment to be installed in the vault. The Contractor is responsible for contacting the manufacturer of the equipment to be installed to obtain environmental limitations of the equipment to be installed. Refer to the electrical vault detail plan sheets for construction requirements. The prefabricated building shall include roof, walls and floor in accordance with the details and these specifications **.**

109.4.1.2 Foundation and Walls

109.4.1.2.1 Reinforced Concrete Construction

(1) Contractor shall construct the foundation and walls in accordance with the details shown in the Plans. Unless otherwise specified, internal ties shall be of the mechanical type so that when the forms are removed the ends of the ties shall be at least one inch beneath the concrete surface; the holes shall be

plugged and finished to prevent discoloration. Reinforcing steel shall be placed, as shown in the drawings, and secured in position to prevent displacement during the concrete placement.

(2) The external surfaces of the concrete shall be thoroughly worked during the placing operation to force all coarse aggregate from the surface. Thoroughly work the mortar against the forms to produce a smooth finish free from air pockets and honeycomb.

(3) The surface film of all pointed surfaces shall be removed before setting occurs. As soon as the pointing has set sufficiently, the entire surface inside and outside of the vault shall be thoroughly wet with water and rubbed with a No. 16 carborundum stone, or equivalent quality abrasive, bringing the surface to a paste. All form marks and projections shall be removed. The surface produced shall be smooth and dense without pits or irregularities. The materials which have been ground into a paste during the rubbing process shall be spread or brushed uniformly over the entire surface (except the interior surfaces that are to be painted shall have all paste removed by washing before painting) and permitted to reset. Final exterior finish shall be obtained by rubbing with No. 30 carborundum stone, or an equivalent quality abrasive. The surface shall be rubbed until the entire surface is smooth and uniform in color.

109.4.1.2.2 Brick and Concrete Construction

(1) When this type of construction is specified, the foundation shall be concrete conforming to the details shown in the Plans. The outer edge of the foundation at the floor level shall be beveled 1-1/2 inches at 45 degrees. Brick walls shall be eight inches thick, laid in running bond with every sixth course a header course. Brick shall be laid in cement mortar (one part masonry cement and three parts sand) with full mortar bed and shoved joints. All joints shall be completely filled with mortar, and facing brick shall be back-parged with mortar as work progresses. All joints shall be 3/8 inch thick, exterior joints tooled concave, and interior joints struck flush. Both interior and exterior brick surfaces shall be cleaned and nail holes, cracks and other defects filled with mortar. When specified, a nonfading mineral pigment mortar coloring shall be added to the mortar. Steel reinforcing bars, 3/8 inch in diameter and 12 inches long, shall be set vertically in the center of the brick wall on not more than two feet centers to project 2-1/2 inches into the concrete roof slab. Lintels for supporting the brickwork over doors, windows, and louvers shall consist of two $4 \times 3 \times 3/8$ inch steel angles. Lintels shall be painted with one coat of corrosion-inhibiting primer before installation, and all exposed parts shall be painted similar to doors and window sash after installation.

(2) Window sills may be concrete poured in place or precast concrete as indicated in the Plans. All exposed surfaces shall have a rubbed finish as specified under reinforced concrete construction. After completion, all interior and exterior faces of walls shall be scrubbed with a solution of muriatic acid and water in the proportions of not less than one part acid to 10 parts of water. All traces of efflorescence, loose mortar, and mortar stain shall be removed, and the walls washed down with clear water.

109.4.1.2.3 Concrete Masonry Construction

(1) When this type of construction is specified, the foundation shall be concrete conforming to the details shown in the Plans. The concrete masonry units shall be standard sizes and shapes and shall conform to ASTM C90 and shall include the closures, jambs, and other shapes required by the construction as shown in the Plans. Standard construction practice shall be followed for this type of work including mortar, joints, reinforcing steel for extensions into roof slab, etc. Plaster for interior walls, if specified, shall be Portland cement plaster.

109.4.1.3 Roof

(1) The roof shall be reinforced concrete as shown in the Plans. Reinforcing steel shall be placed as shown in the drawing and secured in position to prevent displacement during the pouring of the concrete. The concrete shall be poured monolithically and shall be free of honeycombs and voids. The surface shall have a steel-troweled finish and shall be sloped as shown in the drawing. The underside of the roof slab shall be finished in the same manner as specified for walls.

(2) One brush or mop coat of hot asphalt roof coating shall be applied to the top surface of the roof slab. The asphalt material shall be heated to within the range specified by the manufacturer and immediately applied to the roof. The finished coat shall be continuous over the roof surface and free from holidays and blisters. Smears and dribbles of asphalt on the roof edges and building walls shall be removed.

109.4.1.4 Floor

(1) The floor shall be reinforced concrete as shown in the drawings. When present, all sod, roots, refuse, and other perishable material shall be removed from the area under the floor to a depth of eight inches, unless a greater depth is specified in the Plans. This area shall be backfilled with materials consisting of sand, cinders, gravel, or stone. Fill shall be placed in layers (not to exceed four inches)) and shall be

thoroughly compacted by tamping or rolling. A layer of building paper shall be placed over the fill prior to placing concrete. The floor surfaces shall have a steel-troweled finish. The floor shall be level unless a drain is specified, in which case the floor shall be pitched 1/4 inch per foot downward toward the drain. A 1/4-inch asphalt felt expansion joint shall be placed between floor and foundation walls. The floor shall be poured monolithically and shall be free of honeycombs and voids.

109.4.1.5 Floor Drain

(1) If shown in the Plans, a floor drain and dry well shall be installed in the center of the floor of the equipment room. The dry well shall be excavated 4 × 4 feet square and to a depth of four feet below the finished floor elevation and shall be backfilled to the elevation of the underside of the floor with gravel, which shall all pass a two inches mesh sieve and shall all be retained on a 1/4 inch mesh sieve. The gravel backfill shall be placed in six inch maximum layers, and the entire surface of each layer shall be tamped either with a mechanical tamper or with a hand tamper weighing not less than 25 pounds and having a face area of not more than 36 square inches nor less than 16 square inches. The drain inlet shall be set flush in the concrete floor. The drain shall have a clear opening of not less than eight inches in diameter.

109.4.1.6 Conduits in Floor and Foundation

(1) Conduits shall be installed in the floor and through the foundation walls per the details shown in the Plans. All underground conduit shall be painted with a bituminous compound. Conduit shall be installed with a coupling or metal conduit adapter flush with the top of the floor. All incoming conduit shall be closed with a pipe plug to prevent the entrance of foreign material during construction. Space conduit entrances shall be left closed.

109.4.1.7 Doors

(1) Doors shall be metal-clad fireproof Class A (three hour rated) doors conforming to requirements of the National Electrical Code (NEC) and local electrical codes. Panic bar exit hardware shall be installed in accordance with NEC requirements. Refer to the new electrical vault detail plan sheets for construction requirements."

109.4.1.8 Painting

(1) The floor, ceiling, and inside walls of concrete construction shall first be given a hardening treatment, after which the Contractor shall apply two coats of paint as specified below, except that interior face brick walls need not be painted. The hardening treatment shall consist of applying two coats of either a commercial floor hardener or a solution made by dissolving two pounds) of magnesium fluorosilicate or zinc sulfate crystals in one gallon of water. Each coat shall be allowed to dry at least 48 hours before the next application. After the second treating coat has dried, the surfaces shall be brushed clean of all crystals and thoroughly washed with clear water. Paint for walls and ceiling shall be a light gray color approved by the Engineer. The floor paint shall be a medium gray color approved by the Engineer. Before painting, the surfaces shall be dry and clean. The first coat shall be thinned by adding 2/3.quart (0.63 liters) of spar varnish and 1/3.quart of turpentine to each gallon of paint. The second coat shall be applied without thinning. All doors, lintels, and windows shall be cleaned to remove rust or foreign material and shall be given one body and one finish coat of white paint. Bare metal surfaces shall be given a prime coat of corrosion-inhibiting primer prior to the body and finish coats.

109.4.1.9 Lights and Switches

(1) Contractor shall furnish and install a minimum of two duplex convenience outlets in the vault room. Where a control room is specified, at least two duplex outlets shall be installed.

109.4.2 Installation of Equipment in Vault or Prefabricated Metal Housing

109.4.2.1 General

(1) Contractor shall furnish, install, and connect all equipment, equipment accessories, conduit, cables, wires, buses, grounds, and support necessary to ensure a complete and operable electrical distribution center for the airport lighting system as specified herein and shown in the Plans. When specified, an emergency power supply and transfer switch shall be provided and installed.

(2) The equipment installation and mounting shall comply with the requirements of the National Electrical Code and local code agency having jurisdiction. All electrical work shall comply with the NEC and local code agency having jurisdiction including the separation of under 600V work from 5,000V work."

109.4.2.2 Power Supply Equipment

(1) Transformers, regulators, booster transformers, and other power supply equipment items shall be furnished and installed at the location shown in the Plans or as directed by the Engineer. The power supply equipment shall be set on steel "H" sections, "I" beams, channels, or concrete blocks to provide a minimum space of 1-1/2 inch between the equipment and the floor. The equipment shall be placed so

as not to obstruct the oil-sampling plugs of the oil-filled units; and name-plates shall, so far as possible, not be obscured.

(2) If specified in the Plans and Specifications, equipment for an alternate power source or an emergency power generator shall be furnished and installed. The alternate power supply installation shall include all equipment, accessories, an automatic changeover switch, and all necessary wiring and connections. The emergency power generator set shall be the size and type specified.

109.4.2.3 Switchgear and Panels

(1) Oil switches, fused cutouts, relays, transfer switches, panels, panel boards, and other similar items shall be furnished and installed at the location shown in the Plans. Wall or ceiling mounted items shall be attached to the wall or ceiling with galvanized bolts of not less than 3/8 inch diameter engaging metal expansion shields or anchors in masonry or concrete vaults.

109.4.2.4 Duct and Conduit

(1) Contractor shall furnish and install square-type exposed metallic ducts with hinged covers for the control circuits in the vault. These shall be mounted along the walls behind all floor-mounted equipment and immediately below all wall-mounted equipment. The hinged covers shall be placed to open from the front side with the hinges at the front bottom.

(2) Wall brackets for square ducts shall be installed at all joints two feet or more apart with intermediate brackets as specified. Conduit shall be used between square ducts and equipment or between different items of equipment when the equipment is designed for conduit connection. When the equipment is not designed for conduit connection, conductors shall enter the square-type control duct through insulating bushings in the duct or on the conduit risers.

109.4.2.5 Wiring and Connections

(1) Contractor shall make all necessary electrical connections in the vault in accordance with the wiring diagrams furnished and as directed by the Engineer. In wiring to the terminal blocks, the Contractor shall leave sufficient extra length on each control lead to make future changes in connections at the terminal block. This shall be accomplished by running each control lead the longest way around the box to the proper terminal. Leads shall be neatly laced in place.

109.4.2.6 Marking and Labeling

(1) All equipment, control wires, and, terminal blocks shall be tagged, marked, or labeled as follows.

109.4.2.6.1 Wire identification

(1) The Contractor shall furnish and install self-sticking wire labels or identifying tags on all control wires at the point where they connect to the control equipment or to the terminal blocks. Wire labels, if used, shall be of the self-sticking preprinted type and of the manufacturer's recommended size for the wire involved. Identification markings designated in the Plans shall be followed. Tags, if used, shall be of fiber not less than 3/4 inch in diameter and not less than 1/32 inch thick. Identification markings designated in the Plans shall be stamped on tags by means of small tool dies. Each tag shall be securely tied to the proper wire by a nonmetallic cord.

109.4.2.6.2 Labels

(1) Contractor shall stencil identifying labels on the cases of regulators, breakers, and distribution and control relay cases with white oil paint as designated by the Engineer. The letters and numerals shall be not less than one inch in height and shall be of proportionate width. Contractor shall also mark the correct circuit designations in accordance with the wiring diagram on the terminal marking strips, which are a part of each terminal block.

109.5 Measurement

109.5.1 General

(1) Airport Equipment Enclosure, Airport Equipment and Electrical Utility services at the location designated shall be measured on a lump sum basis for complete unit at the location specified.

(2) Regulators shall be measured a complete unit per each furnish installed and tested.

(3) Airport equipment of the type and size shall be furnished installation and tested on a unit basis per each.

109.6 Payment

109.6.1 General

(1) Payment will be made at the Contract prices for each completed and installation. This price will be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, testing and incidentals necessary to complete the Work.

(2) Payment for Equipment Enclosures or prefabricated metal housing will be made at the Contract lump sum price for each completed and accepted installation. This price will be full compensation for furnishing the enclosures on housing and all enclosure facilities equipment, including, but not limited to, raceways, wiring, controls, boxes, fittings, wiring devices, cabinets, enclosures, electrical identification, interior and exterior lighting, distribution systems, separately derived power sources, switches, and heating and ventilating equipment, all as specified in the Contract Documents.

(3) Payment for regulators, regulator monitors, L-847 circuit switch selectors, L-841 relay cabinet, and L-584 radio controller and generator will be made at the contract unit price per each completed unit. This price will be full compensation for each unit installed in place, including all provisions, attachments, connectors, accessories, tools, labor and incidentals necessary to complete the work, installed, tested and accepted.

(4) Electric Utility Service shall include providing an electric service from the electric utility, including coordination, costs, fees, and all appurtenant Work.

(5) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

109.6.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
L109.010 through L109.019	Airport Equipment Enclosure (location)	Lump Sum (LS)
L109.020 through L109.029	Airport Equipment (Furnished) (and) (Installed) (Location)	Lump Sum (LS)
L109.030 through L109.039	Electric Utility Service (location)	Lump Sum (LS)
L109.104	Regulator 6.6A 4KW	Each (EA)
L109.107	Regulator 6.6A 7.5KW	Each (EA)
L109.110	Regulator 6.6A 10KW	Each (EA)
L109.115	Regulator 6.6A 15KW	Each (EA)
L109.120	Regulator 6.6A 20KW	Each (EA)
L109.130	Regulator 6.6A 30KW	Each (EA)
L109.190	Regulator Monitor	Each (EA)
L109.201 through L109.205	L-847 Circuit Switch Selector	Each (EA)
L109.301 through L109.305	L-841 Relay Cabinet	Each (EA)
L109.401 through L109.405	L-854 Radio Controller	Each (EA)
L109.501 through L109.505	Generator (type) (size)	Each (EA)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-3	Specification for L-821, Panels for Remote Control of Airport Lighting
AC 150/5345-5	Circuit Selector Switch
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-10	Specification for Constant Current Regulators and Regulator Monitors

AC 150/5345-13	Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits
AC 150/5345-49	Specification L-854, Radio Control Equipment;
AC 150/5345-53	Airport Lighting Equipment Certification Program

American National Standards Institute / Insulated Cable Engineers Association (ANSI/ICEA)

ANSI/ICEA S-85-625	Standard for Telecommunications Cable Aircore, Polyolefin Insulated, Copper Conductor Technical Requirements

American Society for Testing Materials International (ASTM)

ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C62	Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C90	Standard Specification for Loadbearing Concrete Masonry Units
ASTM D2823	Standard Specification for Asphalt Roof Coatings, Asbestos Containing
ASTM D4479	Standard Specification for Asphalt Roof Coatings – Asbestos-Free

Commercial Item Description (CID)

A-A 59544	Cable and Wire, Electrical (Power, Fixed Installation)

Federal Specification (FED SPEC)

FED SPEC W-C-1094	Conduit and Conduit Fittings Plastic, Rigid

Institute of Electrical and Electronic Engineers (IEEE)

IEEE 1584	Guide for Performing Arc-Flash Hazard Calculations

Master Painter's Institute (MOI)

MPI Reference #9	Alkyd, Exterior, Gloss (MPI Gloss Level 6)
SSPC Paint 25 BCS	Zinc Oxide, Alkyd, Linseed Oil, Primer for

Underwriters Laboratory (UL)

UL Standard 6	Electrical Rigid Metal Conduit – Steel
UL Standard 514B	Conduit, Tubing, and Cable Fittings
UL Standard 514C	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL Standard 651	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL Standard 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit

National Fire Protection Association (NFPA)

NFPA-70	National Electrical Code (NEC)
NFPA-70E	Standard for Electrical Safety in the Workplace
NFPA-780	Standard for the Installation of Lightning Protection Systems

END OF SPECIFICATION L109

Specification L110 - Airport Underground Electrical Duct Banks and Conduits

110.1 Description

110.1.1 General

(1) This Work shall consist of underground electrical conduits and duct banks (single or multiple conduits encased in concrete or buried in sand) installed in accordance with this specification at the locations and at the dimensions, designs, and details shown on the Plans. This item shall include furnishing and installing all underground electrical duct banks and individual and multiple underground conduits. It shall also include all turfing trenching, backfilling, removal, and restoration of paved or turfed areas; concrete encasement, mandrelling, pulling lines, duct markers, plugging conduits, and testing the installation as a completed system ready for installation of cables in accordance with the Plans and Specifications. This item shall also include furnishing and installing conduits and all incidentals for providing positive drainage of the system. Verification of existing ducts is incidental to the Pay Items provided in this specification.

110.1.2 Classification

(1) Type-I shall mean duct encased in concrete.

(2) Type-II shall mean a duct without concrete encasement.

110.2 Equipment and Materials

110.2.1 General

(1) All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the Engineer.

(2) Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials in accordance with these specifications and acceptable to the Engineer. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the Engineer and replaced with materials that comply with these specifications, at the Contractor's cost.

(3) All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals shall be in accordance with 100.2.10.

(4) Provide warranty in accordance with 100.2.18.

110.2.2 Steel Conduit

(1) Rigid galvanized steel (RGS) conduit and fittings shall be hot dipped galvanized inside and out and conform to the requirements of Underwriters Laboratories Standards 6, 514B, and 1242. All RGS conduits or RGS elbows installed below grade, in concrete, permanently wet locations or other similar environments shall be painted with a 10 mil thick coat of asphaltic sealer or shall have a factory bonded polyvinyl chloride (PVC) cover. Exposed galvanizing or steel shall be coated with 10 mil of asphaltic sealer. When using PVC coated RGS conduit, care shall be exercised not to damage the factory PVC coating. Damaged PVC coating shall be repaired in accordance with the manufacturer's written instructions. In lieu of PVC coated RGS, corrosion wrap tape shall be permitted to be used where RGS is in contact with direct earth."

110.2.3 Plastic conduit

(1) Plastic conduit and fittings shall conform to the following requirements:

a. UL 514B covers W-C-1094 - Conduit fittings all types, classes 1 thru 3 and 6 thru 10.

b. UL 514C covers W-C-1094 - all types, Class 5 junction box and cover in plastic (PVC).

c. UL 651 covers W-C-1094 - Rigid PVC Conduit, types I and II, Class 4.

d. UL 651A covers W-C-1094 - Rigid PVC Conduit and high density polyethylene (HDPE) Conduit type III and Class 4.

(2) Underwriters Laboratories Standards UL-651 and Article 352 of the current National Electrical Code shall be one of the following, as shown on the Plans:

a. Type I–Schedule 40 PVC suitable for underground use either direct-buried or encased in concrete.

b. Type II–Schedule 40 PVC suitable for either above ground or underground use.

c. Type III – Schedule 80 PVC suitable for either above ground or underground use either direct-buried or encased in concrete.

d. Type III –HDPE pipe, minimum standard dimensional ratio (SDR) 11, suitable for placement with directional boring under pavement.

(3) The type of solvent cement shall be as recommended by the conduit/fitting manufacturer.

110.2.4 Split Conduit

(1) Split conduit shall be pre-manufactured for the intended purpose and shall be made of steel or plastic conforming to the requirements for steel or plastic conduit.

110.2.5 Conduit Spacers

(1) Conduit spacers shall be prefabricated interlocking units manufactured for the intended purpose. They shall be of double wall construction made of high grade, high density polyethylene complete with interlocking cap and base pads, They shall be designed to accept No. 4 reinforcing bars installed vertically.

110.2.6 Concrete

(1) Concrete shall conform to P610, Structural Portland Cement Concrete or SHS 501 Concrete, using one inch maximum size coarse aggregate with a minimum 28 day compressive strength of 4000 psi except as indicated on the Plans or in the Special Provisions.

(2) Where reinforced duct banks are specified, reinforcing steel shall conform to ASTM A615 Grade 60. Concrete and reinforcing steel are incidental to the respective pay item of which they are a component part.

110.2.7 Precast concrete structures

(1) Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another Engineer approved third party certification program. Precast concrete structures shall conform to ASTM C478.

110.2.8 Backfill

(1) Backfill material shall conform to the material and compaction requirements of P152. When indicated on Plan backfill with granular backfill in accordance with P203.

110.2.9 Detectable Warning Tape

(1) Plastic, detectable, American Public Works Association (APWA) Red (electrical power lines, cables, conduit and lighting cable), Orange (telephone/fiber optic cabling) with continuous legend magnetic tape shall be polyethylene film with a metallized foil core and shall be three to six inches wide. Detectable tape is incidental to the respective Pay Item.

110.3 Construction Methods

110.3.1 General

(1) Contractor shall install underground duct banks and conduits at the approximate locations indicated on the Plans. Engineer shall indicate specific locations as the work progresses, if required to differ from the Plans. Duct banks and conduits shall be of the size, material, and type indicated on the Plans or Specifications. Where no size is indicated on the Plans or in the Specifications, conduits shall be not less than two inches inside diameter or comply with the National Electrical Code based on cable to be installed, whichever is larger. All duct bank and conduit lines shall be laid to drain toward access points and duct or conduit ends for drainage. Unless shown otherwise on the Plans, grades shall be at least three inches in accordance with 100 feet. On runs where it is not practicable to maintain the grade all one way, the duct bank and conduit lines shall be graded from the center in both directions toward access points or conduit ends. Pockets or traps where moisture may accumulate shall be avoided. No duct bank or underground conduit shall be less than 18 inches below finished grade. Where under pavement, the top of the duct bank shall not be less than 18 inches below the subgrade or as indicated on the Plans.

(2) Contractor shall mandrel each individual conduit whether the conduit is direct-buried or part of a duct bank. An iron-shod mandrel, not more than 1/4 inch smaller than the bore of the conduit shall be pulled or pushed through each conduit. The mandrel shall have a leather or rubber gasket slightly larger than the conduit hole.

(3) Contractor shall swab out all conduits/ducts and clean base can, manhole, and pull boxes, IMMEDIATELY prior to pulling cable. Once cleaned and swabbed the light bases, manholes, and pull boxes, and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, base cans, and manholes is incidental to the Pay Item of the item being cleaned. All raceway systems left open, after initial cleaning, shall be re-cleaned at the Contractor's expense. All accessible points shall be kept closed when not installing cable. Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the Engineer of blockage in the existing ducts.

(4) For pulling the permanent wiring, each individual conduit, whether the conduit is direct-buried or part of a duct bank, shall be provided with a 200 pound test polypropylene pull rope. The ends shall be secured and sufficient length shall be left in access points to prevent it from slipping back into the conduit. Where spare conduits are installed, as indicated on the Plans, the open ends shall be plugged with removable plugs, designed for this purpose.

(5) All conduits shall be securely fastened in place during construction and shall be plugged to prevent contaminants from entering the conduits. Any conduit section having a defective joint shall not be installed. Ducts shall be supported and spaced apart using approved spacers at intervals not to exceed five feet or as shown on the Plans.

(6) Unless otherwise shown on the Plans, concrete encased duct banks shall be used when crossing under pavements expected to carry aircraft loads, such as runways, taxiways, taxilanes, ramps and aprons. When under paved shoulders and other paved areas, conduit and duct banks shall be encased using granular fill compact to requirements of P152.

(7) All conduits within concrete encasement of the duct banks shall terminate with female ends for ease in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

(8) Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored.

(9) Trenches for conduits and duct banks may be excavated manually or with mechanical trenching equipment unless in pavement, in which case they shall be excavated with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Blades of graders shall not be used to excavate the trench.

(10) When rock is encountered, the rock shall be removed to a depth of at least three inches below the required conduit or duct bank depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4 inch sieve. Contractor shall ascertain the type of soil or rock to be excavated before bidding. All such rock removal shall be performed and paid for under P152.

(11) Underground electrical warning (Caution) tape shall be installed in the trench above all underground duct banks and conduits in unpaved areas. Contractor shall submit a sample of the proposed warning tape for approval by Engineer. If not shown on the plans, the warning tape shall be located 6 inches above the duct/conduit or the counterpoise wire if present. See 110.3.2(6).

(12) Joints in plastic conduit shall be prepared in accordance with the manufacturer's recommendations for the particular type of conduit. Plastic conduit shall be prepared by application of a plastic cleaner and brushing a plastic solvent on the outside of the conduit ends and on the inside of the couplings. The conduit fitting shall then be slipped together with a quick one-quarter turn twist to set the joint tightly. Where more than one conduit is placed in a single trench, or in duct banks, joints in the conduit shall be staggered a minimum of 2 feet.

(13) Changes in direction of runs exceeding ten degrees, either vertical or horizontal, shall be accomplished using manufactured sweep bends.

(14) Whether or not specifically indicated on the drawings, where the soil encountered at established duct bank grade is an unsuitable material, as determined by the Engineer, the unsuitable material shall be removed in accordance with Item P152 and replaced with suitable material. Alternatively, additional duct bank supports that are adequate and stable shall be installed, as approved by the Engineer.

(15) All excavation shall be unclassified and shall be considered incidental to the respective L110 Pay Item of which it is a component part. Dewatering necessary for duct installation, erosion and turbidity control, in accordance with Federal, state, and local requirements is incidental to its respective Pay Item as a part of L110. The cost of all excavation regardless of type of material encountered, shall be included in the unit price bid for the L110.

(16) Unless otherwise specified, excavated materials that are deemed by the Engineer to be unsuitable for use in backfill or embankments shall be removed and disposed of offsite.

(17) Excess excavation shall be filled with suitable material approved by the Engineer and compacted in accordance with P152.

(18) It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Where existing active cables cross proposed installations, the Contractor shall ensure that these cables are adequately protected. Where crossings are unavoidable, no splices will be allowed in the existing

cables, except as specified on the Plans. Installation of new cable where such crossings must occur shall proceed as follows:

a. Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely no damage has occurred

b. Trenching in cable areas shall then proceed with approval of the Engineer, with care taken to minimize possible damage or disruption of existing cable, including careful backfilling in area of cable.

(19) In the event that any previously identified cable is damaged during the course of construction, the Contractor shall be responsible for the complete, timely repair.

110.3.2 Duct Banks

(1) Unless otherwise shown in the Plans, duct banks shall be installed so that the top of the concrete envelope is not less than 18 inches below the bottom of the base or stabilized base course layers where installed under runways, taxiways, aprons, or other paved areas, and not less than 18 inches below finished grade where installed in unpaved areas.

(2) Unless otherwise shown on the Plans, duct banks under paved areas shall extend at least ten feet beyond the edges of the pavement or three feet beyond any under drains that may be installed alongside the paved area. Trenches for duct banks shall be opened the complete length before concrete is placed so that if any obstructions are encountered, provisions can be made to avoid them. Unless otherwise shown on the Plans, all duct banks shall be placed on a layer of concrete not less than three inches thick prior to its initial set. The Contractor shall space the conduits not less than three inch apart (measured from outside wall to outside wall). All such multiple conduits shall be placed using conduit spacers applicable to the type of conduit. As the conduit laying progresses, concrete shall be placed around and on top of the conduits not less than three inches thick unless otherwise shown on the Plans. All conduits shall terminate with female ends for ease of access in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

(3) Conduits forming the duct bank shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of six inches to anchor the assembly into the earth prior to placing the concrete encasement. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at five-foot intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the Engineer for review prior to use.

(4) When shown on Plans, Contractor shall reinforce the bottom side and top of encasements with steel reinforcing mesh or fabric or other approved metal reinforcement. When shown on Plans, the Contractor shall supply additional supports where the ground is soft and boggy, where ducts cross under pavement. Under such conditions, the complete duct structure shall be supported as shown on the details.

(5) All pavement surfaces that are to have ducts installed therein shall be neatly saw cut to form a vertical face. All excavation shall be included in the contract with price for the duct.

(6) Install a plastic, detectable, color as noted, three to six inches wide tape, eight inches minimum below grade above all underground conduit or duct lines not installed under pavement. Utilize the three inch wide tape only for single conduit runs. Utilize the six-inch wide tape for multiple conduits and duct banks. For duct banks equal to or greater than 24 inches in width, utilize more than one tape for sufficient coverage and identification of the duct bank as required.

(7) When existing cables are to be placed in split duct, encased in concrete, the cable shall be carefully located and exposed by hand tools. Prior to being placed in duct, the Engineer shall be notified so that he may inspect the cable and determine that it is in good condition. Where required, split duct shall be installed as shown on the drawings or as required by the Engineer.

110.3.3 Conduits without Concrete Encasement

(1) Trenches for single-conduit lines shall be not less than 6 inches nor more than 12 inches wide. The trench for two or more conduits installed at the same level shall be proportionately wider. Trench bottoms for conduits without concrete encasement shall be made to conform accurately to grade so as to provide uniform support for the conduit along its entire length.

(2) Unless otherwise shown on the Plans, a layer of fine earth material, at least four inches thick (loose measurement) shall be placed in the bottom of the trench as bedding for the conduit. The bedding material shall consist of soft dirt, sand or other fine fill, and it shall contain no particles that would be retained on a 1/4 inch sieve. The bedding material shall be tamped until firm. Flowable backfill may alternatively be used.

(3) Unless otherwise shown on Plans, conduits shall be installed so that the tops of all conduits within the Airport's secured area where trespassing is prohibited are at least 18 inches below the finished grade.

Conduits outside the Airport's secured area shall be installed so that the tops of the conduits are at least 24 inches below the finished grade in accordance with National Electric Code (NEC), Table 300.5.

(4) When two or more individual conduits intended to carry conductors of equivalent voltage insulation rating are installed in the same trench without concrete encasement, they shall be spaced not less than three inches apart (measured from outside wall to outside wall) in a horizontal direction and not less than six inches apart in a vertical direction. Where two or more individual conduits intended to carry conductors of differing voltage insulation rating are installed in the same trench without concrete encasement, they shall be placed not less than 3 inches apart (measured from outside wall to outside wall) in a horizontal direction and lot less than 6 inches apart in a vertical direction.

(5) Trenches shall be opened the complete length between normal termination points before conduit is installed so that if any unforeseen obstructions are encountered, proper provisions can be made to avoid them.

(6) Conduits shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of six inches to anchor the assembly into the earth while backfilling. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at five-foot intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the Engineer for review prior to use.

110.3.4 Markers

(1) The location of each end and of each change of direction of conduits and duct banks shall be marked by a concrete slab marker two feet square and four to six inches thick extending approximately one inch above the surface. The markers shall also be located directly above the ends of all conduits or duct banks, except where they terminate in a junction/access structure or building. Each cable or duct run from a line of lights and signs to the equipment vault must be marked at approximately every 200 feet along the cable or duct run, with an additional marker at each change of direction of cable or duct run.

(2) Contractor shall impress the word "DUCT" or "CONDUIT" on each marker slab. Impression of letters shall be done in a manner, approved by the Engineer, for a neat, professional appearance. All letters and words must be neatly stenciled. After placement, all markers shall be given one coat of high-visibility orange paint, as approved by the Engineer. Contractor shall also impress on the slab the number and size of conduits beneath the marker along with all other necessary information as determined by the Engineer. The letters shall be four inches high and three inches wide with width of stroke 1/2 inch and 1/4 inch deep or as large as the available space permits.

110.3.5 Backfilling for Conduits

(1) For conduits, eight inches of sand, soft earth, or other fine fill (loose measurement) shall be placed around the conduits ducts and carefully tamped around and over them with hand tampers. The remaining trench shall then be backfilled and compacted in accordance with P152 "Excavation and Embankment" except that material used for back fill shall be select material not larger than 4 inches in diameter.

(2) Trenches shall not contain pools of water during back filling operations.

(3) The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

(4) Excess excavated material shall be removed and disposed as indicated on the Plans or if not indicated on the Plans at a location off-site provided by Contractor.

110.3.6 Backfilling for Duct Banks

(1) After the concrete has cured, the remaining trench shall be backfilled and compacted in accordance with P152 "Excavation and Embankment" except that the material used for backfill shall be select material not larger than four inches in diameter. In addition to the requirements of P152, where duct banks are installed under pavement, one moisture/density test per lift shall be made for each 250 linear feet of duct bank or one work period's construction, whichever is less.

(2) Trenches shall not contain pools of water during backfilling operations.

(3) The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

(4) Excess excavated material shall be removed and disposed of at a location indicated on the Plans; and if no location is indicated, dispose of off-site at a location provided by Contractor.

110.3.7 Restoration

(1) Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the work shall be restored to its original condition. The restoration shall include sodding**,** topsoiling, fertilizing, liming, seeding, and mulching shown on the Plans. Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. All turf restoration shall be considered incidental to the respective L110 Pay Item except as specified herein.

(2) Restore paved areas in kind.

(3) Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD), and remove FOD that is found. This FOD inspection and removal shall be considered incidental to the Pay Item of which it is a component part.

110.4 Measurement

110.4.1 Electrical Duct

(1) Electrical Duct of the various sizes and number of duct indicated, with or without concrete encasement, shall be measured on a unit price basis per lineal foot. Measurement for payment shall be made in a straight line along the centerline duct installed and accepted.

110.4.2 Pavement Restoration

(1) Pavement Restoration for Duct Installation shall be measured on a unit price basis per linear foot. Measurement for payment shall be made in a straight horizontal line along the centerline of the duct that is located beneath pavement.

110.4.3 Duct Markers

(1) Duct Markers shall be measured on a unit price basis per each for markers constructed and accepted.

110.5 Payment

110.5.1 General

(1) Payment will be made at the Contract unit price per lineal foot for each type and size of single-way or multi-way duct, completed and accepted. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials and for all labor, equipment, tools, and incidentals necessary to complete this item. Pay Items for Electrical Duct shall include excavation, installation, materials, bedding and backfill, compaction, concrete encasement when specified, mandrelling, and restoration, except when a Pay Item is included for Pavement Restoration in the Schedule of Prices.

(2) The cost of restoration of turf, pavement, and restoration of other features disturbed by installation of duct shall be included in prices for Electrical Duct, except when specific Pay Items for duct surface restoration are described on the Plans or in the Special Provisions and are included in the Schedule of Prices.

(3) Pay Item for Duct Markers shall include materials and installation.

(4) Pay Item for Pavement Restoration shall include the cost of saw cutting, removing and disposing of existing pavement, and placement of subbase, base course, and surface course in accordance with the details included in the Contract Documents.

(5) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

110.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
L110.121	Electrical Duct Type-I 2-Inch 1-Way	Linear Foot (LF)
L110.122	Electrical Duct Type-I 2-Inch 2-Way	Linear Foot (LF)
L110.123	Electrical Duct Type-I 2-Inch 3-Way	Linear Foot (LF)
L110.124	Electrical Duct Type-I 2-Inch 4-Way	Linear Foot (LF)
L110.131	Electrical Duct Type-I 3-Inch 1-Way	Linear Foot (LF)
L110.132	Electrical Duct Type-I 3-Inch 2-Way	Linear Foot (LF)
L110.133	Electrical Duct Type-I 3-Inch 3-Way	Linear Foot (LF)

L110.134	Electrical Duct Type-I 3-Inch 4-Way	Linear Foot (LF)
L110.135	Electrical Duct Type-I 3-Inch 5-Way	Linear Foot (LF)
L110.136	Electrical Duct Type-I 3-Inch 6-Way	Linear Foot (LF)
L110.141	Electrical Duct Type-I 4-Inch 1-Way	Linear Foot (LF)
L110.142	Electrical Duct Type-I 4-Inch 2-Way	Linear Foot (LF)
L110.143	Electrical Duct Type-I 4-Inch 3-Way	Linear Foot (LF)
L110.144	Electrical Duct Type-I 4-Inch 4-Way	Linear Foot (LF)
L110.145	Electrical Duct Type-I 4-Inch 5-Way	Linear Foot (LF)
L110.146	Electrical Duct Type-I 4-Inch 6-Way	Linear Foot (LF)
L110.221	Electrical Duct Type-II 2-Inch 1-Way	Linear Foot (LF)
L110.222	Electrical Duct Type-II 2-Inch 2-Way	Linear Foot (LF)
L110.223	Electrical Duct Type-II 2-Inch 3-Way	Linear Foot (LF)
L110.224	Electrical Duct Type-II 2-Inch 4-Way	Linear Foot (LF)
L110.231	Electrical Duct Type-II 3-Inch 1-Way	Linear Foot (LF)
L110.232	Electrical Duct Type-II 3-Inch 2-Way	Linear Foot (LF)
L110.233	Electrical Duct Type-II 3-Inch 3-Way	Linear Foot (LF)
L110.234	Electrical Duct Type-II 3-Inch 4-Way	Linear Foot (LF)
L110.235	Electrical Duct Type-II 3-Inch 5-Way	Linear Foot (LF)
L110.236	Electrical Duct Type-II 3-Inch 6-Way	Linear Foot (LF)
L110.241	Electrical Duct Type-II 4-Inch 1-Way	Linear Foot (LF)
L110.242	Electrical Duct Type-II 4-Inch 2-Way	Linear Foot (LF)
L110.243	Electrical Duct Type-II 4-Inch 3-Way	Linear Foot (LF)
L110.244	Electrical Duct Type-II 4-Inch 4-Way	Linear Foot (LF)
L110.245	Electrical Duct Type-II 4-Inch 5-Way	Linear Foot (LF)
L110.246	Electrical Duct Type-II 4-Inch 6-Way	Linear Foot (LF)
L110.300	Duct Marker	Each (EA)
L110.400	Pavement Restoration for Duct Installation	Linear Foot (LF)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circular (AC)

AC 150/5340-30 Design and Installation Details for Airport Visual Aids

AC 150/5345-53 Airport Lighting Equipment Certification Program

American Society for Testing Materials International (ASTM)

ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

National Fire Protection Association (NFPA)

NFPA.70 National Electrical Code (NEC)

Underwriters Laboratories (UL)

UL Standard 6	Electrical Rigid Metal Conduit - Steel
UL Standard 514B	Conduit, Tubing, and Cable Fittings
UL Standard 514C	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL Standard 1242	Electrical Intermediate Metal Conduit Steel
UL Standard 651	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL Standard 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit

END OF SPECIFICATION L110

Specification L115 - Electrical Manholes and Junction Structures

115.1 General Description

(1) This work shall consist of electrical manholes and junction structures (including but not limited to hand holes, pull boxes, and junction cans) installed in accordance with this specification, at the indicated locations and conforming to the lines, grades and dimensions shown on the Plans or as required by the Engineer. This item shall include the installation of each electrical manhole and/or junction structures with all associated excavation, backfilling, sheeting and bracing, concrete, reinforcing steel, ladders, appurtenances, testing, dewatering and restoration of surfaces in accordance with the Plans and Specifications.

115.2 Equipment and Materials

115.2.1 General

(1) All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when so requested by the Engineer.

(2) Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials in accordance with these specifications. Materials supplied and installed that do not comply with these specifications shall be removed (when directed by the Engineer) and replaced with materials that comply with these specifications at the Contractor's cost.

(3) All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals shall be in accordance with 100.2.10.

(4) Provide warranty in accordance with 100.2.18.

115.2.2 Concrete structures

(1) Concrete shall be proportioned, placed, and cured per Item P610, Structural Portland Cement Concrete or SHS 501 Concrete. Cast-in-place concrete structures shall be in accordance with the details and dimensions shown on the Plans.

115.2.3 Precast Concrete Structures

(1) Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another engineer approved third party certification program. Provide precast concrete structures where shown on the plans.

(2) Precast concrete structures, proposed by Contractor as an alternative to cast-in-place structures shown on the Plans, shall be an approved standard design of the manufacturer. Precast units shall have mortar or bitumastic sealer placed between all joints to make them watertight. The structure shall be designed to withstand aircraft loads, shown on the plans. Openings or knockouts shall be provided in the structure as detailed on the Plans.

(4) Threaded inserts and pulling eyes shall be cast in as shown.

(5) If the Contractor chooses to propose a different structural design, signed and sealed shop drawings, design calculations, and other information requested by the Engineer shall be submitted by the Contractor to allow for a full evaluation by the Engineer. The Engineer shall review in accordance with the process defined in the General Provisions.

115.2.4 Junction boxes

(1) Junction boxes shall be L-867 Class 1 (non-load bearing) or L-868 Class 1 (load bearing) airport light bases that are encased in concrete. The light bases shall have a L-894 blank cover, gasket, and stainless steel hardware. All bolts, studs, nuts, lock washers, and other similar fasteners used for the light fixture assemblies must be fabricated from 316L (equivalent to EN 1.4404), 18-8, 410, or 416 stainless steel. If 18-8, 410, or 416 stainless steel is utilized it shall be passivated and be free from any discoloration. Covers shall be 3/8-inch thickness for L-867 and 3/4-inch thickness for L-868. All junction boxes shall be provided with both internal and external ground lugs.

115.2.5 Mortar

(1) Mortar shall be composed of one part of Portland cement and two parts of mortar sand, by volume. The Portland cement shall be in accordance with the requirements in ASTM C150, Type I. The sand shall be in accordance with the requirements in ASTM C144. Hydrated lime may be added to the mixture of sand and cement in an amount not to exceed 15 percent of the weight of cement used. The hydrated

lime shall meet the requirements of ASTM C206. Water shall be potable, reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product.

115.2.6 Concrete

(1) All concrete used in structures shall conform to the requirements of P610, Structural Portland Cement Concrete or SHS 501 Concrete.

115.2.7 Frames and Covers

(1) The frames shall conform to one of the following requirements:

a. ASTM A48 Gray iron castings
b. ASTM A47 Malleable iron castings
c. ASTM A27 Steel castings
d. ASTM A283 Grade D Structural steel for grates and frames
e. ASTM A536 Ductile iron castings
f. ASTM A897 Austempered ductile iron castings

(2) Castings subject to aircraft loading shall withstand a maximum tire pressure and maximum aircraft load specified in the Contract Documents, or if none is specified, then maximum 100 psi tire pressure and 60,000 pound gross aircraft weight.

(2) All castings or structural steel units shall conform to the dimensions shown on the Plans.

(3) Each frame and cover unit shall be provided with fastening members to prevent it from being dislodged by traffic, but which will allow easy removal for access to the structure.

(4) All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A123.

(5) Each cover shall have the word “ELECTRIC” or other approved designation cast on it. Each frame and cover shall be as shown on the Plans or approved equivalent. No cable notches are required.

(6) When shown on the Plans, manholes shall be provided with a “DANGER -- PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER” safety warning sign as detailed in the Contract Documents and in accordance with OSHA 1910.146 (c)(2).

115.2.8 Ladders

(1) Ladders, if specified, shall be galvanized steel or as shown on the Plans.

115.2.9 Reinforcing Steel

(1) All reinforcing steel shall be deformed bars of new billet steel meeting the requirements of ASTM A615, Grade 60.

115.2.10 Bedding

(1) Bedding or special backfill shall be as shown on the Plans.

115.2.11 Cable trays

(1) Cable trays shall be of galvanized steel, plastic, or aluminum. Cable trays shall be located as shown on the Plans.

115.2.12 Plastic Conduit

(1) Plastic conduit shall comply with L110, Airport Underground Electrical Duct Banks and Conduits.

115.2.13 Conduit Terminators

(1) Conduit terminators shall be pre-manufactured for the specific purpose and sized as required or as shown on the Plans.

115.2.14 Pulling-In Irons

(1) Pulling-in irons shall be manufactured with 7/8 inch diameter hot-dipped galvanized steel or stress-relieved carbon steel roping designed for concrete applications (7 strand, 1/2 inch diameter with an ultimate strength of 270,000 psi). Where stress-relieved carbon steel roping is used, a rustproof sleeve shall be installed at the hooking point and all exposed surfaces shall be encapsulated with a polyester coating to prevent corrosion.

115.2.15 Ground Rods or Plates

(1) Furnish and install one piece, solid stainless steel, copper or copper clad as shown on the Plans**.** The ground rods shall be of the length and diameter specified on the Plans, but in no case shall they be less than 8 feet long nor less than 5/8 inch in diameter. Plates shall be the dimensions shown on the Plans.

115.3 Construction Methods

115.3.1 Unclassified Excavation

(1) It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Damage to utility lines, through lack of care in excavating, shall be repaired or replaced to the satisfaction of the Engineer without additional expense to the Owner.

(2) Contractor shall perform excavation for structures and structure footings to the lines and grades or elevations shown on the Plans or as staked by the Engineer. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown.

(3) All excavation shall be unclassified and shall be considered incidental to the respective L115 Pay Item of which it is a component part. Dewatering necessary for L115 structure installation, erosion and turbidity control, in accordance with Federal, state, and local requirements is incidental to its respective Pay Item as a part of L115. The cost of all excavation regardless of type of material encountered, shall be included in the unit price bid for the L115.

(4) Boulders, logs and all other objectionable material encountered in excavation shall be removed. All rock and other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped or serrated, as directed by the Engineer. All seams, crevices, disintegrated rock and thin strata shall be removed. When concrete is to rest on a surface other than rock, special care shall be taken not to disturb the bottom of the excavation. Excavation to final grade shall not be made until just before the concrete or reinforcing is to be placed.

(5) Contractor shall provide all bracing, sheeting and shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheeting and shoring shall be included in the unit price bid for the structure.

(6) Unless otherwise provided, bracing, sheeting and shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall be effected in a manner that will not disturb or mar finished masonry. The cost of removal shall be included in the unit price bid for the structure.

(7) After each excavation is completed, Contractor shall notify the Engineer. Structures shall be placed after the Engineer has approved the depth of the excavation and the suitability of the foundation material.

(8) Prior to installation Contractor shall provide a minimum of 6 inches of sand or a material approved by the Engineer as a suitable base to receive the structure. The base material shall be compacted and graded level and at proper elevation to receive the structure in proper relation to the conduit grade or ground cover requirements, as indicated on the Plans.

115.3.2 Concrete Structures

(1) Concrete structures shall be built on prepared foundations conforming to the dimensions and form indicated on the Plans. The concrete and construction methods shall conform to the requirements specified in P610. Concrete material can alternatively conform to the requirements of SHS 501 Concrete. Reinforcement required shall be placed as indicated on the Plans and shall be approved by the Engineer before the concrete is placed.

115.3.3 Precast Unit Installations

(1) Precast units shall be installed plumb and true. Joints shall be made watertight by use of sealant at each tongue-and-groove joint and at roof of manhole. Excess sealant shall be removed and severe surface projections on exterior of neck shall be removed.

115.3.4 Placement and Treatment of Castings, Frames and Fittings

(1) All castings, frames and fittings shall be placed in the positions indicated on the Plans or as directed by the Engineer and shall be set true to line and to correct elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place and position before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

(2) Field connections shall be made with bolts, unless indicated otherwise. Welding will not be permitted unless shown otherwise on the approved shop drawings and written permission is granted by the casting manufacturer. Erection equipment shall be suitable and safe for the workman. Errors in shop fabrication or deformation resulting from handling and transportation that prevent the proper assembly and fitting of parts shall be reported immediately to the Engineer and approval of the method of correction shall be obtained. Approved corrections shall be made at Contractor's expense.

(3) Anchor bolts and anchors shall be properly located and built into connection work. Bolts and anchors shall be preset by the use of templates or such other methods as required to locate the anchors and anchor bolts accurately.

(4) Pulling-in irons shall be located opposite all conduit entrances into structures to provide a strong, convenient attachment for pulling.in blocks when installing cables. Pulling-in irons shall be set directly into the concrete walls of the structure.

115.3.5 Installation of Ladders

(1) Ladders shall be installed such that they may be removed if necessary. Mounting brackets shall be supplied top and bottom and shall be cast in place during fabrication of the structure or drilled and grouted in place after erection of the structure.

115.3.6 Removal of Sheeting and Bracing

(1) In general, all sheeting and bracing used to support the sides of trenches or other open excavations shall be withdrawn as the trenches or other open excavations are being refilled. That portion of the sheeting extending below the top of a structure shall be withdrawn, unless otherwise directed, before more than six inches of material is placed above the top of the structure and before any bracing is removed. Voids left by the sheeting shall be carefully refilled with selected material and rammed tight with tools especially adapted for the purpose or otherwise as may be approved.

(2) Contractor shall delay the removal of sheeting and bracing if, the installed work has not attained the necessary strength to permit placing of backfill.

115.3.7 Backfilling

(1) After a structure has been completed, the area around it shall be backfilled in horizontal layers not to exceed six inches in thickness measured after compaction to the density requirements in P152. Each layer shall be deposited all around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the Plans or as directed by the Engineer.

(2) Backfill shall not be placed against structures until tests made by the laboratory establish that the concrete has attained sufficient strength to provide a factor of safety against damage or strain in withstanding any pressure created by the backfill or the methods used in placing it.

(3) Where required, the Engineer may direct the Contractor to add, at his own expense, sufficient water during compaction to assure a complete consolidation of the backfill. The Contractor shall be responsible for all damage or injury done to conduits, duct banks, structures, property or persons due to improper placing or compacting of backfill.

115.3.8 Connection of Duct Banks

(1) To relieve stress of joint between concrete-encased duct banks and structure walls, reinforcement rods shall be placed in the structure wall and shall be formed and tied into duct bank reinforcement at the time the duct bank is installed.

115.3.9 Grounding

(1) A ground rod shall be installed in the floor of all concrete structures so that the top of rod extends six inches above the floor. The ground rod shall be installed within one foot of a corner of the concrete structure. Ground rods shall be installed prior to casting the bottom slab. Where the soil condition does not permit driving the ground rod into the earth without damage to the ground rod, the Contractor shall drill a four inch diameter hole into the earth to receive the ground rod. The hole around the ground rod shall be filled throughout its length, below slab, with Portland cement grout. Ground rods shall be installed in precast bottom slab of structures by drilling a hole through bottom slab and installing the ground rod. Bottom slab penetration shall be sealed watertight with Portland cement grout around the ground rod.

(2) A grounding bus of 4/0 bare stranded copper shall be exothermically bonded to the ground rod and loop the concrete structure walls. The ground bus shall be a minimum of one foot above the floor of the structure and separate from other cables. No. 2 American wire gauge (AWG) bare copper pigtails shall bond the grounding bus to all cable trays and other metal hardware within the concrete structure. Connections to the grounding bus shall be exothermic. If an exothermic weld is not possible, connections to the grounding bus shall be made by using connectors approved for direct burial in soil or concrete in accordance with UL 467. Hardware connections may be mechanical, using a lug designed for that purpose.

115.3.10 Cleanup and Repair

(1) After erection of all galvanized items, damaged areas shall be repaired by applying a liquid cold-galvanizing compound in accordance with MIL-P-21035. Surfaces shall be prepared and compound applied in accordance with the manufacturer's recommendations.

(2) Prior to acceptance, the entire structure shall be cleaned of all dirt and debris.

115.3.11 Restoration

(1) After the backfill is completed, the Contractor shall dispose of all surplus material, dirt and rubbish from the site. Contractor shall restore all disturbed areas equivalent to or better than their original condition. All sodding, grading and restoration shall be considered incidental to the respective L115 Pay Item.

(2) Contractor shall grade around structures as required to provide positive drainage away from the structure.

(3) Areas with special surface treatment, such as roads, sidewalks, or other paved areas shall have backfill compacted to match surrounding areas, and surfaces shall be repaired using materials comparable to original materials.

(4) Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD), and remove any such FOD that is found. This FOD inspection and removal shall be considered incidental to the pay item of which it is a component part.

(5) After all work is completed, the Contractor shall remove all tools and other equipment, leaving the entire site free, clear and in good condition.

115.3.12 Inspection

(1) Prior to final approval, the electrical structures shall be thoroughly inspected for conformance with the Plans and this specification. Indication of defects in materials or workmanship shall be further investigated and corrected. Earth resistance to ground of each ground rod shall not exceed 25 ohms. Each ground rod shall be tested using the fall-of-potential ground impedance test in accordance with American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81. This test shall be performed prior to establishing connections to other ground electrodes.

115.3.13 Manhole Elevation Adjustments

(1) Contractor shall adjust the tops of existing manholes in areas designated in the Contract Documents to the new elevations shown. Contractor shall be responsible for determining the exact height adjustment required to raise the top of each manhole to the new elevations. The existing top elevation of each manhole to be adjusted shall be determined in the field and subtracted/added from the proposed top elevation.

(2) Contractor shall remove/extend the existing top section or ring and cover on the manhole structure or manhole access. Contractor shall then install precast concrete sections or grade rings of the required dimensions to adjust the manhole top to the new proposed elevation or shall cut the existing manhole walls to shorten the existing structure, as required by final grades. Finally, the Contractor shall reinstall the manhole top section or ring and cover on top and check the new top elevation.

(3) Contractor shall construct a concrete slab around the top of adjusted structures located in graded areas that are not to be paved. The concrete slab shall conform to the dimensions shown on the Plans.

115.3.14 Duct Extension to Existing Ducts

(1) Where existing concrete encased ducts are to be extended, the duct extension shall be concrete encased plastic conduit. The fittings to connect the ducts together shall be standard manufactured connectors designed and approved for the purpose. The duct extensions shall be installed according to the concrete encased duct detail and as shown on the Plans.

115.4 Measurement

115.4.1 General

(1) Electrical manholes and junction structures shall be measured by each unit completed in place and accepted per each or per lump sum as listed in the Schedule of Prices. The following additional items are specifically included in each unit:

a. All Required Excavation, Dewatering
b. Sheeting and Bracing
c. All Required Backfilling with On-Site Materials
d. Restoration of All Surfaces and Finished Grading, Sodding
e. All Required Connections
f. Dewatering If Required
g. Temporary Cables and Connections
h. Ground Rod Testing

(2) Manhole Elevation Adjustments for existing manholes shall be measured by the completed unit completed, and accepted. Separate measurement shall not be made for the various types and sizes.

115.5 Payment

115.5.1 General

(1) The accepted quantity of electrical manholes and junction structures will be paid for at the Contract unit price per each, complete and in place. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials, furnishing and installation of appurtenances and connections to duct banks and other structures as may be required to complete the item as shown on the Plans and for all labor, equipment, tools and incidentals necessary to complete the structure.

(2) Payment shall be made at the Contract unit price for manhole elevation adjustments. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary, including but not limited to, spacers, concrete, rebar, dewatering, excavating, backfill, topsoil, sodding and pavement restoration, where required, to complete this item as shown in the Plans and to the satisfaction of the Engineer.

(3) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

115.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
L115.100 through L115.109	Electrical Manhole (size) (type)	Each (EA)
L115.200 through L115.209	Electrical Manhole (location)	Lump Sum (LS)
L115.300 through L115.309	Electrical Junction Structure (size) (type)	Each (EA)
L115.400 through L115.409	Electrical Junction Structure (location)	Lump Sum (LS)
L115.500	Existing Manhole Elevation Adjustment	Each (EA)
L115.600 through L115.609	Existing Manhole Elevation Adjustment (location)	Lump Sum (LS)
L115.700 through L115.709	Existing Junction Structure Adjustment	Each (EA)
L115.800 through L115.809	Existing Junction Structure Adjustment (location)	Lump Sum (LS)
L115.900 through L115.919	Electrical Handhole (size) (type)	Each (EA)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

American National Standards Institute / Insulated Cable Engineers Association (ANSI/ICEA)

ANSI/IEEE STD 81 — IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

Advisory Circular (AC)

AC 150/5345-7 — Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits

AC 150/5345-26 — Specification for L-823 Plug and Receptacle, Cable Connectors

AC 150/5345-42 — Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories

AC 150/5340-30 — Design and Installation Details for Airport Visual Aids

AC 150/5345-53	Airport Lighting Equipment Certification Program

Commercial Item Description (CID)

A-A 59544	Cable and Wire, Electrical (Power, Fixed Installation)

American Society for Testing Materials International (ASTM)

ASTM A27	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A47	Standard Specification for Ferritic Malleable Iron Castings
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A123	Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
ASTM A283	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A897	Standard Specification for Austempered Ductile Iron Castings
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C206	Standard Specification for Finishing Hydrated Lime

FAA Engineering Brief (EB)

FAA EB #83	In Pavement Light Fixture Bolts

Military Specification (MIL)

MIL-P-21035	Paint High Zinc Dust Content, Galvanizing Repair

National Fire Protection Association (NFPA)

NFPA-70	National Electrical Code (NEC)

END OF SPECIFICATION L115

Specification L119 - Airport Obstruction Lights

119.1 Description

119.1.1 General

(1) This Work shall consist of furnishing and installing obstruction lights in accordance with these Specifications. Included in this item shall be furnishing and installing wood poles, steel or iron pipes, or other supports as required in the Plans or Specifications and in accordance with the requirements in advisory circular (AC) 70/7460-1, Obstruction Marking and Lighting

(2) This Work shall also include all wire and cable connections, furnishing and installing necessary conduits and fittings, insulators, pole steps, pole cross arms, and painting poles and pipes. In addition, it includes furnishing and installing all lamps and, if required, furnishing and installing insulating transformers, servicing and testing the installation and all incidentals necessary to place lights in operation as completed units to the satisfaction of the Engineer and according to the contract documents. If specified, remove existing obstruction lights shown on the plans to the requirements of the contract documents.

119.2 Equipment and Materials

119.2.1 General

(1) Airport lighting equipment and materials covered by specifications shall be certified and listed under AC 150/5345-53, Airport Lighting Equipment Certification Program (ALECP) and listed in the ALECP Addendum.

(2) All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the Engineer.

(2) Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials in accordance with these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the Engineer) and replaced with materials that comply with these specifications at the Contractor's cost.

(4) All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals shall be in accordance with 100.2.10.

(5) Provide warranty in accordance with 100.2.18.

119.2.2 Obstruction Lights

(1) The obstruction lighting assembly shall be the Type indicated on the Plans or Special Provisions meeting the requirements of AC 150/5345-43, Specification for Obstruction Lighting Equipment."

119.2.3 Isolation Transformers

(1) Where required for series circuits, the isolation transformers shall conform to the requirements of AC 150/5345-47, Specification for Series to Series Isolation Transformers for Airport Lighting Systems.

119.2.4 Transformer Housing

(1) Transformer housings, if specified, shall be in accordance with AC 150/5345-42, Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories.

119.2.5 Conduit

(1) Steel conduit and fittings shall be in accordance with Underwriters Laboratories Standards 6, 514B, and 1242.

119.2.6 Plastic Conduit (For Use Below Grade Only)

(1) Plastic conduit and fittings shall be in accordance with:

a. UL 514B covers W-C-1094 - Conduit fittings all types, classes 1 through 3 and 6 through 10

b. UL 514C covers W-C-1094 - all types, class 5 junction box and cover in plastic (PVC)

c. UL 651 covers W-C-1094 - Rigid PVC Conduit, types I and II, class 4

d. UL 651A covers W-C-1094 - Rigid PVC Conduit and high density polyethylene (HDPE) Conduit type III and class 4

(2) Plastic conduit and fittings shall be one of the following, as shown on the Plans:

a. Type I–Schedule 40 PVC suitable for underground use either direct-buried or encased in concrete.

b. Type II–Schedule 40 PVC suitable for either above ground or underground use.

119.2.7 Electrical Wire And Cable

(1) For ratings up to 600 volts, moisture and heat resistant thermoplastic wire conforming to Commercial Item Description A-A-59544A, Type THWN-2, shall be used. The wires shall be of the type, size, number of conductors, and voltage shown in the Plans or in the proposal. Overhead line wire from pole to pole, where specified, shall be in accordance with American National Standards Institute/Insulated Cable Engineers Association (ANSI/ICEA) S-70-547-2007.

119.2.8 Miscellaneous

(1) Paint, poles, pole steps, insulators, and all other miscellaneous materials necessary for the completion of this item shall be new and first-grade commercial products. These products shall be as specified in the Plans or Specifications.

119.3 Construction

119.3.1 Placing the Obstruction Lights

(1) Contractor shall furnish and install single or double obstruction lights as specified in the proposal and shown in the Plans. The obstruction lights shall be mounted on poles, buildings, or towers at approximately the location shown in the Plans. The exact location shall be as shown on the Plans in accordance with AC 70/7460-1, Obstruction Marking and Lighting.

119.3.2 Installation on Poles

(1) Where obstruction lights are to be mounted on poles, each obstruction light shall be installed with its hub at least as high as the top of the pole. All wiring shall be run in not less than one inch galvanized rigid steel conduit. If specified, pole steps shall be furnished and installed, the lowest step being five feet above ground level. Steps shall be installed alternately on diametrically opposite sides of the pole to give a rise of 18 inches for each step. Conduit shall be fastened to the pole with galvanized steel pipe straps and shall be secured by galvanized lag screws. Poles shall be painted as shown in the Plans and Specifications.

(2) When obstruction lights are installed on existing telephone or power poles, a large fiber insulating sleeve of adequate diameter and not less than four feet long, shall be installed to extend six inches above the conductors on the upper cross arm. In addition, the sleeve shall be at least 18 inches below the conductors on the lower cross arm. The details of this installation shall be in accordance with the Plans.

119.3.3 Installation on Beacon Tower

(1) Where obstruction lights are installed on a beacon tower, two obstruction lights shall be mounted on top of the beacon tower using one inch conduit. The conduit shall screw directly into the obstruction light fixtures and shall support them at a height of not less than four inches above the top of the rotating beacon. If obstruction lights are specified at lower levels, the Contractor shall install not less than one inch galvanized rigid steel conduit with standard conduit fittings for mounting the fixtures. The fixtures shall be mounted in an upright position in all cases. The conduit shall be fastened to the tower members with Wraplock® straps (or equivalent), clamps, or approved fasteners spaced approximately five feet apart. Three coats of international orange paint in accordance with Federal Specification 595, Number 12197 shall be applied (one prime, one body, and one finish coat) to all exposed material installed.

119.3.4 Installation on Buildings, Towers, Smokestacks, and Other Structures

(1) Where obstruction lights are to be installed on buildings or similar structures, the installation shall be made in accordance with the details shown in the Plans. The hub of the obstruction light shall be not less than one foot above the highest point of the obstruction except in the case of smokestacks where the uppermost units shall be mounted not less than five feet, nor more than ten feet below the top of the stack. Conduit supporting the obstruction light units shall be fastened to wooden structures with galvanized steel pipe straps and shall be secured by 1-1/2 inch No. 10 galvanized wood screws. Conduit shall be fastened to masonry structures by the use of expansion shields, screw anchors, or toggle bolts using No. 10, or larger, galvanized wood or machine screws. Conduit fastened to structural steel shall have the straps held with not less than No. 10 roundhead machine screws in drilled and tapped holes. Fastenings shall be approximately five feet apart. Three coats of paint shall be applied (one prime, one body, and one finish coat) with color in accordance with Federal Specification 595, international orange, number 12197 paint to all exposed material installed.

119.3.5 Series Isolation Transformers

(1) If it is designed for use in a series lighting circuit, the L810 series obstruction light does not include a film cutout. Therefore, an isolation transformer is required with each series lamp. Double series units of this type require two isolation transformers. The transformer shall be housed in a light base in

accordance with paragraph 119.2.4 or buried directly in the earth in accordance with the details shown in the Plans.

119.3.6 Wiring

(1) Contractor shall furnish all necessary labor and materials. Contractor shall make complete electrical connections from the underground cable or other source of power in accordance with the wiring diagram furnished with the project Plans. If underground cable is required for the power feed and if duct is required under paved areas, the cable and duct shall be installed in accordance with and paid for as described in L108, Underground Power Cable for Airports, and L110, Airport Underground Electrical Duct Banks and Conduit.

119.3.7 Lamps

(1) Contractor shall furnish and install in each unit one or two lamps that are in accordance with the manufacturer's requirements. Provide two lamp sets as spares.

119.3.8 Tests

(1) Installation shall be fully tested by continuous operation for not less than 1/2 hour as a completed unit prior to acceptance. These tests shall include the functioning of each control not less than ten times.

119.4 Measurement

119.4.1 General

(1) Airport Obstruction Lighting and Electric Utility Service will be measured as complete units per lump sum or per each at location indicated in the Contract Documents.

119.5 Payment

119.5.1 General

(1) Payment will be made at the Contract unit price per each or the Contract price per lump sum for the Classification of Airport Obstruction Lights, at the locations indicated, complete and accepted.

(2) Payment will be made at the Contract price per lump sum for the Electric Utility Service, at the locations indicated, complete and accepted.

(3) These prices will be full compensation for furnishing all materials and for all preparation assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the Work.

a. Airport Obstruction lights will include the obstruction light equipment, lamps, hardware attachments, pole mounting, leveling, conduit, wiring, power source, photoelectric control, ground rods, and servicing and testing of the Obstruction Lights, all in accordance with the Contract Documents.

b. The Electric Utility Service will include the utility meter, meter enclosure, main service switch, pull box, photocell contactor or controller, if required, conduit wire, attachment structure, concrete pad, excavation, and backfill, all in accordance with the contract documents and in particular 100.2.2 and 100.2.3.

(4) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

119.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
L119.100	Obstruction Lighting L-810	Each (EA)
L119.101 through L119.199	Obstruction Lighting L-810 (location)	Lump Sum (LS)
L119.200	Obstruction Lighting L-856	Each (EA)
L119.201 through L119.299	Obstruction Lighting L-856 (location)	Lump Sum (LS)
L119.300	Obstruction Lighting L-857	Each (EA)
L119.301 through L119.399	Obstruction Lighting L-857 (location)	Lump Sum (LS)
L119.400	Obstruction Lighting L-864	Each (EA)
L119.401 through L119.499	Obstruction Lighting L-864 (location)	Lump Sum (LS)
L119.500	Obstruction Lighting L-865	Each (EA)

L119.501 through L119.599	Obstruction Lighting L-865 (location)	Lump Sum (LS)
L119.600	Obstruction Lighting L-866	Each (EA)
L119.601 through L119.699	Obstruction Lighting L-866 (location)	Lump Sum (LS)
L119.700	Obstruction Lighting L-885	Each (EA)
L119.701 through L119.799	Obstruction Lighting L-885 (location)	Lump Sum (LS)
L119.801 through L119.899	Electrical Utility Service (location)	Lump Sum (LS)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 70/7460-1	Obstruction Marking and Lighting
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-7	Specification for L.824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-42	Specification for Airport Light Bases, Transformer Housing, Junction Boxes, and Accessories
AC 150/5345-43	Specification for Obstruction Lighting Equipment
AC 150/5345-47	Specification for Series to Series Isolation Transformers for Airport Lighting Systems
AC 150/5345-53	Airport Lighting Equipment Certification Program

American National Standards Institute / Insulated Cable Engineers Association (ANSI/ICEA)

ANSI/ICEA S-70-547	Standards for Weather-Resistant Polyolefin Covered Connectors

Commercial Item Description (CID)

A-A-59544A	Cable and Wire, Electrical (Power, Fixed Installation)

Federal Standard (FED STD)

FED STD 595	Colors used in Government Procurement

National Fire Protection Association (NFPA)

NFPA-70	National Electrical Code (NEC)

Underwriters Laboratories (UL)

UL Standard 6	Electrical Rigid Metal Conduit – Steel
UL Standard 514B	Conduit, Tubing, and Cable Fittings Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL Standard 651	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL Standard 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit
UL Standard 1242	Electrical Intermediate Metal Conduit - Steel

END OF SPECIFICATION L119

Specification L125 - Installation of Airport Lighting Systems

125.1 Description

125.1.1 General

(1) This work shall consist of airport lighting systems furnished and installed in accordance with this specification, the referenced specifications, and the applicable Advisory Circulars. The systems shall be installed at the locations and in accordance with the dimensions, design, and details shown in the Plans. This work shall include furnishing equipment, materials, services, and incidentals necessary to place the systems in operation as completed units in accordance with the Plans and Specifications.

125.1.2 Certification and Submittals

(1) Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specifications shall be certified under the Airport Lighting Equipment Certification Program in accordance with AC 150/5345-53, current version. FAA certified airfield lighting shall be compatible with each other to perform in compliance with FAA criteria and the intended operation. If the Contractor provides equipment that does not performs as intended because of incompatibility with the system, the Contractor assumes all costs to correct the system for to operate properly.

(2) Manufacturer's certifications shall not relieve the Contractor of their responsibility to provide materials in accordance with these specifications and acceptable to the RPR. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the RPR and replaced with materials, which do comply with these specifications, at the sole cost of the Contractor.

(3) Materials and equipment used to construct this Work shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals shall be in accordance with 100.2.10.

(4) The submitted data shall be sufficient to determine compliance with the Plans and Specifications and AC 150/5345-53.

125.1.3 Warranty

(1) Refer to 100.2.18 for warranty requirements.

125.1.4 Related Document

(1) 100.1 through 100.2.17, and 100.3.2 apply to the Work under this Specification.

125.1.5 Airport Lighting System Items

125.1.5.1 Runway End Identification Lights (REIL)

(1) Provide REIL fixtures as specified in AC 150/5345-51 (current version) including appurtenant materials and equipment to construct a functioning system on the designated runway.

(2) Construct REIL system in accordance with the details and at the location shown on the Plans.

125.1.5.2 Omni-Directional Approach Lighting System (ODALS)

(1) Provide ODALS fixtures as specified in AC 150/5345-51 (current version) including appurtenant materials and equipment to construct a functioning system on the designated runway.

(2) Construct ODALS in accordance with the details and at the location shown on the Plans.

125.1.5.3 Runway In-Pavement Light

(1) Provide Runway In-Pavement Light as specified in AC 150/5345-46 (current version). Lights shall be the type, class, mode, style, and option indicated. Include appurtenant materials and equipment to construct a functioning light in accordance with the detail shown on the Plans.

(2) Construct Runway In-Pavement Light in accordance with the details and at the location shown on the Plans.

125.1.5.4 Taxiway In-Pavement Light

(1) Provide Taxiway In-Pavement Light as specified in AC 150/5345-46 (current version). Lights shall be the type, class, mode, style, and option indicated. Include appurtenant materials and equipment to construct a functioning light in accordance with the detail shown on the Plans.

(2) Construct Taxiway In-Pavement Light in accordance with the Specifications and details, and at the location shown on the Plans.

125.1.5.5 Retroreflective Marker

(1) Provide Retroreflective Marker as specified in AC 150/5345-39 (current version).

(2) Construct Taxiway In-Pavement Light in accordance with the Specifications and details, and at the location shown on the Plans.

125.1.5.6 Runway Guard Light

(1) Provide Runway Guard Light as specified in AC 150/5345-46 (current version). Optional items shall be shown on the Plans or indicated in the Special Provisions. Include appurtenant materials and equipment to construct a functioning light in accordance with the detail shown on the Plans.

(2) Construct Runway Guard Light in accordance with the Specifications and details, and at the location shown on the Plans.

125.1.5.7 Medium Intensity Runway Light (MIRL)

(1) Provide Medium Intensity Runway Light as specified in AC 150/5345-46 (current version). MIRL shall be Mode 1 – Constant Current Fixture, unless Mode 2 - Constant Voltage Fixture is indicated on the Plans or in the Special Provisions. Optional items shall be shown on the Plans or indicated in the Special Provisions. Include appurtenant materials and equipment to construct a functioning light in accordance with the detail shown on the Plans.

(2) Construct Medium Intensity Runway Light in accordance with the Specifications and details, and at the location shown on the Plans.

125.1.5.8 Medium Intensity Threshold Light

(1) Provide Medium Intensity Threshold Light as specified in AC 150/5345-46 (current version). Light shall be Mode 1 – Constant Current Fixture, unless Mode 2 - Constant Voltage Fixture is indicated on the Plans or in the Special Provisions. Optional items shall be shown on the Plans or indicated in the Special Provisions. Include appurtenant materials and equipment to construct a functioning light in accordance with the detail shown on the Plans.

(2) Construct Medium Intensity Threshold Light in accordance with the Specifications and details, and at the location shown on the Plans.

125.1.5.9 Medium Intensity Taxiway Light (MITL)

(1) Provide Medium Intensity Taxiway Light as specified in AC 150/5345-46 (current version). MITL shall be Mode 1 – Constant Current Fixture, unless Mode 2 - Constant Voltage Fixture is indicated on the Plans or in the Special Provisions. Optional items shall be shown on the Plans or indicated in the Special Provisions. Include appurtenant materials and equipment to construct a functioning light in accordance with the detail shown on the Plans.

(2) Construct Medium Intensity Runway Light in accordance with the Specifications and the details, and at the location shown on the Plans.

125.1.5.10 High Intensity Runway Light (HIRL)

(1) Provide High Intensity Runway Light as specified in AC 150/5345-46 (current version). HIRL shall be Mode 1 – Constant Current Fixture. Optional items shall be shown on the Plans or indicated in the Special Provisions. Include appurtenant materials and equipment to construct a functioning light in accordance with the detail shown on the Plans.

(2) Construct High Intensity Runway Light in accordance with the Specifications and the details, and at the location shown on the Plans.

125.1.5.11 High Intensity Threshold Light

(1) Provide High Intensity Threshold Light as specified in AC 150/5345-46 (current version). Light shall be Mode 1 – Constant Current Fixture. Optional items shall be shown on the Plans or indicated in the Special Provisions. Include appurtenant materials and equipment to construct a functioning light in accordance with the detail shown on the Plans.

(2) Construct High Intensity Runway Light in accordance with the Specifications and the details, and at the location shown on the Plans.

125.1.5.12 Stop Bar Light

(1) Provide Stop Bar Light as specified in AC 150/5345-46 (current version). MITL shall be Mode 1 – Constant Current Fixture, unless Mode 2 - Constant Voltage Fixture is indicated on the Plans or in the Special Provisions. Optional items shall be shown on the Plans or indicated in the Special Provisions. Include appurtenant materials and equipment to construct a functioning light in accordance with the detail shown on the Plans.

(2) Construct Stop Bar Light in accordance with the Specifications and the details, and at the location shown on the Plans.

125.1.5.13 Guidance Signs

(1) Provide Guidance Signs as specified in AC 150/5345-44 (current version). Guidance Signs shall be the type, size, style, and class indicated on the Plans. Sign shall be Mode 2, unless another Mode is indicated on the Plans. Include concrete pad, electrical base can, and appurtenant materials and equipment required to construct a functioning sign in accordance with the detail shown on the Plans.

(2) A Guidance Sign with one message element, shown on one legend panel, is a one module sign. A guidance sign with multiple message element will constitute a message array, and will normally be contained in one sign housing. A guidance sign with two message elements, each on a separate panel, will be a two module sign. One guidance sign housing can have up to four message elements (four modules).

(3) Construct Guidance Sign in accordance with the Specifications and the details, and at the location shown on the Plans.

125.1.5.14 Modify Guidance Sign

(1) Existing Guidance Signs designated on the Plans shall be modified by repairing, replacing, removing, or adding components to the sign as indicated. Modifications to Guidance Signs shall result in a sign that is in conformance with AC 150/5345-44 (current version).

(2) Construct Guidance Sign in accordance with the Specifications and the details shown on the Plans. All signs designated to be modified shall have all bulbs replaced. The completed sign shall be fully functional and the surface disturbed by construction shall be restored to its original condition or to an improved condition if indicated on the Plans.

125.1.5.15 Relocate Guidance Sign

(1) Relocate Guidance Signs designated on the Plans to a new location. Relocated Guidance Signs shall result in a sign that is in conformance with AC 150/5345-44 (current version).

(2) Relocate Guidance Sign in accordance with the Specifications and the details, and to the location shown on the Plans. All signs designated to be relocated shall have all bulbs replaced. The completed sign shall be fully functional. The original sign base shall be removed and disposed of off-site at a location provide by Contractor (unless otherwise indicated on the Plans). The original site of the sign shall be backfilled, graded to meet the contour of the surrounding ground and covered with four inches of imported topsoil, seeded, and mulched. Construct a new sign base at the new location and reconstruct the guidance sign in accordance with the Specifications and the detail for guidance signs. Sign components damaged during removal shall be replaced by Contractor at Contractor's expense as part of the cost of the sign relocation. Restore the surface in the vicinity of the new sign location.

125.1.5.16 Runway Distance Remaining Sign

(1) Provide Distance Remaining Signs as specified in AC 150/5345-44 (current version). Guidance Signs shall be the type, size, and style indicated on the Plans. Sign shall be Class 2, Mode 2, unless another Class and Mode is indicated on the Plans. Include concrete pad, electrical base can, and appurtenant materials and equipment required to construct a functioning sign in accordance with the detail shown on the Plans.

(2) Construct Distance Remaining Sign in accordance with the Specifications and the details, and at the location shown on the Plans.

125.1.5.17 Taxiway End Marking Sign

(1) Provide Taxiway End Marking Signs as specified in AC 150/5345-44 (current version). Signs shall be the size indicated. Include appurtenant materials required to construct a functioning sign in accordance with the details shown on the Plans or in the Specification.

(2) Construct Distance Remaining Sign in accordance with the Specifications and the details, and at the location shown on the Plans.

125.1.5.18 Base Can

(1) Provide Base Can as specified in AC 150/5345-42 (current version). Base can shall be the Class IB unless another Class is indicated on the Plans. Include appurtenant materials required to construct a complete installation in accordance with the detail shown on the Plans.

(2) Construct Base Can in accordance with the Specifications and the details, and at the location shown on the Plans.

125.1.5.19 Precision Approach Path Indicator (PAPI)

(1) Provide PAPI components as specified in AC 150/5345-28 (current version) including appurtenant materials and equipment to construct a functioning system on the designated runway. Provide options shown on the Plans or required in the Special Provisions.

(2) Construct PAPI system in accordance with the details and at the location shown on the Plans.

125.1.5.20 Lighted Temporary Runway Closure Aid

(1) Provide Lighted Temporary Runway Closure Aid as specified in AC 150/5345-55 (current version). Provide options shown on the Plans or required in the Special Provisions.

(2) Deliver, setup, and test the Lighted Temporary Runway Closure Aid system in presence of Engineer.

125.1.5.21 Removal

(1) Remove existing Runway or Taxiway stake mounted light, Runway or Taxiway base mounted light, or Guidance Signs at the location indicated on the Plans. Material removed shall be disposed of off-site at a location provided by Contractor at Contractor's expense. Items designated to be salvaged and to remain the property of the Airport shall be indicated on the Plans or in the Special Provisions.

125.1.5.22 Electric Utility Service

(1) Provide an Electric Utility Service in accordance with requirements shown on the Plans. Electric Utility Service refers to products and materials necessary to bring a Public Utility electrical source to the service point. This includes, but is not limited to, permits, fees, utility poles, transmission circuits, service laterals, utility transformers, or provisions for transformers, service metering equipment, main service disconnect switch, and costs incurred by the Public Utility on and off the project site, inside and outside the construction limits, required to bring electrical power to a service point.

125.1.5.23 Spare Electrical Equipment

(1) Provide spare electrical equipment in accordance with the schedule shown on the Plans or as specified in the Special Provisions. Spare electrical equipment shall meet the applicable requirements of L100, this Specification, or other portions of the Contract Documents that are applicable to a particular piece of equipment. Spare equipment shall be delivered to the Airport and unloaded and placed in a location specified by the Airport Manager.

125.2 Materials

125.2.1 Concrete

(1) Concrete shall conform to P610 Structural Portland Cement Concrete or SHS 501 Concrete.

125.2.2 Conduit/Duct

(1) Conduit shall conform to L110 Installation of Airport Underground Electrical Duct Banks and Conduit.

125.2.3 Cable and Counterpoise

(1) Cable and Counterpoise shall conform to L108 Installation of Underground Power Cable for Airports.

125.2.4 Tape

(1) Rubber and plastic electrical tapes shall be Scotch Electrical Tape Numbers 23 and 88 respectively, as manufactured by 3M Company or an approved equal.

125.2.5 Cable Connections

(1) Cable Connections shall conform to L108 Installation of Underground Cable for Airports.

125.2.6 Retroreflective Markers

(1) Retroreflective markers shall be type L-853 and shall conform to the requirements of 150/5345-39 and shall be listed in appendix 3 to AC 150/5345-53.

125.2.7 Light Base and Transformer Housings

(1) Light Base and Transformer Housings shall conform to the requirements of 150/5345-42 and be listed in appendix 3 to AC 150/5345-53. Light bases shall be the type, class and size as indicated or as required to accommodate the fixture or device installed thereon. Base plates, cover plates, and adapter plates shall be provided to accommodate various sizes of fixtures. Type, class, and size may be: Type L-867, L-868, L-869; Class 1A, 1B, 2A, 2B; Size A, B, C, D, E; refer to AC 150/5345-53 for descriptions.

125.2.8 Isolation Transformers

(1) Isolation transformers shall be Type L-830, size as required for each installation. Transformer shall conform to AC 150/5345-47 and be listed in appendix 3 to AC 150/5345-53.

125.2.9 Runway and Taxiway Lights

(1) Runway and Taxiway Edge Lights shall conform to the requirements of 150/5345-46 and be listed in appendix 3 to AC 150/5345-53. Lamps shall be of size and type indicated, or as required by fixture manufacturer for each lighting fixture required under this contract. Filters shall be of colors conforming to the specification for the light concerned or to the standard referenced.

125.2.10 Runway and Taxiway Signs

(1) Runway and Taxiway Signs shall conform to the requirements of 150/5345-44 and be listed in the current version of Appendix 3 to AC 150/5345-53. Guidance signs shall include:

a. L-858Y Direction Sign
b. L-858R Mandatory Sign
c. L-858L Location Sign
d. L-858B Runway Distance Remaining Sign
e. Type L-858Ba Dot Matrix Runway Distance Remaining Sign
f. Type L-858C Taxiway Ending Marker Sign, Size (as indicated), Style4, Mode 1 (yellow 45 degree diagonal stripes on a black background).
g. Type L-858H One-Half Distance Remaining Sign

125.2.11 Runway End Identifier Light (REIL)

(1) The REIL fixtures shall meet the requirements of FAA AC 150/5345-51, and be listed in the current version of Appendix 3 to AC 150/5345-53.

125.2.12 Precision Approach Path Indicator

(1) The light units for the PAPI shall meet the requirements of FAA AC 150/5345-28, and be listed in the current version of Appendix 3 to AC 150/5345-53.

125.2.13 Circuit Selector Cabinet

(1) The circuit selector cabinet shall be FAA AC 150/5345-5, Type L-847, one, two, three, or four circuit control, as indicated, provide Class A, indoor or B, outdoor, Rating for 6.6 amperes or 20 amperes as indicated on Plans or Special Provisions and be listed in the current version of Appendix 3 to AC 150/5345-53.

125.3 Construction

125.3.1 Installation

(1) Contractor shall furnish, install, connect and test all equipment, accessories, conduit, cables, wires, buses, grounds and support items necessary to ensure a complete and operable airport lighting system as specified here and shown in the plans.

(2) Equipment installation and mounting shall comply with the requirements of the National Electrical Code and state and local code agencies having jurisdiction.

(3) Contractor shall install the specified equipment in accordance with the applicable advisory circulars and the *details* shown on the plans.

125.3.2 Testing

(1) All lights shall be fully tested by continuous operation for not less than 24 hours as a completed system prior to acceptance. The test shall include operating the constant current regulator in each step not less than 10 times at the beginning and end of the 24-hour test. The fixtures shall illuminate properly during each portion of the test.

125.3.3 Shipping and Storage

(1) Equipment should be shipped in suitable packing material to prevent damage during shipping. Store and maintain equipment and materials in areas protected from weather and physical damage.

(2) Equipment and materials, in the opinion of the Engineer, damaged during construction or storage shall be replaced by the Contractor at no additional cost to the Owner. Painted or galvanized surfaces that are damaged shall be repaired according to manufacturer's recommendations.

125.3.4 Elevated and In-Pavement Lights

(1) Water, debris, and other foreign substances shall be removed prior to installing light base and light.

(2) A jig or holding device shall be used when installing each light fixture to ensure positioning to the proper elevation, alignment, level control, and azimuth control. Light fixture shall be oriented with the light beams parallel to the runway or taxiway centerline and facing in the required direction. Outermost edge

of fixture shall be level with the surrounding pavement. Surplus sealant or flexible embedding material shall be removed. The holding device shall remain in place until sealant has reached its initial set.

125.3.5 Lighting Systems.

(1) Lighting systems shall be installed at the location indicated in the Contract Documents. The power source and electric utility service shall be installed at the location indicated in the Contract Documents.

125.3.6 Grounding Stake Mounted Lighting Fixtures

(1) Grounding stake mounted fixtures consists of grounding all edge lighting fixtures mounted on angle stakes, including all labor and materials for the grounding electrode conductor, stake grounding connection, and inspecting the system electrode grounding conductor and exothermic weld.

(2) The system grounding electrode conductor shall be installed to all stakes prior to the installation of the stakes so that the conductor lengths and exothermic welds can be inspected at one time. Splices are not allowed in the grounding electrode conductor.

(3) All edge lighting mounting provision shall be metal so that the electrical ground continuity is continuous from the light fixture housing, through the fixture stem, frangible coupling, to the iron mounting stake. Plastic components are not allowed anywhere in the fixture to stake assembly.

125.3.7 Grounding Base Cans

(1) Grounding of L–867 and L-868 base cans consists of grounding all base cans for edge lighting fixtures, REIL's, taxiway guidance signs, and base cans used as junction boxes including all labor and materials for the grounding electrode conductor, base can grounding connection, and inspecting the system electrode grounding conductor and ground lug connection.

(2) The system grounding electrode conductor shall be installed to all cans prior to the installation of the base cans, so that the conductor lengths and compression connections can be inspected at one time. Splices are not allowed in the grounding electrode conductor.

(3) The cable lug shall be a UL listed copper compression connector, Thomas and Betts, Burndy, Blackburn, or equal. The connector shall be attached to the can with a separate self-locking nut/bolt arrangement compatible with the can manufacturer's ground mounting provision. Contractor shall use the manufacturer's approved mechanical indentor tool for installing the compression connector. The bolted connection to the factory grounding provision shall be torqued for adequate bond. Stripped threads will be a cause for rejection.

(4) When the base can is used as a mounting provision for an edge light, the mounting provision shall be metal so that the electrical ground continuity is continuous from the light housing, through the housing stem, frangible coupling, to the base can. Plastic components are not allowed anywhere in the fixture to base can assembly.

125.3.8 Ground Rods for Regulator Secondary 5kv Lighting Circuit

(1) The regulator secondary circuit shall be grounded according to the Contract Documents.

a. The standard grounding method for grounding lights and cans shall consist of two ground rods 5/8" diameter x 8–foot long, for the purpose of connecting it to the grounding electrode conductor as noted on the Drawings.

b. Connect ground rods to the grounding electrode conductor by exothermic welds or other FAA approved grounding connection.

(2) Alternate grounding method for grounding lights and cans. When specified in the Plans or Special Provisions, the alternate method for grounding lighting circuits described in the following paragraphs shall be used.

a. The test shall include Contractor supplied manpower and test equipment to test each grounding system. The test instrument shall be a three pole ground resistance tester, AEMC, Biddle, or equal, as approved by the Engineer, with a plus or minus 5% or better accuracy for ten percent to 100 percent of 0–50 ohm scale range, accompanied by formal proof that the instrument has been calibrated for accuracy, no more than 30 days prior to the test date for this Pay Item. Clamp on testers and high resistance fault locators are not acceptable.

b. The test shall achieve a maximum 25 ohms less five percent (23.75 ohms) to ground with each installation beginning with one eight-foot length installed and tested. If 23.75 ohms are not attained on the first rod, additional lengths shall be installed and tested again until no more than 23.75 ohms is achieved. Ground rod shall be 5/8" diameter by eight feet long sectional type copper clad steel. Ground rod installation shall comply with all the requirements of the latest edition of NFPA Section 70, Article 250.

c. Contractor shall exothermic weld or use other FAA approved grounding connector to connect the grounding electrode conductor to the ground rod below the coupling thread line. Contractor will be paid only once for this connection. More specifically, Contractor will only be paid for one grounding electrode

conductor weld per ground rod. Contractor will not be paid for more than one weld per rod length as a result of a faulty weld performance or damage as a result of careless installation. When more ground rod lengths are added to achieve the specified resistance, Contractor shall cut the conductor off the previous rod and reattach the conductor to the end of the added rod. After each consecutive ground rod section is installed in place, the electrode conductor shall be re-welded, and Contractor shall retest to determine the specified resistance. A threaded coupling and driving stud shall be used to protect the ground rod threads during the installation of the ground rod. When the rod is installed in an L–867 can base, the grounding electrode conductor shall be welded before the rod is driven past the top elevation of the can base. All exothermic welds to ground rods at stake mounted fixtures shall be left exposed until tested.

d. Contractor shall develop a log identifying the final resistance value for each grounding system, signed by both the Contractor and the witness, and copied for the Engineer. As a minimum, the log shall include the name of the Airport, the name and model number of the test instrument, the project number, the date of the test, a tag number for each test location, coordinated with the record drawing, number of ground rod lengths at each location, final resistance values, and place for witness and Contractor signature.

125.4 Measurement

125.4.1 General

(1) Reflective markers will be measured by the number installed as completed units in place, ready for operation, in accordance with the Contract Documents.

(2) Runway and taxiway lights will be measured by the number of each type installed as completed units in place, ready for operation, in accordance with the Contract Documents.

(3) Guidance signs will be measured by the number of each size (modules) installed as completed units, in place, ready for operation, in accordance with the Contract Documents.

(4) Runway End Identifier Lights (REIL) and ODALS shall be measured per lump sum for each individual system installed as a completed unit in place, ready for operation, in accordance with the Contract Documents.

(5) Modify Guidance Sign and Relocate Guidance Sign shall be measured for payment as a complete unit per lump sum for modifications or relocation of individual signs at a given location or as designated by a sign number.

(6) Base Can of the type indicated shall be measure on a unit basis per each for base cans constructed in accordance with the Contract Documents.

(7) Precision Approach Path Indicator shall be measured per lump sum for each system installed as a completed unit, in place, ready for operation, and accepted.

(8) Lighted Temporary Runway Closure Aid L-893 shall be measured on a unit basis per each furnished and delivered in accordance with the Contract Documents.

(9) Removals of the type indicated shall be measured for payment on a unit basis per each for items removed in accordance with the Contract Documents.

(10) Electrical Utility Service, provided at a location indicated, shall be measured for payment on a lump sum basis when completed in accordance with the Contract Documents.

(11) Spare Electrical Equipment shall be measured for payment on a lump sum basis for equipment furnish and delivered in accordance with the Contract Documents.

125.5 Payment

125.5.1 General

(1) Payment will be made at the Contract price measured as specified for each complete runway or taxiway light, guidance sign, retroreflective marker, runway end identification light (REI), ODALS, precision approach path indicator (PAPI), modified or relocated guidance sign, base can, lighted temporary closure aid, removal, electrical utility service, and spare electrical equipment provided and installed in conformance with the Contract Documents. This payment will be full compensation for furnishing all materials and for all preparation, assembly, exothermic welds, and installation of these materials, and for all labor, equipment, tools submittals, testing, and incidentals necessary to complete this work.

(2) Measurement and Payment will only be made for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents shall be included in the Pay Items contained in the Schedule of Prices.

125.5.2 Pay Items

(1) Payment will be made for measured quantities based upon Contract prices for the following Pay Items.

Pay Item	Description	Unit
L125.101 through L125.109	REIL Constant Voltage L-849V (style) (location)	Lump Sum (LS)
L125.110 through L125.119	REIL LED Constant Voltage L-849V, (style) (location)	Lump Sum (LS)
L125.120 through L125.129	REIL Constant Current L-849I (style) (location)	Lump Sum (LS)
L125.130 through L125.139	REIL LED Constant Current L-849I (style) (location)	Lump Sum (LS)
L125.140 through L125.149	ODALS Constant Current L-859V Style F (location)	Lump Sum (LS)
L125.201 through L125.209	Runway In-Pavement Light (type) (class) (mode) (style) (option)	Each (EA)
L125.210 through L125.219	Runway In-Pavement Light LED (type) (class) (mode) (style) (option)	Each (EA)
L125.220 through L125.229	Taxiway In-Pavement Light (type) (class) (mode) (style) (option)	Each (EA)
L125.230 through L125.239	Taxiway In-Pavement Light LED (type) (class) (mode) (style) (option)	Each (EA)
L125.251	Retroreflective Marker, L-853, Type 1, Style 1	Each (EA)
L125.253	Retroreflective Marker, L-853, Type 1, Style 2	Each (EA)
L125.255	Retroreflective Marker, L-853, Type 2	Each (EA)
L125.261	Runway Guard Light LED L-804 Mode 1	Each (EA)
L125.262	Runway Guard Light LED L-804 Mode 2	Each (EA)
L125.300 through L125.309	Medium Intensity Runway and Threshold Light, Stake Mounted	Each (EA)
L125.310 through L125.319	Medium Intensity Runway and Threshold Light, LED, Stake Mounted	Each (EA)
L125.320 through L125.329	Medium Intensity Runway and Threshold Light, Base Mounted	Each (EA)
L125.330 through L125.339	Medium Intensity Runway and Threshold Light, LED, Base Mounted	Each (EA)
L125.340	Medium Intensity Taxiway Light, L-861T, Stake Mounted	Each (EA)
L125.341	Medium Intensity Taxiway Light, L-861T, Base Mounted	Each (EA)
L125.342	Medium Intensity Taxiway Light, L-861T LED, Stake Mounted	Each (EA)
L125.343	Medium Intensity Taxiway Light, L-861T LED, Base Mounted	Each (EA)
L125.350 through L125.359	High Intensity Runway and Threshold Light, Base Mounted	Each (EA)
L125.360 through L125.369	High Intensity Runway and Threshold Light, LED, Base Mounted	Each (EA)
L125.370	Stop Bar Light L-862S	Each (EA)
L125.400 through L125.409	Guidance Sign, 1-Module, per each	Each (EA)
L125.410 through L125.419	Guidance Sign, 2-Module, per each	Each (EA)
L125.420 through L125.429	Guidance Sign, 3-Module, per each	Each (EA)
L125.430 through L125.439	Guidance Sign, 4-Module, per each	Each (EA)
L125.440 through L125.449	Modify Guidance Sign (location)	Lump Sum (LS)

L125.450 through L125.459	Relocate Guidance Sign (location)	Lump Sum (LS)
L125.460 through L125.469	Runway Distance Remaining Sign (type) (size) (style)	Each (EA)
L125.470 through L125.479	Base Can L-867 (size)	Each (EA)
L125.480 through L125.489	Base Can L-867 with Lid and Gasket (size)	Each (EA)
L125.490 through L125.499	Base Can L-868 with Lid and Gasket (size)	Each (EA)
L125.510	PAPI, L-880, Style A, Class I	Lump Sum (LS)
L125.520	PAPI, L-880, Style A, Class II	Lump Sum (LS)
L125.530	PAPI, L-880, Style B, Class I	Lump Sum (LS)
L125.540	PAPI, L-880, Style B, Class II	Lump Sum (LS)
L125.550	PAPI, L-881, Style A, Class I	Lump Sum (LS)
L125.560	PAPI, L-881, Style A, Class II	Lump Sum (LS)
L125.570	PAPI, L-881, Style B, Class I	Lump Sum (LS)
L125.580	PAPI, L-881, Style B, Class II	Lump Sum (LS)
L125.600	Lighted Temporary Runway Closure Aid L-893	Each (EA)
L125.610	Remove Runway or Taxiway Stake Mounted Light, per each	Each (EA)
L125.620	Remove Runway or Taxiway Base Mounted Light, per each	Each (EA)
L125.630	Remove Taxiway Guidance Sign, per each	Each (EA)
L125.640	Electric Utility Service (location)	Lump Sum (LS)
L125.650	Spare Electrical Equipment	Lump Sum (LS)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5340-18	Standards for Airport Sign Systems
AC 150/5340-26	Maintenance of Airport Visual Aid Facilities
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-5	Circuit Selector Switch
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-28	Precision Approach Path Indicator (PAPI) Systems
AC 150/5345-39	Specification for L-853, Runway and Taxiway Retroreflective Markers
AC 150/5345-42	Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories
AC 150/5345-44	Specification for Runway and Taxiway Signs
AC 150/5345-46	Specification for Runway and Taxiway Light Fixtures
AC 150/5345-47	Specification for Series to Series Isolation Transformers for Airport Lighting Systems
AC 150/5345-51	Specification for Discharge-Type Flashing Light Equipment
AC 150/5345-53	Airport Lighting Equipment Certification Program

Engineering Brief (EB)

EB No. 67	Light Sources Other than Incandescent and Xenon for Airport and Obstruction Lighting Fixtures
EB No. 95	Additional Siting and Survey Considerations for Precision Approach Path Indictor (PAPI) and Other Visual Glide Slope Indicators (VGSI)END OF Specification L125

END OF SPECIFICATION L125

WBOA Standard Specification for Airport Construction - 2021
Pay Item List

PAY ITEM		DESCRIPTION	UNIT
C105.010		Mobilization	Lump Sum (LS)
P101.010		Bituminous Pavement Removal	Square Yard (SY)
P101.020		PCC Pavement Removal	Square Yard (SY)
P101.040		Paint and Rubber Removal	Square Feet (SF)
P101.050		PCC Spall Repair	Square Feet (SF)
P101.052		Aspaltic Pavment Repair	Square Feet (SF)
P101.060		Cold Milling for Patching	Square Yard (SY)
P101.062		Cold Milling for Surface Correction	Square Yard (SY)
P151.010		Clearing	ACRE
P151.020	through P151.029	Clearing Area No. (location)	Lump Sum (LS)
P151.030		Clearing and Grubbing	ACRE
P151.040	through P151.049	Clearing and Grubbing for Area (location)	Lump Sum (LS)
P151.050		Clearing Isolated Trees less than 2 feet diameter	Each (EA)
P151.051		Clearing Isolated Trees from 2 to 4 feet diameter	Each (EA)
P151.052		Clearing Isolated Trees greater than 4 feet diameter	Each (EA)
P151.060		Topping Trees	Each (EA)
P151.061	through P151.080	Topping Tree Location (location no.)	Lump Sum (LS)
P152.010		Common Excavation	Cubic Yard (CY)
P152.020		Rock Excavation	Cubic Yard (CY)
P152.030		Muck Excavation	Cubic Yard (CY)
P152.040		Borrow Excavation	Cubic Yard (CY)
P154.010		Subbase Course B60K Gradation No. 1	Cubic Yard (CY)
P154.012		Subbase Course B60K Gradation No. 1	TON
P154.014		Subbase Course A60K Gradation No. 1	Cubic Yard (CY)
P154.016		Subbase Course A60K Gradation No. 1	TON
P154.020		Subbase Course B60K Gradation No. 2	Cubic Yard (CY)
P154.022		Subbase Course B60K Gradation No. 2	TON
P154.024		Subbase Course A60K Gradation No. 2	Cubic Yard (CY)
P154.026		Subbase Course A60K Gradation No. 2	TON
P159.010		Site Finishing	Lump Sum (LS)
P160.100		Remove PCC Pavement	Square Yard (SY)
P160.105		Remove PCC Butt Joints	Square Yard (SY)
P160.110		Remove Asphalt Surface	Square Yard (SY)
P160.115		Remove Asphalt Surface Butt Joints	Square Yard (SY)
P160.120		Remove Asphalt Surface Milling	Square Yard (SY)
P160.125		Remove Asphalt Surface Milling	TON
P160.130		Remove PCC Curb	Linear Foot (LF)
P160.140		Remove PCC Gutter	Linear Foot (LF)
P160.150		Remove PCC Curb & Gutter	Linear Foot (LF)
P160.155		Remove PCC Sidewalk	Square Yard (SY)
P160.159		Remove Chain Link Fence Skirt	Linear Foot (LF)
P160.160		Remove Fence, Woven Wire, Type 1	Linear Foot (LF)
P160.161		Remove Fence, Woven Wire, Type 2	Linear Foot (LF)
P160.162		Remove Fence Gate	Each (EA)
P160.163		Remove Fence, Chain Link, Type 1	Linear Foot (LF)
P160.164		Remove Fence, Chain Link, Type 2	Linear Foot (LF)
P160.165		Remove Fence, Chain Link, Type 3	Linear Foot (LF)
P160.166		Remove Fence, Chain Link, Type 4	Linear Foot (LF)
P160.167		Remove Fence, Chain Link, Type 5	Linear Foot (LF)
P160.168		Remove Fence, Chain Link, Type 6	Linear Foot (LF)
P160.169		Remove Chain Link Fence Gate	Each (EA)
P160.170		Remove Concrete Masonry	Cubic Yard (CY)
P160.180	through P160.189	Remove Concrete Masonry (location)	Lump Sum (LS)

Pay Item List

PAY ITEM		DESCRIPTION	UNIT
P160.190		Remove Surface Drains	Each (EA)
P160.195		Remove Concrete Bases	Each (EA)
P160.200	through P160.209	Remove Utility Pole (location)	Each (EA)
P160.210		Remove Manhole	Each (EA)
P160.215		Remove Catch Basin	Each (EA)
P160.220		Remove Inlet	Each (EA)
P160.225	through P160.229	Remove Septic Tank (location designation)	Lump Sum (LS)
P160.230	through P160.234	Remove Building Location (location designation)	Lump Sum (LS)
P160.235	through P160.239	Site Clearance (location designation)	Lump Sum (LS)
P160.240	through P160.249	Remove Sewer (type) (size)	Linear Foot (LF)
P160.250		Abandon Manhole	Each (EA)
P160.255		Abandon Catch Basin	Each (EA)
P160.260		Abandon Inlet	Each (EA)
P160.265		Abandon Well	Each (EA)
P160.270		Abandon Culvert Pipe	Each (EA)
P160.300		Remove Storm Sewer Under 30 Inch Diameter	Linear Foot (LF)
P160.310		Remove Storm Sewer 30 to 42 Inch Diameter	Linear Foot (LF)
P160.320		Remove Storm Sewer Over 42 Inch Diameter	Linear Foot (LF)
P160.330		Remove Storm Sewer 12-Inch	Linear Foot (LF)
P160.331		Remove Storm Sewer 15-Inch	Linear Foot (LF)
P160.332		Remove Storm Sewer 18-Inch	Linear Foot (LF)
P160.333		Remove Storm Sewer 21-Inch	Linear Foot (LF)
P160.334		Remove Storm Sewer 24-Inch	Linear Foot (LF)
P160.335		Remove Storm Sewer 27-Inch	Linear Foot (LF)
P160.336		Remove Storm Sewer 30-Inch	Linear Foot (LF)
P160.337		Remove Storm Sewer 36-Inch	Linear Foot (LF)
P160.338		Remove Storm Sewer 42-Inch	Linear Foot (LF)
P160.339		Remove Storm Sewer 48-Inch	Linear Foot (LF)
P160.340	through P160.349	Remove Storm Sewer (location)	Linear Foot (LF)
P160.350		Remove Culvert Under 30 Inch Diameter	Linear Foot (LF)
P160.360		Remove Culvert 30 to 42 Inch Diameter	Linear Foot (LF)
P160.370		Remove Culvert Over 42 Inch Diameter	Linear Foot (LF)
P160.380		Remove Culvert 12-Inch	Linear Foot (LF)
P160.381		Remove Culvert 15-Inch	Linear Foot (LF)
P160.382		Remove Culvert 18-Inch	Linear Foot (LF)
P160.383		Remove Culvert 24-Inch	Linear Foot (LF)
P160.384		Remove Culvert 30-Inch	Linear Foot (LF)
P160.385		Remove Culvert 36-Inch	Linear Foot (LF)
P160.386		Remove Culvert 42-Inch	Linear Foot (LF)
P160.387		Remove Culvert 48-Inch	Linear Foot (LF)
P160.390	through P160.399	Remove Culvert (location)	Linear Foot (LF)
P160.400		Remove Wind Cone	Each (EA)
P160.410		Remove Wind Tee	Each (EA)
P160.420		Remove Segmented Circle	Each (EA)
P160.430		Remove Tie-Down Anchor	Each (EA)
P190.010		Prepare Foundation for Asphalt Paving (location)	Lump Sum (LS)
P190.020		Prepare Foundation for PCC Paving (location)	Lump Sum (LS)
P190.030		Prepare Foundation for Concrete Base (location)	Lump Sum (LS)
P203.010		Backfill Granular	Cubic Yard (CY)
P205.010		Select Crushed Material	TON
P205.020		Select Crushed Material	Cubic Yard (CY)
P207.010		Composite Base Course In-Place	Square Yard (SY)
P207.020		Crushed Aggregate Base Course Spread	TON

Pay Item List

PAY ITEM		DESCRIPTION	UNIT
P207.030		Composite Base Course Transported and Placed	Cubic Yard (CY)
P207.040		Fly-Ash for Composite Base	TON
P208.010		Aggregate Base Course B60K Gradation No. 1	Cubic Yard (CY)
P208.012		Aggregate Base Course A60K Gradation No. 1	Cubic Yard (CY)
P208.020		Aggregate Base Course B60K Gradation No. 1	TON
P208.022		Aggregate Base Course A60K Gradation No. 1	TON
P208.030		Aggregate Base Course B60K Gradation No. 2	Cubic Yard (CY)
P208.032		Aggregate Base Course A60K Gradation No. 2	Cubic Yard (CY)
P208.040		Aggregate Base Course B60K Gradation No. 2	TON
P208.042		Aggregate Base Course A60K Gradation No. 2	TON
P208.050		Aggregate Base Course B60K Gradation No. 3	Cubic Yard (CY)
P208.052		Aggregate Base Course A60K Gradation No. 3	Cubic Yard (CY)
P208.060		Aggregate Base Course B60K Gradation No. 3	TON
P208.062		Aggregate Base Course A60K Gradation No. 3	TON
P209.010		Crushed Aggregate Base Course B60K	TON
P209.012		Crushed Aggregate Base Course A60K	TON
P209.020		Crushed Aggregate Base Course B60K	Cubic Yard (CY)
P209.022		Crushed Aggregate Base Course A60K	Cubic Yard (CY)
P219.010		Recycled Concrete Aggregate Base Course, 4-Inches	Square Yard (SY)
P219.011		Recycled Concrete Aggregate Base Course, 5-Inches	Square Yard (SY)
P219.012		Recycled Concrete Aggregate Base Course, 6-Inches	Square Yard (SY)
P219.013		Recycled Concrete Aggregate Base Course, 7-Inches	Square Yard (SY)
P219.014		Recycled Concrete Aggregate Base Course, 8-Inches	Square Yard (SY)
P219.015		Recycled Concrete Aggregate Base Course, 9-Inches	Square Yard (SY)
P219.016		Recycled Concrete Aggregate Base Course, 10-Inches	Square Yard (SY)
P219.017		Recycled Concrete Aggregate Base Course, 11-Inches	Square Yard (SY)
P219.018		Recycled Concrete Aggregate Base Course, 12-Inches	Square Yard (SY)
P304.010		Cement-Treated Base Course, 4-Inch	Square Yard (SY)
P304.011		Cement-Treated Base Course, 5-Inch	Square Yard (SY)
P304.012		Cement-Treated Base Course, 6-Inch	Square Yard (SY)
P304.013		Cement-Treated Base Course, 7-Inch	Square Yard (SY)
P304.014		Cement-Treated Base Course, 8-Inch	Square Yard (SY)
P304.015		Cement-Treated Base Course, 9-Inch	Square Yard (SY)
P304.016		Cement-Treated Base Course, 10-Inch	Square Yard (SY)
P304.017		Cement-Treated Base Course, 11-Inch	Square Yard (SY)
P304.018		Cement-Treated Base Course, 12-Inch	Square Yard (SY)
P306.010		Lean Concrete Base Course Gradation A, 4-Inch	Square Yard (SY)
P306.011		Lean Concrete Base Course Gradation A, 5-Inch	Square Yard (SY)
P306.012		Lean Concrete Base Course Gradation A, 6-Inch	Square Yard (SY)
P306.013		Lean Concrete Base Course Gradation A, 7-Inch	Square Yard (SY)
P306.014		Lean Concrete Base Course Gradation A, 8-Inch	Square Yard (SY)
P306.015		Lean Concrete Base Course Gradation A, 9-Inch	Square Yard (SY)
P306.016		Lean Concrete Base Course Gradation A, 10-Inch	Square Yard (SY)
P306.020		Lean Concrete Base Course Gradation B, 4-Inch	Square Yard (SY)
P306.021		Lean Concrete Base Course Gradation B, 5-Inch	Square Yard (SY)
P306.022		Lean Concrete Base Course Gradation B, 6-Inch	Square Yard (SY)
P306.023		Lean Concrete Base Course Gradation B, 7-Inch	Square Yard (SY)
P306.024		Lean Concrete Base Course Gradation B, 8-Inch	Square Yard (SY)
P306.025		Lean Concrete Base Course Gradation B, 9-Inch	Square Yard (SY)
P306.026		Lean Concrete Base Course Gradation B, 10-Inch	Square Yard (SY)
P401.101		HMA Pavment Surface, Gradation 2, 58-28 S	TON
P401.102		HMA Pavment Surface, Gradation 3, 58-28 S	TON
P401.103		HMA Pavment Surface, Gradation 2, 58-34 S	TON

PAY ITEM		DESCRIPTION	UNIT
P401.104		HMA Pavment Surface, Gradation 3, 58-34 S	TON
P401.105		HMA Pavment Surface, Gradation 2, 58-28 H	TON
P401.106		HMA Pavment Surface, Gradation 3, 58-28 H	TON
P401.107		HMA Pavment Surface, Gradation 2, 58-34 H	TON
P401.108		HMA Pavment Surface, Gradation 3, 58-34 H	TON
P401.109		HMA Pavment Surface, Gradation 2, 58-28 V	TON
P401.110		HMA Pavment Surface, Gradation 3, 58-28 V	TON
P401.111		HMA Pavment Surface, Gradation 2, 58-34 V	TON
P401.112		HMA Pavment Surface, Gradation 3, 58-34 V	TON
P401.201		HMA Pavment Binder, Gradation 1, 58-28 S	TON
P401.202		HMA Pavment Binder, Gradation 2, 58-28 S	TON
P401.203		HMA Pavment Binder, Gradation 3, 58-28 S	TON
P401.204		HMA Pavment Binder, Gradation 1, 58-34 S	TON
P401.205		HMA Pavment Binder, Gradation 2, 58-34 S	TON
P401.206		HMA Pavment Binder, Gradation 3, 58-34 S	TON
P401.207		HMA Pavment Binder, Gradation 1, 58-28 H	TON
P401.208		HMA Pavment Binder, Gradation 2, 58-28 H	TON
P401.209		HMA Pavment Binder, Gradation 3, 58-28 H	TON
P401.210		HMA Pavment Binder, Gradation 1, 58-34 H	TON
P401.211		HMA Pavment Binder, Gradation 2, 58-34 H	TON
P401.212		HMA Pavment Binder, Gradation 3, 58-34 H	TON
P401.213		HMA Pavment Binder, Gradation 1, 58-28 V	TON
P401.214		HMA Pavment Binder, Gradation 2, 58-28 V	TON
P401.215		HMA Pavment Binder, Gradation 3, 58-28 V	TON
P401.216		HMA Pavment Binder, Gradation 1, 58-34 V	TON
P401.217		HMA Pavment Binder, Gradation 2, 58-34 V	TON
P401.218		HMA Pavment Binder, Gradation 3, 58-34 V	TON
P401.301		HMA Pavment Base, Gradation 1, 58-28 S	TON
P401.302		HMA Pavment Base, Gradation 2, 58-28 S	TON
P401.303		HMA Pavment Base, Gradation 3, 58-28 S	TON
P401.304		HMA Pavment Base, Gradation 1, 58-34 S	TON
P401.305		HMA Pavment Base, Gradation 2, 58-34 S	TON
P401.306		HMA Pavment Base, Gradation 3, 58-34 S	TON
P401.307		HMA Pavment Base, Gradation 1, 58-28 H	TON
P401.308		HMA Pavment Base, Gradation 2, 58-28 H	TON
P401.309		HMA Pavment Base, Gradation 3, 58-28 H	TON
P401.310		HMA Pavment Base, Gradation 1, 58-34 H	TON
P401.311		HMA Pavment Base, Gradation 2, 58-34 H	TON
P401.312		HMA Pavment Base, Gradation 3, 58-34 H	TON
P401.313		HMA Pavment Base, Gradation 1, 58-28 V	TON
P401.314		HMA Pavment Base, Gradation 2, 58-28 V	TON
P401.315		HMA Pavment Base, Gradation 3, 58-28 V	TON
P401.316		HMA Pavment Base, Gradation 1, 58-34 V	TON
P401.317		HMA Pavment Base, Gradation 2, 58-34 V	TON
P401.318		HMA Pavment Base, Gradation 3, 58-34 V	TON
P401.401		HMA Pavment Leveling, Gradation 2, 58-28 S	TON
P401.402		HMA Pavment Leveling, Gradation 3, 58-28 S	TON
P401.403		HMA Pavment Leveling, Gradation 2, 58-34 S	TON
P401.404		HMA Pavment Leveling, Gradation 3, 58-34 S	TON
P401.405		HMA Pavment Leveling, Gradation 2, 58-28 H	TON
P401.406		HMA Pavment Leveling, Gradation 3, 58-28 H	TON
P401.407		HMA Pavment Leveling, Gradation 2, 58-34 H	TON
P401.408		HMA Pavment Leveling, Gradation 3, 58-34 H	TON

PAY ITEM		DESCRIPTION	UNIT
P401.409		HMA Pavment Leveling, Gradation 2, 58-28 V	TON
P401.410		HMA Pavment Leveling, Gradation 3, 58-28 V	TON
P401.411		HMA Pavment Leveling, Gradation 2, 58-34 V	TON
P401.412		HMA Pavment Leveling, Gradation 3, 58-34 V	TON
P402.513		HMA Pavement 3 LT 58-28 S	TON
P402.514		HMA Pavement 4 LT 58-28 S	TON
P402.515		HMA Pavement 5 LT 58-28 S	TON
P402.523		HMA Pavement 3 LT 58-34 S	TON
P402.524		HMA Pavement 4 LT 58-34 S	TON
P402.525		HMA Pavement 5 LT 58-34 S	TON
P402.534		HMA Pavement 4 LT 58-28 H	TON
P402.535		HMA Pavement 5 LT 58-28 H	TON
P402.544		HMA Pavement 4 LT 58-34 H	TON
P402.545		HMA Pavement 5 LT 58-34 H	TON
P402.612		HMA Pavement 2 MT 58-28 S	TON
P402.613		HMA Pavement 3 MT 58-28 S	TON
P402.614		HMA Pavement 4 MT 58-28 S	TON
P402.615		HMA Pavement 5 MT 58-28 S	TON
P402.622		HMA Pavement 2 MT 58-34 S	TON
P402.623		HMA Pavement 3 MT 58-34 S	TON
P402.624		HMA Pavement 4 MT 58-34 S	TON
P402.625		HMA Pavement 5 MT 58-34 S	TON
P402.633		HMA Pavement 3 MT 58-28H	TON
P402.634		HMA Pavement 4 MT 58-28 H	TON
P402.635		HMA Pavement 5 MT 58-28 H	TON
P402.643		HMA Pavement 3 MT 58-34 H	TON
P402.644		HMA Pavement 4 MT 58-34 H	TON
P402.645		HMA Pavement 5 MT 58-34 H	TON
P402.712		HMA Pavement 2 HT 58-28 S	TON
P402.713		HMA Pavement 3 HT 58-28 S	TON
P402.714		HMA Pavement 4 HT 58-28 S	TON
P402.715		HMA Pavement 5 HT 58-28 S	TON
P402.722		HMA Pavement 2 HT 58-34 S	TON
P402.723		HMA Pavement 3 HT 58-34 S	TON
P402.724		HMA Pavement 4 HT 58-34 S	TON
P402.725		HMA Pavement 5 HT 58-34 S	TON
P402.732		HMA Pavement 2 HT 58-28 H	TON
P402.733		HMA Pavement 3 HT 58-28 H	TON
P402.734		HMA Pavement 4 HT 58-28 H	TON
P402.735		HMA Pavement 5 HT 58-28 H	TON
P402.742		HMA Pavement 2 HT 58-34 H	TON
P402.743		HMA Pavement 3 HT 58-34 H	TON
P402.744		HMA Pavement 4 HT 58-34 H	TON
P402.745		HMA Pavement 5 HT 58-34 H	TON
P402.754		HMA Pavement 4 HT 58-28 V	TON
P402.755		HMA Pavement 5 HT 58-28 V	TON
P402.764		HMA Pavement 4 HT 58-34 V	TON
P402.765		HMA Pavement 5 HT 58-34 V	TON
P402.800	through P402.899	HMA Pavement Leveling (gradation) (type) (binder) (designation)	TON
P402.900		Incentive Density HMA Pavement	DOL
P402.910		HMA Cold Weather Paving	TON
P501.006		Portland Cement Concrete Pavement 6-Inch	Square Yard (SY)
P501.007		Portland Cement Concrete Pavement 7-Inch	Square Yard (SY)

Pay Item List

PAY ITEM		DESCRIPTION	UNIT
P501.008		Portland Cement Concrete Pavement 8-Inch	Square Yard (SY)
P501.009		Portland Cement Concrete Pavement 9-Inch	Square Yard (SY)
P501.010		Portland Cement Concrete Pavement 10-Inch	Square Yard (SY)
P501.011		Portland Cement Concrete Pavement 11-Inch	Square Yard (SY)
P501.012		Portland Cement Concrete Pavement 12-Inch	Square Yard (SY)
P501.013		Portland Cement Concrete Pavement 13-Inch	Square Yard (SY)
P501.014		Portland Cement Concrete Pavement 14-Inch	Square Yard (SY)
P501.015		Portland Cement Concrete Pavement 15-Inch	Square Yard (SY)
P501.016		Portland Cement Concrete Pavement 16-Inch	Square Yard (SY)
P501.017		Portland Cement Concrete Pavement 17-Inch	Square Yard (SY)
P501.018		Portland Cement Concrete Pavement 18-Inch	Square Yard (SY)
P501.019		Portland Cement Concrete Pavement 19-Inch	Square Yard (SY)
P501.020		Portland Cement Concrete Pavement 20-Inch	Square Yard (SY)
P501.021		Portland Cement Concrete Pavement 21-Inch	Square Yard (SY)
P501.022		Portland Cement Concrete Pavement 22-Inch	Square Yard (SY)
P501.023		Portland Cement Concrete Pavement 23-Inch	Square Yard (SY)
P501.024		Portland Cement Concrete Pavement 24-Inch	Square Yard (SY)
P626.010		Emulsified Asphalt Slurry Seal Surface Treatment	Square Yard (SY)
P603.010		Emulsified Asphalt Tack Coat	Gallon (GAL)
P603.020		Emulsified Asphalt Tack Coat	TON
P605.010		Silicone Joint Sealant	Gallon (GAL)
P605.012		Silicone Joint Sealant	Pound (LB)
P605.014		Silicone Joint Sealant	Linear Foot (LF)
P605.020		Hot Applied Joint Sealant	Gallon (GAL)
P605.022		Hot Applied Joint Sealant	Pound (LB)
P605.024		Hot Applied Joint Sealant	Linear Foot (LF)
P605.030		Hot Applied Fuel Resistant Joint Sealant	Gallon (GAL)
P605.032		Hot Applied Fuel Resistant Joint Sealant	Pound (LB)
P605.034		Hot Applied Fuel Resistant Joint Sealant	Linear Foot (LF)
P606.010		Adhesive Compound for Sealing Wire in Pavement	Pound (LB)
P606.020		Adhesive Compound for Sealing Wire in Pavement	Gallon (GAL)
P610.010		Structural Portland Cement Concrete	Cubic yard (CY)
P610.020		Steel Reinforcement for Structures	Pound (LB)
P610.030	through P610.039	Portland Cement Concrete for Structure ____	Lump Sum (LS)
P620.111		Painting White Waterborne Type I	Square Feet (SF)
P620.112		Painting White Waterborne Type II	Square Feet (SF)
P620.113		Painting White Waterborne Type III	Square Feet (SF)
P620.211		Painting Red Waterborne Type I	Square Feet (SF)
P620.212		Painting Red Waterborne Type II	Square Feet (SF)
P620.213		Painting Red Waterborne Type III	Square Feet (SF)
P620.311		Painting Yellow Waterborne Type I	Square Feet (SF)
P620.312		Painting Yellow Waterborne Type II	Square Feet (SF)
P620.313		Painting Yellow Waterborne Type III	Square Feet (SF)
P620.411		Painting Black Waterborne Type I	Square Feet (SF)
P620.412		Painting Black Waterborne Type II	Square Feet (SF)
P620.413		Painting Black Waterborne Type III	Square Feet (SF)
P620.511		Painting Pink Waterborne Type I	Square Feet (SF)
P620.512		Painting Pink Waterborne Type II	Square Feet (SF)
P620.513		Painting Pink Waterborne Type III	Square Feet (SF)
P620.611		Painting Green Waterborne Type I	Square Feet (SF)
P620.612		Painting Green Waterborne Type II	Square Feet (SF)
P620.613		Painting Green Waterborne Type III	Square Feet (SF)
P620.120		Painting White Epoxy	Square Feet (SF)

PAY ITEM		DESCRIPTION	UNIT
P620.220		Painting Red Epoxy	Square Feet (SF)
P620.320		Painting Yellow Epoxy	Square Feet (SF)
P620.420		Painting Black Epoxy	Square Feet (SF)
P620.520		Painting Pink Epoxy	Square Feet (SF)
P620.620		Painting Green Epoxy	Square Feet (SF)
P620.710		Reflective Media Type I Gradation A	Pound (LB)
P620.720		Reflective Media Type III	Pound (LB)
P620.730		Reflective Media Type IV	Pound (LB)
P620.740		Temporary Marking White Waterborne Type I	Square Feet (SF)
P620.741		Temporary Marking White Waterborne Type II	Square Feet (SF)
P620.742		Temporary Marking Red Waterborne Type I	Square Feet (SF)
P620.743		Temporary Marking Red Waterborne Type II	Square Feet (SF)
P620.744		Temporary Marking Yellow Waterborne Type I	Square Feet (SF)
P620.745		Temporary Marking Yellow Waterborne Type II	Square Feet (SF)
P620.746		Temporary Marking Black Waterborne Type I	Square Feet (SF)
P620.747		Temporary Marking Black Waterborne Type II	Square Feet (SF)
P620.750	through P620.759	Temporary Marking (color) Waterborne (type)	Square Feet (SF)
P620.800		Marking Removal	Square Feet (SF)
P621.010		Saw-Cut Grooves	Square Yard (SY)
P628.010		Crack Sealing Asphalt Pavement	Pound (LB)
P640.015		Sawing Asphalt	Linear foot (LF)
P640.025		Sawing Concrete	Linear foot (LF)
P642.010	through P642.019	Field Office (type) (location)	Each (EA)
P642.020	through P642.029	Field Laboratory	Each (EA)
P642.030	through P642.035	Communication Equipment (location)	Lump sum (LS)
P642.040	through P642.045	Copier and Scanner (location)	Lump sum (LS)
P643.010		Airport Construction Traffic Control	Lump Sum (LS)
P644.010		Riprap Light	Cubic Yard (CY)
P644.012		Riprap Medium	Cubic Yard (CY)
P644.014		Riprap Heavy	Cubic Yard (CY)
P644.016		Riprap Extra-Heavy	Cubic Yard (CY)
P644.020		Grouted Riprap Light	Cubic Yard (CY)
P644.022		Grouted Riprap Medium	Cubic Yard (CY)
P644.024		Grouted Riprap Heavy	Cubic Yard (CY)
P644.026		Grouted Riprap Extra-Heavy	Cubic Yard (CY)
P645.010		Geotextile Fabric Type C	Square Yard (SY)
P645.011		Geotextile Fabric Type DF Schedule A	Square Yard (SY)
P645.012		Geotextile Fabric Type DF Schedule B	Square Yard (SY)
P645.013		Geotextile Fabric Type DF Schedule C	Square Yard (SY)
P645.015		Geotextile Fabric Type ES	Square Yard (SY)
P645.020		Geotextile Fabric Type HR	Square Yard (SY)
P645.025		Geotextile Fabric Type MS	Square Yard (SY)
P645.030		Geotextile Fabric Type R	Square Yard (SY)
P645.035		Geotextile Fabric Type SR	Square Yard (SY)
P645.040		Geotextile Fabric Type SAS	Square Yard (SY)
P645.100		Geogrid Type SR	Square Yard (SY)
P645.110		Geogrid Type MR	Square Yard (SY)
P645.120		Geogrid Type SSR	Square Yard (SY)
P646.010		Maintenance and Repair of Haul Roads	Lump Sum (LS)
P646.020		Maintenance and Repair of Airport Haul Roads	Lump Sum (LS)
P648.010		Aircraft Tie-Down Type A	SET
P648.011		Aircraft Tie-Down Type B	SET
P648.015	through P648.019	Aircraft Tie-Down (type)	SET

PAY ITEM		DESCRIPTION	UNIT
P648.020		Aircraft Tie-Down Anchor (type)	Each (EA)
P665.010		Micro-Surfacing	Square Yard (SY)
F161.010		Woven Wire Fence Type 1, 4' Height	Linear Foot (LF)
F161.011		Woven Wire Fence Type 1, 5' Height	Linear Foot (LF)
F161.012		Woven Wire Fence Type 1, 6' Height	Linear Foot (LF)
F161.013		Woven Wire Fence Type 1, 7' Height	Linear Foot (LF)
F161.014		Woven Wire Fence Type 1, 8' Height	Linear Foot (LF)
F161.015		Woven Wire Fence Type 1, 9' Height	Linear Foot (LF)
F161.016		Woven Wire Fence Type 1, 10' Height	Linear Foot (LF)
F161.020		Woven Wire Fence Type 2, 4' Height	Linear Foot (LF)
F161.021		Woven Wire Fence Type 2, 5' Height	Linear Foot (LF)
F161.022		Woven Wire Fence Type 2, 6' Height	Linear Foot (LF)
F161.023		Woven Wire Fence Type 2, 7' Height	Linear Foot (LF)
F161.024		Woven Wire Fence Type 2, 8' Height	Linear Foot (LF)
F161.025		Woven Wire Fence Type 2, 9' Height	Linear Foot (LF)
F161.026		Woven Wire Fence Type 2, 10' Height	Linear Foot (LF)
F161.030		Woven Wire Fence Gate Type 1, 4' Height	Each (EA)
F161.031		Woven Wire Fence Gate Type 1, 5' Height	Each (EA)
F161.032		Woven Wire Fence Gate Type 1, 6' Height	Each (EA)
F161.033		Woven Wire Fence Gate Type 1, 7' Height	Each (EA)
F161.034		Woven Wire Fence Gate Type 1, 8' Height	Each (EA)
F161.035		Woven Wire Fence Gate Type 1, 9' Height	Each (EA)
F161.036		Woven Wire Fence Gate Type 1, 10' Height	Each (EA)
F161.040		Woven Wire Fence Gate Type 2, 4' Height	Each (EA)
F161.041		Woven Wire Fence Gate Type 2, 5' Height	Each (EA)
F161.042		Woven Wire Fence Gate Type 2, 6' Height	Each (EA)
F161.043		Woven Wire Fence Gate Type 2, 7' Height	Each (EA)
F161.044		Woven Wire Fence Gate Type 2, 8' Height	Each (EA)
F161.045		Woven Wire Fence Gate Type 2, 9' Height	Each (EA)
F161.046		Woven Wire Fence Gate Type 2, 10' Height	Each (EA)
F161.050	through F161.059	Woven Wire Fence Gate (location)	Lump Sum (LS)
F162.010		Chain-Link Fence, Type 1, 4' Height	Linear Foot (LF)
F162.011		Chain-Link Fence, Type 1, 5' Height	Linear Foot (LF)
F162.012		Chain-Link Fence, Type 1, 6' Height	Linear Foot (LF)
F162.013		Chain-Link Fence, Type 1, 7' Height	Linear Foot (LF)
F162.014		Chain-Link Fence, Type 1, 8' Height	Linear Foot (LF)
F162.015		Chain-Link Fence, Type 1, 9' Height	Linear Foot (LF)
F162.016		Chain-Link Fence, Type 1, 10' Height	Linear Foot (LF)
F162.017		Chain-Link Fence, Type 1, 11' Height	Linear Foot (LF)
F162.018		Chain-Link Fence, Type 1, 12' Height	Linear Foot (LF)
F162.020		Chain-Link Fence, Type 2, 4' Height	Linear Foot (LF)
F162.021		Chain-Link Fence, Type 2, 5' Height	Linear Foot (LF)
F162.022		Chain-Link Fence, Type 2, 6' Height	Linear Foot (LF)
F162.023		Chain-Link Fence, Type 2, 7' Height	Linear Foot (LF)
F162.024		Chain-Link Fence, Type 2, 8' Height	Linear Foot (LF)
F162.025		Chain-Link Fence, Type 2, 9' Height	Linear Foot (LF)
F162.026		Chain-Link Fence, Type 2, 10' Height	Linear Foot (LF)
F162.027		Chain-Link Fence, Type 2, 11' Height	Linear Foot (LF)
F162.028		Chain-Link Fence, Type 2, 12' Height	Linear Foot (LF)
F162.030		Chain-Link Fence, Type 3, 4' Height	Linear Foot (LF)
F162.031		Chain-Link Fence, Type 3, 5' Height	Linear Foot (LF)
F162.032		Chain-Link Fence, Type 3, 6' Height	Linear Foot (LF)
F162.033		Chain-Link Fence, Type 3, 7' Height	Linear Foot (LF)

Pay Item List

PAY ITEM		DESCRIPTION	UNIT
F162.034		Chain-Link Fence, Type 3, 8' Height	Linear Foot (LF)
F162.035		Chain-Link Fence, Type 3, 9' Height	Linear Foot (LF)
F162.036		Chain-Link Fence, Type 3, 10' Height	Linear Foot (LF)
F162.037		Chain-Link Fence, Type 3, 11' Height	Linear Foot (LF)
F162.038		Chain-Link Fence, Type 3, 12' Height	Linear Foot (LF)
F162.040		Chain-Link Fence, Type 4, 4' Height	Linear Foot (LF)
F162.041		Chain-Link Fence, Type 4, 5' Height	Linear Foot (LF)
F162.042		Chain-Link Fence, Type 4, 6' Height	Linear Foot (LF)
F162.043		Chain-Link Fence, Type 4, 7' Height	Linear Foot (LF)
F162.044		Chain-Link Fence, Type 4, 8' Height	Linear Foot (LF)
F162.045		Chain-Link Fence, Type 4, 9' Height	Linear Foot (LF)
F162.046		Chain-Link Fence, Type 4, 10' Height	Linear Foot (LF)
F162.047		Chain-Link Fence, Type 4, 11' Height	Linear Foot (LF)
F162.048		Chain-Link Fence, Type 4, 12' Height	Linear Foot (LF)
F162.050		Chain-Link Fence, Type 5, 4' Height	Linear Foot (LF)
F162.051		Chain-Link Fence, Type 5, 5' Height	Linear Foot (LF)
F162.052		Chain-Link Fence, Type 5, 6' Height	Linear Foot (LF)
F162.053		Chain-Link Fence, Type 5, 7' Height	Linear Foot (LF)
F162.054		Chain-Link Fence, Type 5, 8' Height	Linear Foot (LF)
F162.055		Chain-Link Fence, Type 5, 9' Height	Linear Foot (LF)
F162.056		Chain-Link Fence, Type 5, 10' Height	Linear Foot (LF)
F162.057		Chain-Link Fence, Type 5, 11' Height	Linear Foot (LF)
F162.058		Chain-Link Fence, Type 5, 12' Height	Linear Foot (LF)
F162.060		Chain-Link Fence, Type 6, 4' Height	Linear Foot (LF)
F162.061		Chain-Link Fence, Type 6, 5' Height	Linear Foot (LF)
F162.062		Chain-Link Fence, Type 6, 6' Height	Linear Foot (LF)
F162.063		Chain-Link Fence, Type 6, 7' Height	Linear Foot (LF)
F162.064		Chain-Link Fence, Type 6, 8' Height	Linear Foot (LF)
F162.065		Chain-Link Fence, Type 6, 9' Height	Linear Foot (LF)
F162.066		Chain-Link Fence, Type 6, 10' Height	Linear Foot (LF)
F162.067		Chain-Link Fence, Type 6, 11' Height	Linear Foot (LF)
F162.068		Chain-Link Fence, Type 6, 12' Height	Linear Foot (LF)
F162.070	through F162.079	Chain-Link Fence Gate (height) (opening size)	Each (EA)
F162.080	through F162.089	Chain-Link Fence Gate with Barbed Wire (height) (opening size)	Each (EA)
F162.090	through F162.099	Chain-Link Fence (type) (location)	Lump Sum (LS)
F163.010		Chain-Link Fence Fabric for Fence Skirt	Linear Foot (LF)
F163.020		Concrete Pads at Gates	Each (EA)
F163.030		Borrow Fill Material for Fence Construction	Cubic Yard (CY)
F163.040		Weed Control Application	Linear Foot (LF)
F164.010		Wildlife Exclusion Fence, 4' Height	Linear Foot (LF)
F164.011		Wildlife Exclusion Fence, 6' Height	Linear Foot (LF)
F164.012		Wildlife Exclusion Fence, 8' Height	Linear Foot (LF)
F164.013		Wildlife Exclusion Fence, 10' Height	Linear Foot (LF)
F164.014		Wildlife Exclusion Fence, 12' Height	Linear Foot (LF)
F164.015		Chain-Link Skirt Fence Fabric	Linear Foot (LF)
F164.020	through F164.029	Vehicle Gate (height) (opening size)	Each (EA)
F164.030	through F164.039	Pedestrian Gate (height) (opening size)	Each (EA)
F164.040	through F164.049	Wildlife Exclusion Fence Gate (location)	Lump Sum (LS)
F164.050		Concrete Gate Pad	Each (EA)
F164.060		Weed Control	Linear Foot (LF)
F164.065		Weed Control	Square Yard (SY)
F164.070	through F164.079	Swale Crossing (type) (location)	Each (EA)
D701.100		Culvert Pipe Corrugated Steel 12-Inch	Linear Foot (LF)

PAY ITEM		DESCRIPTION	UNIT
D701.101		Culvert Pipe Corrugated Steel 15-Inch	Linear Foot (LF)
D701.102		Culvert Pipe Corrugated Steel 18-Inch	Linear Foot (LF)
D701.103		Culvert Pipe Corrugated Steel 21-Inch	Linear Foot (LF)
D701.104		Culvert Pipe Corrugated Steel 24-Inch	Linear Foot (LF)
D701.105		Culvert Pipe Corrugated Steel 30-Inch	Linear Foot (LF)
D701.106		Culvert Pipe Corrugated Steel 36-Inch	Linear Foot (LF)
D701.107		Culvert Pipe Corrugated Steel 42-Inch	Linear Foot (LF)
D701.108		Culvert Pipe Corrugated Steel 48-Inch	Linear Foot (LF)
D701.109		Culvert Pipe Corrugated Steel 54-Inch	Linear Foot (LF)
D701.110		Culvert Pipe Corrugated Steel 60-Inch	Linear Foot (LF)
D701.111		Culvert Pipe Arch Corrugated Steel 17x13-Inch	Linear Foot (LF)
D701.112		Culvert Pipe Arch Corrugated Steel 21x15-Inch	Linear Foot (LF)
D701.113		Culvert Pipe Arch Corrugated Steel 24x18-Inch	Linear Foot (LF)
D701.114		Culvert Pipe Arch Corrugated Steel 28x20-Inch	Linear Foot (LF)
D701.115		Culvert Pipe Arch Corrugated Steel 35x24-Inch	Linear Foot (LF)
D701.116		Culvert Pipe Arch Corrugated Steel 42x29-Inch	Linear Foot (LF)
D701.117		Culvert Pipe Arch Corrugated Steel 49x33-Inch	Linear Foot (LF)
D701.118		Culvert Pipe Arch Corrugated Steel 57x38-Inch	Linear Foot (LF)
D701.119		Culvert Pipe Arch Corrugated Steel 64x43-Inch	Linear Foot (LF)
D701.120		Culvert Pipe Arch Corrugated Steel 71x47-Inch	Linear Foot (LF)
D701.200		Culvert Pipe Reinforced Concrete Class III 12-Inch	Linear Foot (LF)
D701.201		Culvert Pipe Reinforced Concrete Class III 15-Inch	Linear Foot (LF)
D701.202		Culvert Pipe Reinforced Concrete Class III 18-Inch	Linear Foot (LF)
D701.203		Culvert Pipe Reinforced Concrete Class III 21-Inch	Linear Foot (LF)
D701.204		Culvert Pipe Reinforced Concrete Class III 24-Inch	Linear Foot (LF)
D701.205		Culvert Pipe Reinforced Concrete Class III 27-Inch	Linear Foot (LF)
D701.206		Culvert Pipe Reinforced Concrete Class III 30-Inch	Linear Foot (LF)
D701.207		Culvert Pipe Reinforced Concrete Class III 36-Inch	Linear Foot (LF)
D701.208		Culvert Pipe Reinforced Concrete Class III 42-Inch	Linear Foot (LF)
D701.209		Culvert Pipe Reinforced Concrete Class III 48-Inch	Linear Foot (LF)
D701.210		Culvert Pipe Reinforced Concrete Class III 54-Inch	Linear Foot (LF)
D701.211		Culvert Pipe Reinforced Concrete Class III 60-Inch	Linear Foot (LF)
D701.212		Culvert Pipe Reinforced Concrete Class III 66-Inch	Linear Foot (LF)
D701.213		Culvert Pipe Reinforced Concrete Class III 72-Inch	Linear Foot (LF)
D701.214		Culvert Pipe Reinforced Concrete Class III 84-Inch	Linear Foot (LF)
D701.215		Culvert Pipe Reinforced Concrete Class III 96-Inch	Linear Foot (LF)
D701.220		Culvert Pipe Reinforced Concrete Class IV 12-Inch	Linear Foot (LF)
D701.221		Culvert Pipe Reinforced Concrete Class IV 15-Inch	Linear Foot (LF)
D701.222		Culvert Pipe Reinforced Concrete Class IV 18-Inch	Linear Foot (LF)
D701.223		Culvert Pipe Reinforced Concrete Class IV 21-Inch	Linear Foot (LF)
D701.224		Culvert Pipe Reinforced Concrete Class IV 24-Inch	Linear Foot (LF)
D701.225		Culvert Pipe Reinforced Concrete Class IV 27-Inch	Linear Foot (LF)
D701.226		Culvert Pipe Reinforced Concrete Class IV 30-Inch	Linear Foot (LF)
D701.227		Culvert Pipe Reinforced Concrete Class IV 36-Inch	Linear Foot (LF)
D701.228		Culvert Pipe Reinforced Concrete Class IV 42-Inch	Linear Foot (LF)
D701.229		Culvert Pipe Reinforced Concrete Class IV 48-Inch	Linear Foot (LF)
D701.230		Culvert Pipe Reinforced Concrete Class IV 54-Inch	Linear Foot (LF)
D701.231		Culvert Pipe Reinforced Concrete Class IV 60-Inch	Linear Foot (LF)
D701.232		Culvert Pipe Reinforced Concrete Class IV 66-Inch	Linear Foot (LF)
D701.233		Culvert Pipe Reinforced Concrete Class IV 72-Inch	Linear Foot (LF)
D701.234		Culvert Pipe Reinforced Concrete Class IV 84-Inch	Linear Foot (LF)
D701.240		Culvert Pipe Reinforced Concrete Class V 12-Inch	Linear Foot (LF)
D701.241		Culvert Pipe Reinforced Concrete Class V 15-Inch	Linear Foot (LF)

PAY ITEM		DESCRIPTION	UNIT
D701.242		Culvert Pipe Reinforced Concrete Class V 18-Inch	Linear Foot (LF)
D701.243		Culvert Pipe Reinforced Concrete Class V 21-Inch	Linear Foot (LF)
D701.244		Culvert Pipe Reinforced Concrete Class V 24-Inch	Linear Foot (LF)
D701.245		Culvert Pipe Reinforced Concrete Class V 27-Inch	Linear Foot (LF)
D701.246		Culvert Pipe Reinforced Concrete Class V 30-Inch	Linear Foot (LF)
D701.247		Culvert Pipe Reinforced Concrete Class V 36-Inch	Linear Foot (LF)
D701.248		Culvert Pipe Reinforced Concrete Class V 42-Inch	Linear Foot (LF)
D701.249		Culvert Pipe Reinforced Concrete Class V 48-Inch	Linear Foot (LF)
D701.250		Culvert Pipe Reinforced Concrete Class V 54-Inch	Linear Foot (LF)
D701.251		Culvert Pipe Reinforced Concrete Class V 60-Inch	Linear Foot (LF)
D701.252		Culvert Pipe Reinforced Concrete Class V 66-Inch	Linear Foot (LF)
D701.253		Culvert Pipe Reinforced Concrete Class V 72-Inch	Linear Foot (LF)
D701.254		Culvert Pipe Reinforced Concrete Class V 84-Inch	Linear Foot (LF)
D701.260		Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 14x23-Inch	Linear Foot (LF)
D701.261		Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 19x30-Inch	Linear Foot (LF)
D701.262		Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 24x38-Inch	Linear Foot (LF)
D701.263		Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 29x45-Inch	Linear Foot (LF)
D701.264		Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 34x53-Inch	Linear Foot (LF)
D701.265		Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 38x60-Inch	Linear Foot (LF)
D701.266		Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 48x76-Inch	Linear Foot (LF)
D701.267		Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 58x91-Inch	Linear Foot (LF)
D701.268		Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 68x106-Inch	Linear Foot (LF)
D701.269		Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-IV 14x23-Inch	Linear Foot (LF)
D701.270		Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-IV 19x30-Inch	Linear Foot (LF)
D701.271		Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-IV 24x38-Inch	Linear Foot (LF)
D701.272		Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-IV 29x45-Inch	Linear Foot (LF)
D701.273		Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-IV 34x53-Inch	Linear Foot (LF)
D701.300		Culvert Pipe Plastic 12-Inch	Linear Foot (LF)
D701.301		Culvert Pipe Plastic 15-Inch	Linear Foot (LF)
D701.302		Culvert Pipe Plastic 18-Inch	Linear Foot (LF)
D701.303		Culvert Pipe Plastic 21-Inch	Linear Foot (LF)
D701.304		Culvert Pipe Plastic 24-Inch	Linear Foot (LF)
D701.305		Culvert Pipe Plastic 30-Inch	Linear Foot (LF)
D701.400		Apron Endwalls for Culvert Pipe Corrugated Steel 12-Inch	Each (EA)
D701.401		Apron Endwalls for Culvert Pipe Corrugated Steel 15-Inch	Each (EA)
D701.402		Apron Endwalls for Culvert Pipe Corrugated Steel 18-Inch	Each (EA)
D701.403		Apron Endwalls for Culvert Pipe Corrugated Steel 21-Inch	Each (EA)
D701.404		Apron Endwalls for Culvert Pipe Corrugated Steel 24-Inch	Each (EA)
D701.405		Apron Endwalls for Culvert Pipe Corrugated Steel 30-Inch	Each (EA)
D701.406		Apron Endwalls for Culvert Pipe Corrugated Steel 36-Inch	Each (EA)
D701.407		Apron Endwalls for Culvert Pipe Corrugated Steel 42-Inch	Each (EA)
D701.408		Apron Endwalls for Culvert Pipe Corrugated Steel 48-Inch	Each (EA)
D701.409		Apron Endwalls for Culvert Pipe Corrugated Steel 54-Inch	Each (EA)
D701.410		Apron Endwalls for Culvert Pipe Corrugated Steel 60-Inch	Each (EA)
D701.411		Apron Endwalls for Culvert Pipe Arch Corrugated Steel 17x13-Inch	Each (EA)
D701.412		Apron Endwalls for Culvert Pipe Arch Corrugated Steel 21x15-Inch	Each (EA)
D701.413		Apron Endwalls for Culvert Pipe Arch Corrugated Steel 24x18-Inch	Each (EA)
D701.414		Apron Endwalls for Culvert Pipe Arch Corrugated Steel 28x20-Inch	Each (EA)
D701.415		Apron Endwalls for Culvert Pipe Arch Corrugated Steel 35x24-Inch	Each (EA)
D701.416		Apron Endwalls for Culvert Pipe Arch Corrugated Steel 42x29-Inch	Each (EA)
D701.417		Apron Endwalls for Culvert Pipe Arch Corrugated Steel 49x33-Inch	Each (EA)
D701.418		Apron Endwalls for Culvert Pipe Arch Corrugated Steel 57x38-Inch	Each (EA)
D701.419		Apron Endwalls for Culvert Pipe Arch Corrugated Steel 64x43-Inch	Each (EA)

PAY ITEM		DESCRIPTION	UNIT
D701.420		Apron Endwalls for Culvert Pipe Arch Corrugated Steel 71x47-Inch	Each (EA)
D701.500		Apron Endwalls for Culvert Pipe Reinforced Concrete 12-Inch	Each (EA)
D701.501		Apron Endwalls for Culvert Pipe Reinforced Concrete 15-Inch	Each (EA)
D701.502		Apron Endwalls for Culvert Pipe Reinforced Concrete 18-Inch	Each (EA)
D701.503		Apron Endwalls for Culvert Pipe Reinforced Concrete 21-Inch	Each (EA)
D701.504		Apron Endwalls for Culvert Pipe Reinforced Concrete 24-Inch	Each (EA)
D701.505		Apron Endwalls for Culvert Pipe Reinforced Concrete 27-Inch	Each (EA)
D701.506		Apron Endwalls for Culvert Pipe Reinforced Concrete 30-Inch	Each (EA)
D701.507		Apron Endwalls for Culvert Pipe Reinforced Concrete 36-Inch	Each (EA)
D701.508		Apron Endwalls for Culvert Pipe Reinforced Concrete 42-Inch	Each (EA)
D701.509		Apron Endwalls for Culvert Pipe Reinforced Concrete 48-Inch	Each (EA)
D701.510		Apron Endwalls for Culvert Pipe Reinforced Concrete 54-Inch	Each (EA)
D701.511		Apron Endwalls for Culvert Pipe Reinforced Concrete 60-Inch	Each (EA)
D701.512		Apron Endwalls for Culvert Pipe Reinforced Concrete 66-Inch	Each (EA)
D701.513		Apron Endwalls for Culvert Pipe Reinforced Concrete 72-Inch	Each (EA)
D701.514		Apron Endwalls for Culvert Pipe Reinforced Concrete 84-Inch	Each (EA)
D701.515		Apron Endwalls for Culvert Pipe Reinforced Concrete 96-Inch	Each (EA)
D701.520		Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 14x23-Inch	Each (EA)
D701.521		Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 19x30-Inch	Each (EA)
D701.522		Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 24x38-Inch	Each (EA)
D701.523		Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 29x45-Inch	Each (EA)
D701.524		Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 34x53-Inch	Each (EA)
D701.525		Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 38x60-Inch	Each (EA)
D701.526		Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 48x76-Inch	Each (EA)
D701.527		Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 58x91-Inch	Each (EA)
D701.528		Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 68x106-Inch	Each (EA)
D701.600		Storm Sewer Reinforced Concrete Class III 12-Inch	Linear Foot (LF)
D701.601		Storm Sewer Reinforced Concrete Class III 15-Inch	Linear Foot (LF)
D701.602		Storm Sewer Reinforced Concrete Class III 18-Inch	Linear Foot (LF)
D701.603		Storm Sewer Reinforced Concrete Class III 21-Inch	Linear Foot (LF)
D701.604		Storm Sewer Reinforced Concrete Class III 24-Inch	Linear Foot (LF)
D701.605		Storm Sewer Reinforced Concrete Class III 27-Inch	Linear Foot (LF)
D701.606		Storm Sewer Reinforced Concrete Class III 30-Inch	Linear Foot (LF)
D701.607		Storm Sewer Reinforced Concrete Class III 36-Inch	Linear Foot (LF)
D701.608		Storm Sewer Reinforced Concrete Class III 42-Inch	Linear Foot (LF)
D701.609		Storm Sewer Reinforced Concrete Class III 48-Inch	Linear Foot (LF)
D701.610		Storm Sewer Reinforced Concrete Class III 54-Inch	Linear Foot (LF)
D701.611		Storm Sewer Reinforced Concrete Class III 60-Inch	Linear Foot (LF)
D701.612		Storm Sewer Reinforced Concrete Class III 66-Inch	Linear Foot (LF)
D701.613		Storm Sewer Reinforced Concrete Class III 72-Inch	Linear Foot (LF)
D701.614		Storm Sewer Reinforced Concrete Class III 84-Inch	Linear Foot (LF)
D701.615		Storm Sewer Reinforced Concrete Class III 96-Inch	Linear Foot (LF)
D701.620		Storm Sewer Reinforced Concrete Class IV 12-Inch	Linear Foot (LF)
D701.621		Storm Sewer Reinforced Concrete Class IV 15-Inch	Linear Foot (LF)
D701.622		Storm Sewer Reinforced Concrete Class IV 18-Inch	Linear Foot (LF)
D701.623		Storm Sewer Reinforced Concrete Class IV 21-Inch	Linear Foot (LF)
D701.624		Storm Sewer Reinforced Concrete Class IV 24-Inch	Linear Foot (LF)
D701.625		Storm Sewer Reinforced Concrete Class IV 27-Inch	Linear Foot (LF)
D701.626		Storm Sewer Reinforced Concrete Class IV 30-Inch	Linear Foot (LF)
D701.627		Storm Sewer Reinforced Concrete Class IV 36-Inch	Linear Foot (LF)
D701.628		Storm Sewer Reinforced Concrete Class IV 42-Inch	Linear Foot (LF)
D701.629		Storm Sewer Reinforced Concrete Class IV 48-Inch	Linear Foot (LF)
D701.630		Storm Sewer Reinforced Concrete Class IV 54-Inch	Linear Foot (LF)

PAY ITEM		DESCRIPTION	UNIT
D701.631		Storm Sewer Reinforced Concrete Class IV 60-Inch	Linear Foot (LF)
D701.632		Storm Sewer Reinforced Concrete Class IV 66-Inch	Linear Foot (LF)
D701.633		Storm Sewer Reinforced Concrete Class IV 72-Inch	Linear Foot (LF)
D701.634		Storm Sewer Reinforced Concrete Class IV 84-Inch	Linear Foot (LF)
D701.640		Storm Sewer Reinforced Concrete Class V 12-Inch	Linear Foot (LF)
D701.641		Storm Sewer Reinforced Concrete Class V 15-Inch	Linear Foot (LF)
D701.642		Storm Sewer Reinforced Concrete Class V 18-Inch	Linear Foot (LF)
D701.643		Storm Sewer Reinforced Concrete Class V 21-Inch	Linear Foot (LF)
D701.644		Storm Sewer Reinforced Concrete Class V 24-Inch	Linear Foot (LF)
D701.645		Storm Sewer Reinforced Concrete Class V 27-Inch	Linear Foot (LF)
D701.646		Storm Sewer Reinforced Concrete Class V 30-Inch	Linear Foot (LF)
D701.647		Storm Sewer Reinforced Concrete Class V 36-Inch	Linear Foot (LF)
D701.648		Storm Sewer Reinforced Concrete Class V 42-Inch	Linear Foot (LF)
D701.649		Storm Sewer Reinforced Concrete Class V 48-Inch	Linear Foot (LF)
D701.650		Storm Sewer Reinforced Concrete Class V 54-Inch	Linear Foot (LF)
D701.651		Storm Sewer Reinforced Concrete Class V 60-Inch	Linear Foot (LF)
D701.652		Storm Sewer Reinforced Concrete Class V 66-Inch	Linear Foot (LF)
D701.653		Storm Sewer Reinforced Concrete Class V 72-Inch	Linear Foot (LF)
D701.654		Storm Sewer Reinforced Concrete Class V 84-Inch	Linear Foot (LF)
D701.660		Storm Sewer Reinforced Concrete Horizontal Elliptical Class HE-III 14x23-Inch	Linear Foot (LF)
D701.661		Storm Sewer Reinforced Concrete Horizontal Elliptical Class HE-III 19x30-Inch	Linear Foot (LF)
D701.662		Storm Sewer Reinforced Concrete Horizontal Elliptical Class HE-III 24x38-Inch	Linear Foot (LF)
D701.663		Storm Sewer Reinforced Concrete Horizontal Elliptical Class HE-III 29x45-Inch	Linear Foot (LF)
D701.664		Storm Sewer Reinforced Concrete Horizontal Elliptical Class HE-III 34x53-Inch	Linear Foot (LF)
D701.665		Storm Sewer Reinforced Concrete Horizontal Elliptical Class HE-III 38x60-Inch	Linear Foot (LF)
D701.666		Storm Sewer Reinforced Concrete Horizontal Elliptical Class HE-III 48x76-Inch	Linear Foot (LF)
D701.667		Storm Sewer Reinforced Concrete Horizontal Elliptical Class HE-III 58x91-Inch	Linear Foot (LF)
D701.668		Storm Sewer Reinforced Concrete Horizontal Elliptical Class HE-III 68x106-Inch	Linear Foot (LF)
D701.670		Storm Sewer Reinforced Concrete Horizontal Elliptical Class HE-IV 14x23-Inch	Linear Foot (LF)
D701.671		Storm Sewer Reinforced Concrete Horizontal Elliptical Class HE-IV 19x30-Inch	Linear Foot (LF)
D701.672		Storm Sewer Reinforced Concrete Horizontal Elliptical Class HE-IV 24x38-Inch	Linear Foot (LF)
D701.673		Storm Sewer Reinforced Concrete Horizontal Elliptical Class HE-IV 29x45-Inch	Linear Foot (LF)
D701.674		Storm Sewer Reinforced Concrete Horizontal Elliptical Class HE-IV 34x53-Inch	Linear Foot (LF)
D701.700		Storm Sewer Plastic 12-Inch	Linear Foot (LF)
D701.701		Storm Sewer Plastic 15-Inch	Linear Foot (LF)
D701.702		Storm Sewer Plastic 18-Inch	Linear Foot (LF)
D701.703		Storm Sewer Plastic 21-Inch	Linear Foot (LF)
D701.704		Storm Sewer Plastic 24-Inch	Linear Foot (LF)
D701.705		Storm Sewer Plastic 27-Inch	Linear Foot (LF)
D701.706		Storm Sewer Plastic 30-Inch	Linear Foot (LF)
D701.800		Rock Excavation for Trenches	Cubic Yard (CY)
D702.010	through D702.029	Slotted Drain (type)(size)	Linear Foot (LF)
D702.050		Concrete Backfill for Slotted Drain	Cubic Yard (CY)
D705.106		Airport Underdrain 6-Inch	Linear Foot (LF)
D705.108		Airport Underdrain 8-Inch	Linear Foot (LF)
D705.110		Airport Underdrain 10-Inch	Linear Foot (LF)
D705.112		Airport Underdrain 12-Inch	Linear Foot (LF)
D705.201		Airport Underdrain Riser	Each (EA)
D705.306		Airport Underdrain End Section 6-Inch	Each (EA)
D705.308		Airport Underdrain End Section 8-Inch	Each (EA)
D705.310		Airport Underdrain End Section 10-Inch	Each (EA)
D705.312		Airport Underdrain End Section 12-Inch	Each (EA)
D705.406		Airport Underdrain Unperforated 6-Inch	Linear Foot (LF)

PAY ITEM		DESCRIPTION	UNIT
D705.408		Airport Underdrain Unperforated 8-Inch	Linear Foot (LF)
D705.410		Airport Underdrain Unperforated 10-Inch	Linear Foot (LF)
D705.412		Airport Underdrain Unperforated 12-Inch	Linear Foot (LF)
D751.010		Manhole 3-Foot Diameter	Each (EA)
D751.011		Manhole 4-Foot Diameter	Each (EA)
D751.012		Manhole 5-Foot Diameter	Each (EA)
D751.013		Manhole 6-Foot Diameter	Each (EA)
D751.014		Manhole 7-Foot Diameter	Each (EA)
D751.015		Manhole 8-Foot Diameter	Each (EA)
D751.020		Manhole 3x3-Foot	Each (EA)
D751.021		Manhole 4x4-Foot	Each (EA)
D751.022		Manhole 5x5-Foot	Each (EA)
D751.023		Manhole 6x6-Foot	Each (EA)
D751.030	through D751.049	Manhole (location)	Lump Sum (LS)
D751.050		Catch Basin 3-Foot Diameter	Each (EA)
D751.051		Catch Basin 4-Foot Diameter	Each (EA)
D751.052		Catch Basin 5-Foot Diameter	Each (EA)
D751.053		Catch Basin 6-Foot Diameter	Each (EA)
D751.054		Catch Basin 2x3-Foot	Each (EA)
D751.055		Catch Basin 2.5x3-Foot	Each (EA)
D751.070		Inlets 2x2-Foot	Each (EA)
D751.071		Inlets 2x3-Foot	Each (EA)
D751.072		Inlets Median 1 Grate	Each (EA)
D751.073		Inlets Median 2 Grate	Each (EA)
D751.080		Inspection Holes	Each (EA)
D752.010		Excavation for Structures	Cubic Yard (CY)
D752.012		Structural Concrete	Cubic Yard (CY)
D752.014		Reinforcing Steel	Pound (LB)
D752.020	through D752.039	Structure (type)(location or number)	Lump Sum (LS)
D754.010		Concrete Gutter 24-Inch	Linear Foot (LF)
D754.020		Concrete Gutter 24-Inch	Square Foot (SF)
D754.030		Concrete Ditch 2-Foot Wide	Linear Foot (LF)
D754.031		Concrete Ditch 3-Foot Wide	Linear Foot (LF)
D754.032		Concrete Ditch 4-Foot Wide	Linear Foot (LF)
D754.033		Concrete Ditch 5-Foot Wide	Linear Foot (LF)
D754.040		Concrete Ditch 4-Inch Thick	Square Foot (SF)
D754.041		Concrete Ditch 5-Inch Thick	Square Foot (SF)
D754.042		Concrete Ditch 6-Inch Thick	Square Foot (SF)
D754.043		Concrete Ditch 8-Inch Thick	Square Foot (SF)
D754.050		Concrete Flume (type)	Linear Foot (LF)
D754.060		Concrete Flume (type)	Square Foot (SF)
T901.010		Seeding Mixture No. 10	Pound (LB)
T901.011		Seeding Mixture No. 20	Pound (LB)
T901.012		Seeding Mixture No. 30	Pound (LB)
T901.013		Seeding Mixture No. 40	Pound (LB)
T901.014		Seeding Mixture No. 60	Pound (LB)
T901.015		Seeding Mixture No. 70	Pound (LB)
T901.016		Seeding Mixture No. 70A	Pound (LB)
T901.017		Seeding Mixture No. 75	Pound (LB)
T901.018		Seeding Mixture No. 80	Pound (LB)
T901.020	through T901.029	Seeding Mixture (type)	Pound (LB)
T901.030		Seeding Temporary	Pound (LB)
T901.032		Seeding Borrow Pit	Pound (LB)

Pay Item List

PAY ITEM		DESCRIPTION	UNIT
T901.034		Seeding Nurse Crop	Pound (LB)
T901.040		Watering Seeding	1000-gallon (MGAL)
T902.010		Fertilizer Type A	CWT
T902.020		Fertilizer Type B	CWT
T902.030		Agricultural Limestone Treatment	TON
T904.010		Sodding	Square Yard (SY)
T904.012		Sod Erosion Control	Square Yard (SY)
T904.014		Sod Erosion Control Sandy Soil	Square Yard (SY)
T904.020		Sod Water	1000-gallon (MGAL)
T905.010		Imported Topsoil	Square Yard (SY)
T905.012		Imported Topsoil	Cubic Yard (CY)
T905.015		Salvaged Topsoil	Square Yard (SY)
T908.010		Standard Mulching	Square Yard (SY)
T908.012		Standard Mulching	TON
T908.020		Hydro-Mulching	Square Yard (SY)
T908.030		Mulching	Square Yard (SY)
L101.010		Airport Rotating Beacon, Medium Intensity, L-801A, Class 1	Lump Sum (LS)
L101.011		Airport Rotating Beacon, Medium Intensity LED, L-801A, Class 1	Lump Sum (LS)
L101.012		Airport Rotating Beacon, Medium Intensity, L-801A, Class 2	Lump Sum (LS)
L101.013		Airport Rotating Beacon, Medium Intensity LED, L-801A, Class 2	Lump Sum (LS)
L101.020		Airport Rotating Beacon, High Intensity, L-802A, Class 1	Lump Sum (LS)
L101.021		Airport Rotating Beacon, High Intensity LED, L-802A, Class 1	Lump Sum (LS)
L101.022		Airport Rotating Beacon, High Intensity, L-802A, Class 2	Lump Sum (LS)
L101.023		Airport Rotating Beacon, High Intensity LED, L-802A, Class 2	Lump Sum (LS)
L103.010		Aiport Beacon Tipdown Pole, 25' Height	Lump Sum (LS)
L103.011		Aiport Beacon Tipdown Pole, 30' Height	Lump Sum (LS)
L103.012		Aiport Beacon Tipdown Pole, 35' Height	Lump Sum (LS)
L103.013		Aiport Beacon Tipdown Pole, 40' Height	Lump Sum (LS)
L103.014		Aiport Beacon Tipdown Pole, 45' Height	Lump Sum (LS)
L103.015		Aiport Beacon Tipdown Pole, 50' Height	Lump Sum (LS)
L103.016		Aiport Beacon Tipdown Pole, 55' Height	Lump Sum (LS)
L103.020		Airport Beacon Structural Steel Tower, 51' Height	Lump Sum (LS)
L103.021		Airport Beacon Structural Steel Tower, 62' Height	Lump Sum (LS)
L103.022		Airport Beacon Structural Steel Tower, 75' Height	Lump Sum (LS)
L103.023		Airport Beacon Structural Steel Tower, 91' Height	Lump Sum (LS)
L103.024		Airport Beacon Structural Steel Tower, 108' Height	Lump Sum (LS)
L103.025		Airport Beacon Structural Steel Tower, 129' Height	Lump Sum (LS)
L103.026		Airport Beacon Structural Steel Tower, 152' Height	Lump Sum (LS)
L103.030		Airport Beacon Tubular Steel Tower	Lump Sum (LS)
L103.040		Airport Beacon Pre-Fabriciated Tower Structure	Lump Sum (LS)
L107.010		Airport Wind Cone L-806, Style I-A, Size 1	Lump Sum (LS)
L107.011		Airport Wind Cone L-806, LED Style I-A, Size 1	Lump Sum (LS)
L107.012		Airport Wind Cone L-806, Style I-B, Size 1	Lump Sum (LS)
L107.013		Airport Wind Cone L-806, LED Style I-B, Size 1	Lump Sum (LS)
L107.014		Airport Wind Cone L-806, Style II, Size 1	Lump Sum (LS)
L107.020		Airport Wind Cone L-807, Style I-A, Size 1	Lump Sum (LS)
L107.021		Airport Wind Cone L-807, LED Style I-A, Size 1	Lump Sum (LS)
L107.022		Airport Wind Cone L-807, Style I-B, Size 1	Lump Sum (LS)
L107.023		Airport Wind Cone L-807, LED Style I-B, Size 1	Lump Sum (LS)
L107.024		Airport Wind Cone L-807, Style II, Size 1	Lump Sum (LS)
L107.030		Airport Wind Cone L-807, Style I-A, Size 2	Lump Sum (LS)
L107.031		Airport Wind Cone L-807, LED Style I-A, Size 2	Lump Sum (LS)
L107.032		Airport Wind Cone L-807, Style I-B, Size 2	Lump Sum (LS)

PAY ITEM		DESCRIPTION	UNIT
L107.033		Airport Wind Cone L-807, LED Style I-B, Size 2	Lump Sum (LS)
L107.034		Airport Wind Cone L-807, Style II, Size 2	Lump Sum (LS)
L107.040	through L107.049	Segmented Circle Mark Sysytem (location)	Each (EA)
L108.101		Locate and Protect Existing Circuits	Lump Sum (LS)
L108.110		Plow	Linear Foot (LF)
L108.206		Trench 6-Inch	Linear Foot (LF)
L108.209		Trench 9-Inch	Linear Foot (LF)
L108.212		Trench 12-Inch	Linear Foot (LF)
L108.218		Trench 18-Inch	Linear Foot (LF)
L108.221		Trench 21-Inch	Linear Foot (LF)
L108.224		Trench 24-Inch	Linear Foot (LF)
L108.301		Flexible Polyethylene Duct 1-Inch	Linear Foot (LF)
L108.302		Flexible Polyethylene Duct 1 1/4-Inch	Linear Foot (LF)
L108.303		Flexible Polyethylene Duct 1 1/2-Inch	Linear Foot (LF)
L108.310		Trench or Plow	Linear Foot (LF)
L108.320		Counterpoise Plow	Linear Foot (LF)
L108.506		5000 Volt Cable No. 6	Linear Foot (LF)
L108.508		5000 Volt Cable No. 8	Linear Foot (LF)
L108.604		600 Volt Cable No. 4	Linear Foot (LF)
L108.606		600 Volt Cable No. 6	Linear Foot (LF)
L108.608		600 Volt Cable No. 8	Linear Foot (LF)
L108.610		600 Volt Cable No. 10	Linear Foot (LF)
L108.706		Bare Counterpoise Wire No. 6	Linear Foot (LF)
L108.708		Bare Counterpoise Wire No. 8	Linear Foot (LF)
L108.810		Counterpoise Ground Rod	Linear Foot (LF)
L108.820		Cable Markers	Each (EA)
L108.830		Turf Restoration for Trench or Plow	Lump Sum (LS)
L108.831		Turf Restoration for Trench or Plow	Linear Foot (LF)
L108.840		Pavement Restoration for Trench	Lump Sum (LS)
L108.841		Pavement Restoration for Trench	Linear Foot (LF)
L109.010	through L109.019	Airport Equipment Enclosure (location)	Lump Sum (LS)
L109.020	through L109.029	Airport Equipment (Furnished) (and) (Installed) (location)	Lump Sum (LS)
L109.030	through L109.039	Electric Utility Serivce (location)	Lump Sum (LS)
L109.104		Regulator 6.6A 4KW	Each (EA)
L109.107		Regulator 6.6A 7.5KW	Each (EA)
L109.110		Regulator 6.6A 10KW	Each (EA)
L109.115		Regulator 6.6A 15KW	Each (EA)
L109.120		Regulator 6.6A 20KW	Each (EA)
L109.130		Regulator 6.6A 30KW	Each (EA)
L109.190		Regulator Monitor	Each (EA)
L109.201	through L109.205	L-847 Circuit Switch Selector	Each (EA)
L109.301	through L109.305	L-841 Relay Cabinet	Each (EA)
L109.401	through L109.405	L-854 Radio Controller	Each (EA)
L109.501	through L109.505	Generator (type) (size)	Each (EA)
L110.121		Electrical Duct Type-I 2-Inch 1-Way	Linear Foot (LF)
L110.122		Electrical Duct Type-I 2-Inch 2-Way	Linear Foot (LF)
L110.123		Electrical Duct Type-I 2-Inch 3-Way	Linear Foot (LF)
L110.124		Electrical Duct Type-I 2-Inch 4-Way	Linear Foot (LF)
L110.131		Electrical Duct Type-I 3-Inch 1-Way	Linear Foot (LF)
L110.132		Electrical Duct Type-I 3-Inch 2-Way	Linear Foot (LF)
L110.133		Electrical Duct Type-I 3-Inch 3-Way	Linear Foot (LF)
L110.134		Electrical Duct Type-I 3-Inch 4-Way	Linear Foot (LF)
L110.135		Electrical Duct Type-I 3-Inch 5-Way	Linear Foot (LF)

PAY ITEM		DESCRIPTION	UNIT
L110.136		Electrical Duct Type-I 3-Inch 6-Way	Linear Foot (LF)
L110.141		Electrical Duct Type-I 4-Inch 1-Way	Linear Foot (LF)
L110.142		Electrical Duct Type-I 4-Inch 2-Way	Linear Foot (LF)
L110.143		Electrical Duct Type-I 4-Inch 3-Way	Linear Foot (LF)
L110.144		Electrical Duct Type-I 4-Inch 4-Way	Linear Foot (LF)
L110.145		Electrical Duct Type-I 4-Inch 5-Way	Linear Foot (LF)
L110.146		Electrical Duct Type-I 4-Inch 6-Way	Linear Foot (LF)
L110.221		Electrical Duct Type-II 2-Inch 1-Way	Linear Foot (LF)
L110.222		Electrical Duct Type-II 2-Inch 2-Way	Linear Foot (LF)
L110.223		Electrical Duct Type-II 2-Inch 3-Way	Linear Foot (LF)
L110.224		Electrical Duct Type-II 2-Inch 4-Way	Linear Foot (LF)
L110.231		Electrical Duct Type-II 3-Inch 1-Way	Linear Foot (LF)
L110.232		Electrical Duct Type-II 3-Inch 2-Way	Linear Foot (LF)
L110.233		Electrical Duct Type-II 3-Inch 3-Way	Linear Foot (LF)
L110.234		Electrical Duct Type-II 3-Inch 4-Way	Linear Foot (LF)
L110.235		Electrical Duct Type-II 3-Inch 5-Way	Linear Foot (LF)
L110.236		Electrical Duct Type-II 3-Inch 6-Way	Linear Foot (LF)
L110.241		Electrical Duct Type-II 4-Inch 1-Way	Linear Foot (LF)
L110.242		Electrical Duct Type-II 4-Inch 2-Way	Linear Foot (LF)
L110.243		Electrical Duct Type-II 4-Inch 3-Way	Linear Foot (LF)
L110.244		Electrical Duct Type-II 4-Inch 4-Way	Linear Foot (LF)
L110.245		Electrical Duct Type-II 4-Inch 5-Way	Linear Foot (LF)
L110.246		Electrical Duct Type-II 4-Inch 6-Way	Linear Foot (LF)
L110.300		Duct Marker	Each (EA)
L110.400		Pavement Restoration for Duct Installation	Linear Foot (LF)
L115.100	through L115.109	Electrical Manhole (size) (type)	Each (EA)
L115.200	through L115.209	Electrical Manhole (location)	Lump Sum (LS)
L115.300	through L115.309	Electrical Junction Structure (size) (type)	Each (EA)
L115.400	through L115.409	Electrical Junction Structure (location)	Lump Sum (LS)
L115.500		Existing Manhole Elevation Adjustment	Each (EA)
L115.600	through L115.609	Existing Manhole Elevation Adjustment (location)	Lump Sum (LS)
L115.700	through L115.709	Existing Junction Structure Adjustment	Each (EA)
L115.800	through L115.809	Existing Junction Structure Adjustment (location)	Lump Sum (LS)
L115.900	through L115.919	Electrical Handhole (size) (type)	Each (EA)
L119.100		Obstruction Lighting L-810	Each (EA)
L119.101	through L119.199	Obstruction Lighting L-810 (location)	Lump Sum (LS)
L119.200		Obstruction Lighting L-856	Each (EA)
L119.201	through L119.299	Obstruction Lighting L-856 (location)	Lump Sum (LS)
L119.300		Obstruction Lighting L-857	Each (EA)
L119.301	through L119.399	Obstruction Lighting L-857 (location)	Lump Sum (LS)
L119.400		Obstruction Lighting L-864	Each (EA)
L119.401	through L119.499	Obstruction Lighting L-864 (location)	Lump Sum (LS)
L119.500		Obstruction Lighting L-865	Each (EA)
L119.501	through L119.599	Obstruction Lighting L-865 (location)	Lump Sum (LS)
L119.600		Obstruction Lighting L-866	Each (EA)
L119.601	through L119.699	Obstruction Lighting L-866 (location)	Lump Sum (LS)
L119.700		Obstruction Lighting L-885	Each (EA)
L119.701	through L119.799	Obstruction Lighting L-885 (location)	Lump Sum (LS)
L119.801	through L119.899	Electrical Utility Service (location)	Lump Sum (LS)
L125.101	through L125.109	REIL Constant Voltage L-849V (style) (location)	Lump Sum (LS)
L125.110	through L125.119	REIL LED Constant Voltage L-849V, (style) (location)	Lump Sum (LS)
L125.120	through L125.129	REIL Constant Current L-849I (style) (location)	Lump Sum (LS)
L125.130	through L125.139	REIL LED Constant Current L-849I (style) (location)	Lump Sum (LS)

Pay Item List

PAY ITEM		DESCRIPTION	UNIT
L125.140	through L125.149	ODALS Constant Current L-859V Style F (location)	Lump Sum (LS)
L125.201	through L125.209	Runway In-Pavement Light (type) (class) (mode) (style) (option)	Each (EA)
L125.210	through L125.219	Runway In-Pavement Light LED (type) (class) (mode) (style) (option)	Each (EA)
L125.220	through L125.229	Taxiway In-Pavement Light (type) (class) (mode) (style) (option)	Each (EA)
L125.230	through L125.239	Taxiway In-Pavement Light LED (type) (class) (mode) (style) (option)	Each (EA)
L125.251		Retroreflective Marker, L-853, Type 1, Style 1	Each (EA)
L125.253		Retroreflective Marker, L-853, Type 1, Style 2	Each (EA)
L125.255		Retroreflective Marker, L-853, Type 2	Each (EA)
L125.261		Runway Guard Light LED L-804 Mode 1	Each (EA)
L125.262		Runway Guard Light LED L-804 Mode 2	Each (EA)
L125.300		Medium Intensity Runway Light, L-861, Stake Mounted, White/White	Each (EA)
L125.301		Medium Intensity Runway Light, L-861, Stake Mounted, White/Yellow	Each (EA)
L125.302		Medium Intensity Threshold Light, L-861E, Stake Mounted, Red/Green	Each (EA)
L125.303		Medium Intensity Threshold Light, L-861SE, Stake Mounted, Red/Green	Each (EA)
L125.310		Medium Intensity Runway Light, L-861 LED, Stake Mounted, White/White	Each (EA)
L125.311		Medium Intensity Runway Light, L-861 LED, Stake Mounted, White/Yellow	Each (EA)
L125.312		Medium Intensity Threshold Light, L-861E LED, Stake Mounted, Red/Green	Each (EA)
L125.313		Medium Intensity Threshold Light, L-861SE LED, Stake Mounted, Red/Green	Each (EA)
L125.320		Medium Intensity Runway Light, L-861, Base Mounted, White/White	Each (EA)
L125.321		Medium Intensity Runway Light, L-861, Base Mounted, White/Yellow	Each (EA)
L125.322		Medium Intensity Threshold Light, L-861E, Base Mounted, Red/Green	Each (EA)
L125.323		Medium Intensity Threshold Light, L-861E, Base Mounted, Red/Red	Each (EA)
L125.324		Medium Intensity Threshold Light, L-861E, Base Mounted, Green	Each (EA)
L125.325		Medium Intensity Threshold Light, L-861SE, Base Mounted, Red/Green	Each (EA)
L125.326		Medium Intensity Threshold Light, L-861SE, Base Mounted, Green	Each (EA)
L125.330		Medium Intensity Runway Light, L-861 LED, Base Mounted, White/White	Each (EA)
L125.331		Medium Intensity Runway Light, L-861 LED, Base Mounted, White/Yellow	Each (EA)
L125.332		Medium Intensity Threshold Light, L-861E LED, Base Mounted, Red/Green	Each (EA)
L125.333		Medium Intensity Threshold Light, L-861E LED, Base Mounted, Red/Red	Each (EA)
L125.334		Medium Intensity Threshold Light, L-861E LED, Base Mounted, Green	Each (EA)
L125.335		Medium Intensity Threshold Light, L-861SE LED, Base Mounted, Red/Green	Each (EA)
L125.336		Medium Intensity Threshold Light, L-861SE LED, Base Mounted, Green	Each (EA)
L125.340		Medium Intensity Taxiway Light, L-861T, Stake Mounted	Each (EA)
L125.341		Medium Intensity Taxiway Light, L-861T, Base Mounted	Each (EA)
L125.342		Medium Intensity Taxiway Light, L-861T LED, Stake Mounted	Each (EA)
L125.343		Medium Intensity Taxiway Light, L-861T LED, Base Mounted	Each (EA)
L125.350		High Intensity Runway Light, L-862, Base Mounted, White/White	Each (EA)
L125.351		High Intensity Runway Light, L-862, Base Mounted, White/Yellow	Each (EA)
L125.352		High Intensity Threshold Light, L-862E, Base Mounted, Red/Green	Each (EA)
L125.353		High Intensity Threshold Light, L-862E, Base Mounted, Red/Red	Each (EA)
L125.354		High Intensity Threshold Light, L-862E, Base Mounted, Green	Each (EA)
L125.360		High Intensity Runway Light, L-862 LED, Base Mounted, White/White	Each (EA)
L125.361		High Intensity Runway Light, L-862 LED, Base Mounted, White/Yellow	Each (EA)
L125.362		High Intensity Threshold Light, L-862E LED, Base Mounted, Red/Green	Each (EA)
L125.363		High Intensity Threshold Light, L-862E LED, Base Mounted, Red/Red	Each (EA)
L125.364		High Intensity Threshold Light, L-862E LED, Base Mounted, Green	Each (EA)
L125.370		Stop Bar Light L-862S	Each (EA)
L125.400	through L125.409	Guidance Sign, 1-Module, per each	Each (EA)
L125.410	through L125.419	Guidance Sign, 2-Module, per each	Each (EA)
L125.420	through L125.429	Guidance Sign, 3-Module, per each	Each (EA)
L125.430	through L125.439	Guidance Sign, 4-Module, per each	Each (EA)
L125.440	through L125.449	Modify Guidance Sign (location)	Lump Sum (LS)
L125.450	through L125.459	Relocate Guidance Sign (location)	Lump Sum (LS)

PAY ITEM		DESCRIPTION	UNIT
L125.460	through L125.469	Runway Distance Remaining Sign (type) (size) (style)	Each (EA)
L125.470	through L125.479	Base Can L-867 (size)	Each (EA)
L125.480	through L125.489	Base Can L-867 with Lid and Gasket (size)	Each (EA)
L125.490	through L125.499	Base Can L-868 with Lid and Gasket (size)	Each (EA)
L125.510		PAPI, L-880, Style A, Class I	Lump Sum (LS)
L125.520		PAPI, L-880, Style A, Class II	Lump Sum (LS)
L125.530		PAPI, L-880, Style B, Class I	Lump Sum (LS)
L125.540		PAPI, L-880, Style B, Class II	Lump Sum (LS)
L125.550		PAPI, L-881, Style A, Class I	Lump Sum (LS)
L125.560		PAPI, L-881, Style A, Class II	Lump Sum (LS)
L125.570		PAPI, L-881, Style B, Class I	Lump Sum (LS)
L125.580		PAPI, L-881, Style B, Class II	Lump Sum (LS)
L125.600		Lighted Temporary Runway Closure Aid L-893	Each (EA)
L125.610		Remove Runway or Taxiway Stake Mounted Light, per each	Each (EA)
L125.620		Remove Runway or Taxiway Base Mounted Light, per each	Each (EA)
L125.630		Remove Taxiway Guidance Sign, per each	Each (EA)
L125.640		Electric Utility Service (location)	Lump Sum (LS)
L125.650		Spare Electrical Equipment	Lump Sum (LS)

NOTE:
Pay Items which contain () allow the specifier the option to insert more specific information into the Pay Item description. In some cases where the additional information is not appropriate or where the specifier chooses to put the information into the Special Provisions or on the Plans, the () should be deleted from the Pay Item when it is used in the Schedule of Prices or elsewhere in the Contract Documents.

STANDARD SPECIFICATIONS FOR
AIRPORT CONSTRUCTION

State of Wisconsin Department of Transportation

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