NOTICE OF PROPOSED GUIDANCE DOCUMENT

DTIMBOA13

Pursuant to Wis. Stat. s. 227.112, the Wisconsin Department of Transportation is hereby seeking comment on DTIMBOA13, a proposed guidance document.

PUBLIC COMMENTS AND DEADLINE FOR SUBMISSION

Comments may be submitted to the Wisconsin Department of Transportation for 21 days by:

1. Department's website: https://appengine.egov.com/apps/wi/dot/guidance-docs?guidDocId=DTIMBOA13
2. Mailing written comments to:

Division of Transportation Investment Management
Wisconsin Department of Transportation
4822 Madison Yards Way
PO Box 7913
Madison, WI 53707- 7913

WEBSITE LOCATION OF FINAL GUIDANCE DOCUMENT

The final version of this guidance document will be posted at wisconsindot.gov to allow for ongoing comment.

AGENCY CONTACT

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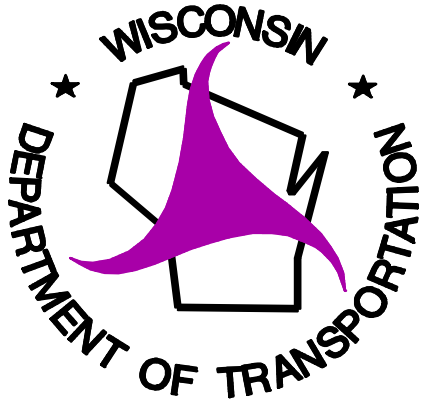
Standard Specifications for Airport Construction

State of Wisconsin
Department of Transportation
Bureau of Aeronautics



1998 Edition

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STATE OF WISCONSIN, BUREAU OF AERONAUTICS
STANDARD SPECIFICATIONS FOR AIRPORT CONSTRUCTION

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SECTION 10. TERMS, FORMAT, AND DEFINITIONS

10-01 INTENTION OF TERMS. The “direction,” “requirement,” “permission,” “order,” “designation,” or “prescription,” of the Engineer is intended wherever, in these Specifications or on the Plans, “directed,” “required,” permitted,” “ordered,” “designated,” “prescribed,” or similar words are used. Similarly, “approved,” “acceptable,” “satisfactory,” or similar words imply “approved by,” or “acceptable to,” or “satisfactory to” the Engineer.

These Specifications may be written in the imperative mood. In sentences using the imperative mood, the subject, *"the Contractor,"* is implied. Also implied is *"shall," "shall be,"* or similar words and phrases. In material specifications, the subject may also be the supplier, fabricator, or manufacturer supplying material, products, or equipment for use on the project. The term “will” is used for “the Engineer” “the Department” or other subjects who are not Contractors.

Interpret references to a specific requirement of a numbered paragraph of the Specifications or a cited standard to include all general requirements of the entire section, Specification, or cited standard.

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.

"Provide" means furnish and install.

10-02 SPECIFICATION FORMAT. These Specifications are divided into the General Requirements and Covenants, and Parts II through XI.

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.

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

(1) Description,
(2) Materials,
(3) Construction Methods,
(4) Method of Measurement, and
(5) Basis of Payment.

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 Subsection 90-02, Scope of Payment, and the specification section ordering the Work.

10-03 DEFINITION OF TERMS. Interpret the intent and meaning of the following terms and acronyms in these Specifications, in the Contract, in any documents or other instruments pertaining to construction where these Specifications govern, 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. A modification of the Plans or other Contract Documents issued by the Engineer and distributed to prospective Bidders prior to the opening of the Proposal.

ADMINISTRATOR (FAA). Administrator of the Federal Aviation Administration (FAA) or their duly authorized representative.

ADVERTISEMENT (ADVERTISEMENT FOR BIDS). A public notice, as required by law, inviting bids for work to be performed and materials to be furnished.

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, is 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.

AIP. The Airport Improvement Program, a grant–in–aid program, administered by the FAA and successor programs.

AIR OPERATIONS AREA. Air Operations Area (AOA) means any area of the Airport used or intended to be used for the landing, takeoff, or surface maneuvering of aircraft. An AOA includes 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. Any area of land or water which is used, or intended for use, for the landing and takeoff of aircraft, and any appurtenant areas which are used, or intended for use, for Airport buildings or other Airport facilities or rights–of–way, together with all airport buildings and facilities located thereon.

APRON. The area of the Airport required by airplane pilots to position airplanes during ground operations, not involving landing, taxiing and takeoff.

ASTM. The American Society for Testing and Materials.

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.

BIDDER. Any individual, partnership, firm, or corporation, acting directly or through a duly authorized representative, who submits a Proposal for the Work contemplated.

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.

CALENDAR DAY. Every day shown on the calendar.

CERTIFICATE OF COMPLIANCE (MANUFACTURER'S CERTIFICATE). A document, provided by a manufacturer, producer, or supplier of a product, that states the product, as furnished to the Contract or, complies with the pertinent Specifications and Contract requirements.

CERTIFIED REPORT OF TEST OR ANALYSIS. A test report, provided by a manufacturer, producer, or supplier of a product, indicating actual results of tests or analyses, covering elements of the Specification requirements and validated by certification.

CHANGE ORDER. A written order, authorization, or agreement, executed by the Contractor and the Department, covering work not otherwise provided for, revisions in or amendments to the Contract, or conditions specifically prescribed in the Specifications as requiring Contract Change Orders. The document becomes a part of the Contract when executed by the contracting parties.

COMPLETION DATE. Calendar date shown in the Proposal on or before the Work contemplated under this Contract shall be completed.

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

CONTRACT DOCUMENTS. The Contract Documents include the Advertisement for Bids, Proposal Forms, Contract Form and Contract Bonds, 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 BONDS. The approved form of security, executed by the Contractor and their surety or sureties, guaranteeing the faithful performance of the Contract and the payment, to persons entitled thereto, of all claims as provided in Section 779.14, Wisconsin Statutes. (See Performance Bond and Payment Bond.)

CONTRACT ITEM (PAY ITEM). A specific unit of work for which a price is provided in the Contract.

CONTRACT TIME. The number of working days, stated in the Proposal, allowed for completion of the Contract, including authorized time extensions. If a calendar date of completion is stated in the Proposal, instead of a number of working days, the Contract shall be completed by that date.

CONTRACTOR. The party of the second part to the Contract; the individual partnership, joint ventures, corporation or agency undertaking the execution of the Work under the terms of the Contract and acting directly or through a duly authorized representative.

CONTROLLING ITEM OF WORK. The item shown on the approved progress schedule that must be partially or wholly completed in accordance with the approved progress schedule to permit progress essential for the completion of the Work within the Contract period.

DEPARTMENT. The Department of Transportation of the State of Wisconsin.

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 of the State of Wisconsin or their authorized representative limited by the particular entrusted duties.

EQUIPMENT. All machinery, together with the necessary supplies for upkeep and maintenance, and also all tools and apparatus necessary for the proper construction and acceptable completion of the Work.

EXTRA WORK. An item of work not provided for in the awarded Contract as previously modified by Change Order, but which is found by the Engineer to be necessary to complete the Work within the intended scope of the Contract as previously modified.

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

FORCE ACCOUNT. A basis of payment for the directed performance of Work, with payment based on the actual cost of labor, equipment, materials furnished, and consideration for overhead and profit.

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

HAZARDOUS SUBSTANCE. Any substance or combination of substance including any 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.

INSPECTOR. An authorized representative of the Engineer assigned to make inspections and/or tests of the Work performed or being performed, or of the materials furnished or being furnished by the Contractor.

LABORATORY. The official testing laboratories of the Department or other laboratories that are designated by the Engineer.

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.

MATERIALS. Substances specified for use in the construction of the Contract Work.

NOTICE TO PROCEED. A written notice to the Contractor of the time they shall begin the prosecution of the Work.

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

PAYMENT BOND. The approved form of security furnished by the Contractor and the Contractor's surety as a guaranty that the Contractor will pay in full all bills and accounts for materials and labor used in the construction of the Work.

PERFORMANCE BOND. The approved form of security furnished by the Contractor and the Contractor's surety as a guaranty that the Contractor will complete the Work in accordance with the terms of the Contract.

PLANS. The official drawings or exact reproductions approved by the Department that show the location, character, dimensions, and details of the Airport. Plans also show the Work to be done, which is considered a part of the Contract, supplementary to the Specifications. Plans can also be referred to as Drawings.

PROJECT. The agreed scope of Work for accomplishing specific Airport development with respect to a particular Airport.

PROPOSAL. The written offer of the Bidder (when submitted on an approved Proposal form) to perform the contemplated Work and furnish the necessary materials in accordance with the provisions of the Plans, Specifications, General Requirements and Covenants, Special Provisions, Supplemental Specifications, Wage Rates, Schedule of Prices, and Addenda.

PROPOSAL GUARANTY (BID BOND). The security furnished with a Proposal to guaranty that the Bidder will enter into a Contract if the Bidder's Proposal is accepted by the Department.

RESIDENT ENGINEER. The representative of the Engineer, directly assigned to the Project.

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 and operation of an Airport and its appurtenances.

RUNWAY. The area on the Airport prepared for the landing and takeoff of aircraft.

SECRETARY. Secretary of Transportation of Department of Transportation, State of Wisconsin.

SCHEDULE OF PRICES. The schedule containing a list of the Pay Items, corresponding quantities, and the Bidder’s Bid Prices for the Work to be included in the Contract.

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.

SHOP DRAWINGS. Drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for the Contractor and submitted by the Contractor to illustrate some portion of the Work.

SPECIAL PROVISIONS. Special directions, provisions or requirements peculiar to a project and not otherwise thoroughly or satisfactorily detailed or prescribed in the Specifications.

SPECIFICATIONS. The body of directions, provisions and requirements contained herein, or in supplements thereto, together with written agreements and all documents of any description, made or to be made, pertaining to the method or manner of performing the Work, the quantities and the quality of materials to be furnished under the Contract.

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.”

STANDARD SPECIFICATIONS. Written directions and requirements approved for general application and repetitive use; as contained herein for airport construction and for administration of the Contract.

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 a base course; or in the case of Portland cement concrete pavement, the layer that lies immediately below the concrete pavement.

SUBCONTRACTOR. An individual, partnership, joint venture or corporation to whom the Contractor, with the written consent of the Department, sublets any part of the Contract.

SUBGRADE. The soil that forms the pavement foundation.

SUPERINTENDENT. The Contractor's executive representative 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 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 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.

TARGET VALUE (DENSITY). A number established as a center for operating a given process. Once established, adjustments should be made in the process as necessary to maintain a central tendency about the target value. Test results obtained from a well-controlled process should cluster closely around the established target value and the mean of the test results should be equal to or nearly equal to the established target value.

TAXIWAY. For the purpose of this document, the term taxiway means the portion of the AOA of an Airport that has been designated by competent Airport authority for movement of aircraft to and from the Airport's runways or aircraft parking areas.

UNBALANCED BID. A bid containing lump sum or unit price bid items that do not reflect reasonable actual costs of labor, equipment, materials, profit, overhead costs and indirect costs to the bidder.

WORK. The furnishing of all labor, materials, tools, equipment, and incidentals necessary or convenient to the Contractor's performance of all duties and obligations imposed by the Contract Documents, Plans, and Specifications.

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

SECTION 20. PROPOSAL REQUIREMENTS AND CONDITIONS

20–01 COMPETENCY OF BIDDERS. Each Bidder shall furnish the Department with satisfactory evidence of their competency to perform the Work contemplated The qualification requirements will be stated in the Advertisement for Bids.

Any individual, partnership, or corporation desiring to bid on work under the jurisdiction or direct supervision of the Department shall furnish a statement, on a 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.

For statements completed under the Statement of Bidder's Qualifications and Experience, the Department will determine the classification/capacity of work on which the Bidder will be eligible to bid. The qualification, except as specifically extended, withdrawn, or reduced by the Department, will be on an annual basis and will expire 1 year and 4 months after the date of the approval determination.

In addition to the approval of the Statement of Bidder's Qualifications and Experience or Bidders inclusion on other "lists," as stated in the Advertisement for Bids, each Bidder shall submit a *Request to Bid/Current Workload* Form for each Proposal. The *Request to Bid/Current Workload* Form should list the contracts and subcontracts representing all incomplete work in or out–of–State under contract at that given time. The Department should receive this form no later than 24 hours prior to the time for opening of Bids. The determination of acceptability of the information submitted and authorization to bid is at the sole discretion of the Department. The Department will contact the Bidder on the Department's determination for authorization to bid.

Prior establishment of the competency of a prospective Bidder will not be required for specific contemplated work when indicated in the Advertisement for Bids.

20–02 CONTENTS OF PROPOSAL FORMS. This form will state the location and description of the contemplated construction and will show the estimate of the various quantities and kinds of work to be performed or materials to be furnished. The form will also have a Schedule of Prices for which unit prices are invited. The Proposal Form will state the time in which the Work must be completed, the amount of the Proposal Guaranty, and the date and hour after which Proposals will no longer be received. The form will be accompanied by Bidding Documents in addition to these Specifications.

All papers bound with or attached to the Proposal Form are considered a part of the Bidding Documents and must not be detached or altered when the Proposal is submitted. The Plans, Specifications, and other documents designated in the Proposal Form will be considered a part of the Proposal whether attached or not.

20–03 FURNISHING OF PROPOSAL FORMS, PLANS, AND SPECIFICATIONS. Proposal Forms are included with the Plans and Specifications. Proposals are subject to the provisions of Section 66.29 and Chapter 114 of the Wisconsin Statutes.

Plans and Specifications that govern the Work are on file and available for office examination at the Office of the Wisconsin Bureau of Aeronautics, Room 701, Hill Farms State Transportation Building, 4802 Sheboygan Avenue, Madison, Wisconsin and at other locations as stated in the Advertisement for Bids. The Advertisement for Bids provides the location for purchasing Bidding Documents.

The type of qualification requirements will be stated in the Advertisement for Bids. Subsection 20–01, Competency 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 20–12, Disqualification of Bidders, outlines some of the causes for disqualification of the Bidder and rejection of Bid(s).

20–04 INTERPRETATION OF QUANTITIES IN SCHEDULE OF PRICES. An estimate of the quantities of Work to be done or materials to be furnished is given in the Schedule of Prices.

Consider itemized quantities of Work as approximate and for the comparison of Bids only. The Bidder shall not plead deception or misunderstanding of the character, location, or other condition pertaining to the Work due to variations of estimated quantities. The unit prices to be tendered by the Bidder are to be tendered expressly for the scheduled Pay Items of Work. Payment to the Contractor will be made only for the actual quantities of the Work performed or materials furnished in accordance with the Contract. The scheduled quantities of Work to be done or materials to be furnished may each be increased or decreased as provided in Subsection 90–03, Increased or Decreased Quantities, without in any way invalidating the Bid Prices.

20–05 EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE. Carefully examine the Work site, the Proposal Form, Plans, Specifications, Supplemental Specifications, Special Provisions, Addenda, and Contract Forms for the Work contemplated. The submission of a Proposal will be considered conclusive evidence that the Bidder has investigated and is satisfied as to the conditions to be encountered in performing the Work, and as to the character, quality, and quantities of Work to be performed and materials to be furnished, including increases and decreases, and as to the requirements of the Plans, Specifications, Supplemental Specifications, Special Provisions, Addenda, and Contract.

When the Plans, Special Provisions, or Addenda contain information relative to subsurface exploration, borings, soundings, water levels, elevations, profiles, or other preliminary investigations, that information represents only the best knowledge of the Engineer and was obtained for design and estimating purposes only. It is only included for the convenience of the Bidder, and is not intended as a substitute for personal investigation, interpretation, and judgment of the Bidder. The information given is applicable only to the locations indicated and shall not be construed to apply uniformly throughout the Project site.

20–06 PREPARATION OF PROPOSAL. Submit the Proposal on the form furnished or in the format approved by the Department. Instead of using the Department's Schedule of Prices, the Bidder may submit a computer generated substitute schedule with the Proposal. The substitute schedule shall be in a format conforming to the Department's guidelines for approval of computer generated Schedule of Prices and must be approved in writing by the Department prior to use. The Proposal shall be executed properly and shall clearly specify a numerical unit price in dollars and cents for each Pay Item listed. It shall also show in the column provided for that purpose, the numerical products of the respective unit prices and quantities, and the total amount of the Bid obtained by adding the extended amounts of the several Pay Items. A lump sum Pay Item should be shown as the same price in dollars and cents in the unit price column and in the extended amount column pertaining to that Pay Item. If one column is left blank for a lump sum Pay Item, the single amount shown will be used to obtain the total amount of the Bid.

If a unit price or lump sum price already entered by the Bidder in the Proposal is to be altered, it shall be crossed out with ink or typewriter and the new price entered above or below and initialed by the Bidder with ink.

Changes made by the Bidder in the Proposal in accordance with a specific instruction contained in any Addendum issued by the Department will not be considered to be an alteration within the meaning of these Specifications.

Unless otherwise required in the Special Provisions, when Alternate Bids are requested, a Bid on each alternate will be required.

In case of a conflict between a unit price and the corresponding extended amount, or in the absence of an extended amount, the unit price will govern.

All writing shall be in ink or typewriter, except the signature of the Bidder that shall be written with ink.

A Proposal submitted by an individual shall be signed by the Bidder or a duly authorized agent. A Proposal submitted by a partnership shall be signed by a member or a duly authorized agent. A Proposal submitted by a corporation shall be signed by an authorized officer or duly authorized agent of the corporation, and the Proposal shall show the name of the State under the laws of which the corporation was chartered. the required signatures shall in all cases appear in the space provided on the Proposal. All addenda to the Contract Documents shall be attached to the Proposal submitted by the Bidder.

20–07 IRREGULAR PROPOSALS. Proposals will be considered irregular and may be rejected if they show alterations of form or format, additions or amendments not called for, alterations or omissions in Pay Item numbers, quantities, descriptions or units of measure, incomplete Bids, erasures, or irregularities.

Use of a Department approved computer generated Schedule of Prices will not be considered an alteration of form or format within the meaning of these Contract Documents.

Department approved computer generated Schedule of Prices will be considered irregular and may be rejected if they show any alterations of format, additions or amendments not called for, errors or omissions in units of measure, or erasures.

If on a computer generated Schedule of Prices the quantity is incorrect, then the quantity will be corrected.

If on a computer generated Schedule of Prices the Pay Item number is correct and the description is incorrect, then the description will be corrected.

If on a computer generated Schedule of Prices the Pay Item number is incorrect and the description is correct, then the item number will be corrected.

A correct Pay Item number that is out of sequence remains a correct item number, provided the description is also correct.

Proposals will be considered irregular and will be rejected for, but not necessarily limited to, the following reasons:

a. Failure to furnish the required Proposal Guaranty in proper form and amount.

b. Failure to submit a unit price for each Pay Item listed, except for lump sum Pay Items where the price may be shown in the extension column pertaining to that Pay Item.

c. The inclusion of conditions or qualifications not provided for in the Bid Proposal form.

d. Proposals tendered as a Bid by a Bidder other than the one to who originally issued.

e. Unauthorized revisions in the name of the party to whom issued.

f. Failure to sign the Proposal.

g. Wrong computer generated Schedule of Prices attached to the Proposal.

h. Incorrect item number and incorrect description for a single line on a computer generated Schedule of Prices.

i. Omitted items on a computer generated Schedule of Prices.

j. Illegibly printed item numbers, descriptions, or unit prices on a computer generated Schedule of Prices.

20–08 PROPOSAL GUARANTY. No Proposal will be considered unless accompanied by properly executed Bid Bond, of not less than 5 percent of the total bid, ON THE DEPARTMENT'S FORM contained in the Proposal, or cashier's check, certified check, bank's check or postal money order in the amount designated on the Proposal and payable to the Department. Certified checks will be drawn on the account of the Bidder submitting the Proposal.

The Bidder may also meet the above requirements by having a properly executed annual Bid Bond of not less than 5 percent of the total bid(s) on file with the Department. The annual Bid Bond shall be on the FORM PROVIDED BY THE DEPARTMENT.

The surety issuing the Bid Bond must have an equivalent A.M. Best rating of A- or better, and must be licensed to do business in the State of Wisconsin.

If alternate Bids are invited and submitted, the Bidder may submit one Proposal Guaranty in the total amount required for the combined alternate which will also be considered as covering each individual Proposal.

20–09 DELIVERY OF PROPOSAL. Place each Proposal, together with the Proposal Guaranty, in a sealed envelope, furnished by the Department, and mark the envelope to indicate the project number, the location of the Airport, and the name and business address of the Bidder. When sent by mail, enclose the sealed Proposal marked as indicated above in an additional envelope. Proposals will be received at the place and until the hour on the date designated in the Advertisement for Bids. Proposals received after the time designated will be returned to the Bidder unopened.

20–10 WITHDRAWAL OF PROPOSALS. All proposals filed with the Department will be kept secure and unopened and will not be allowed to pass out of the custody of a representative of the Department except on written request of the Bidder or their authorized representative made prior to expiration of the time set for receiving Proposals. If a withdrawal is made, the prospective Bidder is not entitled to bid on the Contract unless the same is readvertised.

20–11 PUBLIC OPENING OF PROPOSALS. Proposals will be opened publicly at the time and place indicated in the legal Advertisement for Bids. The grand total of each Proposal will be read. In the event a grand total is not shown, a "no total" will be announced.

Bidders or their authorized agents and other interested persons are invited to be present.

The time of receiving and opening Bids may be postponed by the Department. When circumstances arise which the Department determines to necessitate changing the time or date for receipt of Bids, the prospective Bidders will be notified by the Department by issuance of an Addendum or by public notice.

20–12 DISQUALIFICATION OF BIDDERS. Any one or more of the following causes may be considered as sufficient for rejection of the Bid or Bids and disqualification of the Bidder from further bidding for a period of time as may be determined by the Department.

a. Developments, subsequent to establishment of a Bidder's competency and qualifications, which in the opinion of the Department would reasonably be construed as affecting the responsibility of the Bidder.

b. Conviction of a major violation of a State or Federal law, or a rule or regulation of a Federal department, board or bureau, or a State department, board or commission, relating to or reflecting on the competency of the Bidder for performing airport construction work.

c. More than one Proposal for the same work from an individual, partnership, or corporation under the same or different names.

d. Indictment for or evidence of collusion among Bidders.

e. Lack of responsibility as shown by past work for the Department.

f Noncompliance with terms of previous or existing contracts.

g. Uncompleted work which in the judgment of the Department might hinder or prevent the completion of the additional work, if awarded.

h. Uncompleted work on which the actual time used has exceeded the Contract Time set, or on which the performance or progress is not satisfactory in the judgment of the Department.

SECTION 30. AWARD AND EXECUTION OF CONTRACT

30–01 CONSIDERATION OF PROPOSALS. After the Proposals are publicly opened and read, they will be compared on the basis of the summation of the lump sum prices and the products. This is obtained by multiplying the estimated quantities by the unit prices offered in the Schedule of Prices. In case of discrepancy between the gross sum shown in the Proposal and that obtained by adding the products of the quantities of Work and the unit prices, the unit prices will govern and all errors found in the products and summation will be corrected. If a gross sum is not shown, the gross sum will be obtained by adding the correct extended amounts.

Until the award of a Contract is made, the Department reserves the right to reject a Bidder's Proposal for any of the following reasons:

a. If the Proposal is irregular as specified in Subsection 20-07, Irregular Proposals.

b. If the Bidder is disqualified for any of the reasons specified in Subsection 20-12, Disqualification of Bidders.

The Department may take into consideration the responsibility of the Bidder as determined from a study of the data required in Subsection 20-01, Competency of Bidders..

Consideration will be given to determining whether irregularities are matters of form rather than substance and can be waived without prejudice to other Bidders or the public interest.

Proposals in which any of the unit prices are significantly unbalanced may be rejected.

In addition, until the award of a Contract is made, the Department reserves the right to reject all Proposals, waive technicalities (if the waiver is in the best interest of the Department and Sponsor and is in conformance with applicable State and local laws or regulations pertaining to the letting of construction contracts), advertise for new Proposals, or proceed with the Work otherwise. All these actions will promote the Department's and Sponsor's best interests.

30–02 AWARD OF CONTRACT. The award of a Contract, if it is to be awarded, will be made within 30 calendar days of the date specified for publicly opening Proposals, unless otherwise specified .

Award of the Contract will be made by the Department to the lowest, responsible Bidder whose Proposal conforms to the cited requirements of the Department. Should no award be made within 30 days after the date of opening of Proposals, the lowest responsible Bidder may, upon the expiration of such period, request in writing that the award be made within a stipulated time not less than 10 days, exclusive of Sundays and holidays, after the date of the request. Should no award be made within the stipulated time, the lowest responsible Bidder shall be relieved of their obligation to execute a Contract and Contract Bonds.

NOTE TO SPECIFIER:
For AIP contracts, unless otherwise specified in this subsection, no award shall be made until the FAA has concurred in the sponsor's recommendation to make such award and has approved the sponsor's proposed contract to the extent that such concurrence and approval are required by 49 CFR Part 18. If there is a change required in the length of time to award, the WBOA will initiate the changes.

30–03 CANCELLATION OF AWARD. The Department reserves the right to cancel the Award without liability to the Bidder, except return of Proposal Guaranty, at any time before a Contract has been fully executed by all parties and is approved by the Department in accordance with Subsection 30-07, Approval of Contract.

30–04 RETURN OF PROPOSAL GUARANTY. All Proposal Guaranties, except those of the two lowest Bidders, will be returned immediately after the Department has made a comparison of bids as specified in the Subsection 30-01, Consideration of Proposals. Proposal Guaranties of the two lowest Bidders will be retained by the Department until an award is made, at which time, the unsuccessful Bidder's Proposal Guaranty will be returned. The Proposal Guaranty of the lowest responsible Bidder will be returned when the Contract, Performance and Payment Bonds, and other documents required to be filed by the Bidder have been properly executed and submitted in proper form to the Department. In the event no award is made within the extended time stipulated by the lowest responsible Bidder, as provided by Subsection 30–02, Award of Contract, the Bidder's Proposal Guaranty will be returned promptly upon expiration of the extended time.

30–05 REQUIREMENTS OF CONTRACT BONDS. Upon execution of the Contract, the successful Bidder shall furnish the Contract Bonds that have been fully executed by the Bidder and the Surety guaranteeing the performance of the Work and the payment of all legal debts that may be incurred by reason of the Contractor's performance of the Work. A 100 Percent Performance and 100 Percent Payment Bond in the amount of the Contract awarded shall be furnished. Bonds shall be on the form furnished by the Department, executed by a Surety acceptable to the Department, and licensed to do business in Wisconsin.

NOTE TO SPECIFIER:
49 CFR Part 18 provides that sponsors of AIP contracts awarded in excess of $100,000 should use local bonding policy and requirements provided that the FAA has made a determination that the Government's interest is adequately protected. If such a determination has not been made, the performance and payment bonds shall be in the full amount of the awarded contract. For AIP contracts awarded in an amount of $100,000 or less, the sponsor should specify bonding in accordance with local requirements.

30–06 EXECUTION OF CONTRACT. The successful Bidder shall execute the necessary agreements for entering into the Contract and return the signed Contract to the Department, along with the fully executed Contract Bonds specified in Subsection 30-05, Requirements of Contract Bonds, within 15 calendar days from the date of Notice of Award of the Contract.

30–07 APPROVAL OF CONTRACT. Upon receipt of the Contract, Contract Bonds, and other required documents that have been executed by the successful Bidder, the Department will complete the execution of the Contract and return the fully executed Contract to the Contractor. No Contract will be considered binding upon the Department until the final execution of the Contract Agreement. The date of final execution of the Contract will be the date of the final signature .

30–08 FAILURE TO EXECUTE CONTRACT. Failure of the successful Bidder to return required forms or to supply information requested by the Department and to execute the Contract and furnish acceptable Contract Bonds within 15 calendar days after the date of Notice of Award of the Contract, at the discretion of the Department, will be just cause for annulment of the award and forfeiture of the Proposal Guaranty to the State, not as a penalty, but as liquidation of damages to the Department. Award may then be made to the next qualified Bidder, or the Project will be readvertised, or handled as the Department may elect.

30–09 RIGHT OF BIDDER TO NULLIFY PROPOSAL (ABROGATION). Should the Department fail to execute a Contract within 30 days after the filing of the Contract by Bidder, together with acceptable Contract Bonds and such other schedules, or documents as are required to be filed, all in proper form and order, the Bidder may nullify their acceptance of the Contract by their filing due notice of intent with the Department. The notice shall be in writing and may be filed at any time after the expiration of 30 days after the filing by the Bidder in proper form and order of the required Contract Documents. The notice shall stipulate the maximum number of days, not less than 10, exclusive of Sundays and holidays, within which the Contract will be executed by the Department. Failure of the Department to execute the Contract within the time set forth in the notice, will be construed to be a Department acceptance of the nullification of the Bid, and the Bidder and Bidder's Surety will be relieved of all obligations to the State that may have been incurred under the Contract and Contract Bonds.

It is agreed and understood, however, that nullification is a purely voluntary act of the Bidder, and no liability or obligation toward the Bidder, Bidder's Surety, or any other party who may have an interest, directly or indirectly in the Contract, has been incurred by the Department.

Unless and until the Bidder files a notice of nullification, and until the notice becomes effective, if filed, the Contract may be executed by the Department without prejudice to any of the terms and conditions.

SECTION 40. SCOPE OF WORK

40–01 INTENT OF CONTRACT. The intent of the Contract is to provide for construction and completion, in every detail, of the Work described in the Contract Documents. Furnish all labor, materials, equipment, tools, transportation, and supplies required to complete the Work according to the Contract.

40–02 ALTERATION OF WORK AND QUANTITIES. A Major Pay Item is a Pay Item whose total cost, by multiplying the original quantity and the corresponding unit price, is equal to or greater than 5 percent of the total amount of the original Contract. A Minor Pay Item is one whose total cost, determined as above, is less than 5 percent of the total amount of the original Contract. A Minor Pay Item will become a Major Pay Item when increased to the extent that the total cost of the Pay Item becomes equal to or greater than 5 percent of the total amount of the original Contract.

If the quantity of a Major Pay Item required to complete the Work varies from the original estimated quantity for that Pay Item by 25 percent or less, payment for the quantity of Work actually performed for that Pay Item will be made based upon the original unit price.

Should the quantity of a Major Pay Item of Work be decreased more than 25 percent from the original estimated quantity for that Pay Item, an adjustment will be made in the unit price; provided the total payment for the final quantity will not exceed that which would be made for 75 percent of the original estimated quantity, at the original unit price for that Pay Item.

Should the quantity of a Major Pay Item of Work be increased more than 25 percent above the original quantity for that Pay Item, an adjustment in the unit price will be made and applied to quantities of the Pay Item required in excess of 125 percent of the original estimated quantity.

The adjustment or revision of unit prices will be negotiated on the basis of actual cost for the entire Pay Item plus a negotiated allowance for profit and applicable overhead.

Where a Minor Pay Item has been increased to become a Major Pay Item, any adjustment in the unit price for the Item will apply only to that quantity of the item having a value, determined from the unit price, in excess of 6–1/4 percent of the total amount of the original Contract.

Minor Pay Items that, as increased, do not qualify for adjustment as a Major Pay Item, or are not a part of an approved subcontract, or, if a part of an approved subcontract, vary from the original quantity for the Item by 50 percent or less, will be paid for at the original unit price.

Should the quantity of a Minor Pay Item of Work, that is part of an approved subcontract and exceeds 10 percent of the original value of the subcontract, be decreased more than 50 percent, the Contractor may submit a request for a revision of the unit price for that Pay Item and shall submit evidence to support the claim. The claim will be considered insofar as it justifies an increase in the pro rata share of the fixed expense chargeable to that Pay Item because of the decreased quantity; provided the total payment for the final quantity will in no case exceed that which would be made for 75 percent of the original quantity at the original unit price.

Should the quantity of a Minor Pay Item of Work that is part of an approved subcontract and exceeds 10 percent of the original value of the subcontract be 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 unit price for the quantity of the Pay Item as is in excess of 125 percent of the original quantity. The revision of the unit price will be negotiated on the basis of actual cost for the entire Pay Item, plus a negotiated allowance for profit and applicable overhead.

The Department reserves the right to make, in writing, at any time during the Work, changes in quantities and alterations in the Work as are necessary to complete the Project satisfactorily. These changes in quantities and alterations will not invalidate the Contract nor release the Surety, and the Contractor agrees to perform the Work as altered.

If the alterations or changes in quantities significantly change the character of the Work under the Contract, whether or not changed by different quantities or alterations, an adjustment, excluding loss of anticipated profits, will be made to the Contract. The basis for the adjustment will be agreed upon prior to the performance of the Work. If a basis cannot be agreed upon, then an adjustment will be made either for or against the Contractor in such amount as the Department may determine to be fair and equitable.

If the alterations or changes in quantities do not significantly change the character of the Work to be performed under the Contract, the altered Work will be paid for as provided elsewhere in the Contract.

The term "significant change" applies only to the following circumstances:

a. When the character of the Work as altered differs materially in kind or nature from that involved or included in the original proposed construction, or

b. When a Major Pay Item of Work is increased in excess of 125 percent or decreased below 75 percent of the original estimated quantity for that Pay Item. An allowance for an increase in quantity will apply only to that portion in excess of 125 percent of original Pay Item quantity, or in case of a decrease below 75 percent, to the actual amount of Work performed.

c. When a minor Pay Item of Work, is part of an approved subcontract and exceeds 10 percent of the original value of the subcontract, is increased or decreased more than 50 percent from the original Contract quantity. Any allowance for an increase in quantity shall apply only to that portion in excess of 125 percent of the original Contract quantity, or in the case of a decrease below 50 percent, to the actual amount of Work performed.

The Work involved in significant changes will be paid for at adjusted Contract unit prices as provided, except as portions of it may qualify as Extra Work in accordance with the provisions of Subsection 90-05, Payment For Extra and Force Account Work .

NOTE TO SPECIFIER:
Supplemental Agreements (Change Orders) on AIP Contracts (indicated by AIP number on Contract), shall be approved by the FAA and shall include valid wage determinations of the U.S. Secretary of Labor when the amount of the supplemental agreement exceeds $2,000. However, if the Contractor elects to waive the limitations on work that increases or decreases the originally awarded contract or any major contract item by more than 25 percent, the supplemental agreement shall be subject to the same U.S. Secretary of Labor wage determination as was included in the originally awarded contract.

All supplemental agreements shall require consent of the Contractor's surety and separate performance and payment bonds.

40–03 OMITTED ITEMS. The Department may omit or modify the quantity of any Contract Pay Item, as provided in Subsection 40–02, Alteration of Work and Quantities. These modifications of will not invalidate any other Contract provision or requirement.

Should a Contract Pay Item be omitted or otherwise ordered to be nonperformed, the Contractor will be paid for acceptable Work performed toward completion of the Pay Item prior to the date of the order to omit the Pay Item. Payment for Work performed will be in accordance with the Subsection 90-04, Payment for Omitted Items.

40–04 EXTRA WORK. In connection with the Work covered by the Contract, the Engineer, at any time during its progress, may order other work or materials incidental to the Work. All Work and materials that do not appear in the Proposal or Contract as a specific item accompanied by a unit price, and are not included under the price bid for other items in the Contract, will be designated as Extra Work. Extra Work also may consist of additions to or changes in design of Contract items or portions of Contract items, when these additions are wholly disassociated from or outside the scope of the Work in the Plans, Special Provisions, Addenda and Specifications, and when the Work caused by these additions or changes in design must be performed under conditions or in a manner materially and inherently different from the conditions and manner existent for the Contract items under the original scope of the Work. The Contractor shall perform Extra Work whenever it is deemed necessary or desirable by the Engineer to complete the project as originally contemplated, or as subsequently altered, and it shall be done in accordance with the requirements in the Contract Documents.

Submit a written proposal of the Work plan to be followed, the equipment to be used, and the amount and character of labor to be employed. The Engineer will approve the proposal.

Except when directed by the Engineer, do not perform Extra Work until a Contract Change Order has been authorized. Claims for compensation for Extra Work performed, that has not been authorized and not covered by Contract Change Order, may be rejected.

The Contract Change Order for Extra Work may provide for payment at an agreed lump sum for the Work described, an agreed unit price basis for the units of Extra Work performed, or on a force account basis as stipulated in Section 90.

40–05 MAINTENANCE OF TRAFFIC. The most important consideration of the Contract is the safety of aircraft, as well as the Contractor's equipment and personnel. It is understood and agreed that the Contractor shall:

a. Provide for the free and unobstructed movement of aircraft in the Air Operations Areas of the Airport with respect to Contractor's own operations and the operations of Contractor's subcontractors as specified in the Subsection 80-04, Limitation of Operations .

b. **b.** 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 Subsection 70-15, Contractor’s Responsibility for Utility Service and Facilities of Others

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NOTE TO SPECIFIER:

Special conditions affecting the Contractor's operations during IMC must be specified in the Special Provisions. For example, if the Sponsor must maintain VOR or Localizer signals during IMC, the Contractor may be required to discontinue certain operations; or a Contractor may be required to have a Flight Check performed, thus requiring the Contractor to cooperate with the FAA Airways Facilities Sector Office.

c. With respect to Contractor's and subcontractor's operations, provide marking, lighting, and other acceptable means of identifying the following items that may be hazardous to the operation of aircraft, fire-rescue, or maintenance vehicles at the Airport:

(1) Personnel
(2) Equipment
(3) Vehicles
(4) Storage areas
(5) Work areas
(6) Conditions

d. When the Contract requires the maintenance of vehicular traffic on an existing road, street, or highway during the performance of Work that is otherwise provided for in the Contract, Plans, and Specifications, keep the road, street, or highway open to all traffic and provide the maintenance required to accommodate traffic. Furnish, erect, and maintain barricades, warning signs, flagmen, and other traffic control devices in reasonable conformity with the Manual of Uniform Traffic Control Devices for Streets and Highways (published by the United States Government Printing Office), unless otherwise specified. Also, construct and maintain in a safe condition 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 the existing road, street, or highway.

Make an estimate of all labor, materials, equipment, and incidentals necessary for providing the maintenance of aircraft and vehicular traffic, as specified in this Subsection. The cost of maintaining the aircraft and vehicular traffic, specified in this Subsection, will not be measured or paid for directly, but shall be included in the various Contract Pay Items.

40–06 REMOVAL OF EXISTING STRUCTURES. Remove all existing structures encountered within the established lines, grades, or grading sections, unless the 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 will not be measured or paid for directly, but shall be included in the various Contract Pay Items bid, unless separate Contract Pay Items are included in the Schedule of Prices.

Notify the Engineer prior to disturbing an existing structure (above or below ground) in the Work for which the disposition is not indicated on the Plans. The Engineer, in accordance with provisions of the Contract, will immediately determine the disposition of the existing structures in question.

Except as provided in Subsection 40-07, Rights and Use of Materials Found in the Work, 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 Sponsor when so utilized in the Work.

NOTE TO SPECIFIER:
The removal of large or complicated existing structures such as box–culverts, underground storage tanks, large underground electrical vaults, large reinforced concrete structures or foundations, or similar existing airport facilities should be provided for in separate technical specifications. Contract pay items should also be provided in the contract proposal to cover payment for such work. Refer to Specification Item P–158 Removing Miscellaneous Structures.

40–07 RIGHTS IN AND USE OF MATERIALS FOUND IN THE WORK. Should material be encountered such as (but not restricted to) sand, stone, gravel, slag, or concrete slabs within the established lines, grades, or grading sections, the use of which is intended by the terms of the Contract to be either embankment or waste, either:

a. Use the material in another Contract Pay Item, providing the use is approved by the Engineer and is in conformance with the Contract Specifications applicable to the use,

b. Remove the material from the site, upon written approval of the Engineer,

c. Use the material for temporary construction on site, or

d. Use the material as intended by the terms of the Contract.

Request the Engineer's approval prior to exercising option a., b., or c.

Should the Engineer approve the Contractor's request to exercise option a., b., or c., the Contractor will be paid for the excavation or removal of the material at the applicable Contract Price. The Contractor shall replace, at Contractor's expense, the removed or excavated material with an agreed equal volume of material that is acceptable for use in constructing embankment, backfills, or otherwise to the extent that replacement material is needed to complete the Work. The Contractor will be charged for use of such material in the Work or removed from the site.

Should the Engineer approve the Contractor's exercise of option a., payment will be made at the applicable Contract Price, for furnishing and installing the material in accordance with requirements of the Contract Item in which the material is used.

It is understood and agreed that the Contractor shall make no claim for delays by reason of Contractor's exercise of option a., b., or c.

Do not excavate, remove, or otherwise disturb materials, structures, or parts of structures that are located outside the lines, grades, or grading sections established for the Work, except where such excavation or removal is provided for in the Contract, Plans, or Specifications.

40–08 FINAL CLEANING UP. Upon completion of the Work and before acceptance and final payment will be made, remove from the site all machinery, equipment, surplus and discarded materials, rubbish, temporary structures, stumps, or portions of trees. Cut brush and woods within the limits indicated and leave the site in a neat and presentable condition. Material cleared from the site and deposited on adjacent property will not be considered as having been disposed of satisfactorily.

If material is procured or produced from a pit, quarry, or deposit that is not an active commercial source or is not naturally submerged, do the work as necessary and practical to shape, slope, 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 water will not collect or stand therein. Comply with ordinances relating to the reclamation of the sites. In special cases, the Contractor may be authorized to procure material below the elevation of drainability by surface water flow in accordance with a plan mutually agreed to by the Contractor and the property owner and meeting with the approval of the Engineer if:

a. The Contractor presents a written request and written evidence that the property owner has a valid and practical plan.

b. The plan is approved by local government officials and other agencies with respect to area development.

c. The plan complies with applicable regulations for creating or enlarging a body of impounded water for soil or water conservation, irrigation, wildlife propagation, agriculture, recreation or other purposes.

d. the Engineer deems this creation harmonious to public interest and will not create a public nuisance or hazard.

Final Cleanup shall be incidental to the other items of the Contract, and no separate or additional compensation will be made.

SECTION 50. CONTROL OF WORK

50–01 AUTHORITY OF THE ENGINEER. The Engineer will:

a. Decide questions regarding quality and acceptability of materials furnished, work performed, the manner of performance, and the rate of progress of the Work.

b. Provide interpretation of the Specifications or Plans relating to the Work, the fulfillment of the Contract on the part of the Contractor, and the rights of different Contractors on the Project.

c. Determine the amount and quality of the several kinds of Work performed and materials furnished that are to be paid for under the Contract.

50–02 CONFORMITY WITH PLANS AND SPECIFICATIONS. All work and all materials furnished shall be in reasonably close conformity with the lines, grades, grading sections, cross sections, dimensions, material requirements, and testing requirements that are specified (including specified tolerances) in the Contract, Plans, or Specifications.

If the Engineer finds the materials furnished, work performed, or the finished product not within reasonably close conformity with the Plans and Specifications but that the portion of the Work affected will, in the Engineer's opinion, result in a finished product having a level of, economy, durability, and workmanship acceptable to the Department, the Engineer will advise the Department of the determination that the affected Work be accepted and remain in place. In this event, the Engineer will document the determination and recommend to the Department a basis of acceptance that will provide for an adjustment in the Contract Price for the affected portion of the Work. The Engineer's determination and recommended Contract Price adjustments will be based on good engineering judgment and the tests or retests of the affected work as are, in the Engineer's opinion, needed. Changes in the Contract Price will be covered by Contract Change Order.

If the Engineer finds the materials furnished, work performed, or the finished product are not in reasonably close conformity with the Plans and Specifications and have resulted in an unacceptable finished product, the affected work or materials shall be removed and replaced or otherwise corrected by and at the expense of the Contractor in accordance with the Engineer's written orders.

If the Engineer determines that noncomplying Work or materials may remain in place, the Contract Change Order for the price adjustment for each affected Pay Item will include a $400 sum credit to the Department for administrative costs.

For the purpose of this Subsection, the term "reasonably close conformity" will not be construed as waiving the Contractor's responsibility to complete the Work in accordance with the Contract, Plans, and Specifications. The term will not be construed as waiving the Engineer's right to insist on strict compliance with the requirements of the Contract, Plans, and Specifications during the prosecution of the Work, when, in the Engineer's opinion, compliance is essential to provide an acceptable finished portion of the Work.

For the purpose of this Subsection, the term "reasonably close conformity" is also intended to provide the Engineer with the authority to use good engineering judgment when determining acceptance of Work that is not in strict conformity but will provide a finished product equal to or better than that intended by the requirements of the Contract, Plans, and Specifications.

NOTE TO SPECIFIER:
For AIP contracts, the sponsor should keep the FAA advised of the Engineer's determinations as to acceptance of work that is not in reasonably close conformity to the contract, plans, and specifications. Change Orders must bear the written approval of the FAA.

50–03 COORDINATION OF CONTRACT, PLANS, AND SPECIFICATIONS. These Specifications, Supplemental Specifications, Plans, Special Provisions, Addenda and all supplemental documents are essential parts of the Contract, and a requirement in one document is as binding as though occurring in all. They are intended to be cooperative, to describe and provide for a complete Work. In the event of a discrepancy between a drawing and the figured dimensions thereon, the figured dimensions, unless obviously incorrect, will govern over scaled dimensions. In the case of a discrepancy between the Supplemental Specifications and these Specifications, the Supplemental Specifications will govern. If a discrepancy occurs between the Plans and these Specifications, or the Supplemental Specifications, the Plans will govern. If there is a discrepancy between the Special Provisions and these Specifications, Supplemental Specifications or the Plans, the Special Provisions will govern. In the event of a discrepancy in the Plans between the standard detail drawings and the typical sections or details, the typical sections or details will govern; and between the Special Provisions and the Addenda, the Addenda will govern.

Do not take advantage of apparent errors or omissions on the Plans or Specifications. In the event an apparent error or discrepancy is discovered, immediately call the Engineer for an interpretation and a final decision.

NOTE TO SPECIFIER:

A full time Contractor's Superintendent may be required for certain projects. A Special Provision requiring the Superintendent be on site, and provided for liquidated damages may be added to the Contract.

50–04 COOPERATION OF CONTRACTOR. Two copies of the Plans and Specifications will be supplied to the Contractor. Have on the Work at all times one copy each of the Plans and Specifications. Additional copies of Plans and Specifications may be obtained for the cost of reproduction.

Give constant attention to the Work to facilitate progress and cooperate with the Engineer and Inspectors and with other contractors in every way possible. In case of conflicts in schedule or operations, resolve schedules and operations in a mutually acceptable manner, which will result in the Work on each Contract being constructed in accordance with Plans and Specifications. Have a competent superintendent on the Work at all times who is fully authorized as the Contractor's agent on the Work. The superintendent shall be capable of reading and thoroughly understanding the Plans and Specifications and shall receive and fulfill instructions from the Engineer or the Engineer's authorized representative.

50–05 COOPERATION BETWEEN CONTRACTORS. The Department or Sponsor reserves the right to contract for and perform other or additional work on or near the Work covered by this Contract.

Arrange and conduct work so as not to interfere with the operation of other contractors, subcontractors, or the public engaged upon or near the Work. Perform the Work in the proper sequence in relation to that of other contractors. Contractors working on the same project shall cooperate with each other as directed.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with their respective Contract and shall protect and save harmless the Department 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 Contractor will be held responsible for damage done by them or their agents to the work performed by another contractor. Each Contractor shall conduct their operations and maintain the Work in a condition that adequate drainage will be in effect at all times.

Arrange Work and place and dispose of the materials being used so as not to interfere with the operations of the other Contractors within the limits of the same Project. Work shall join with work of others and perform it in proper sequence to that of the others.

50–06 CONSTRUCTION LAYOUT AND STAKES.

The Engineer will:

a. Furnish and set construction survey stakes for reference points, slope intercepts, subgrade shoulder points, and reference lines to establish the alignment, slopes, and continuous profile-grade for the Work.

b. Establish bench marks and set the stakes or reference points deemed necessary to establish the location, alignment, and elevation for structures.

These stakes and marks will constitute the field control by and in accordance with which the Contractor shall govern and execute the Work.

The Contractor shall:

a. Govern and execute the Work.

b. Furnish, at Contractor's expense, such other facilities and labor required by the Engineer in establishing the points and lines necessary to the prosecution of the Work after the Work is started.

c. Furnish free of charge all additional stakes and other material necessary for marking and maintaining the points and lines given.

d. Set and be responsible for all additional stakes or markings needed to facilitate layout or construction of the Work.

e. Be responsible for the preservation of all stakes and marks. If any of the surface stakes or marks have been carelessly or willfully destroyed or disturbed by the Contractor, the cost to the Department of replacing them may be charged against the Contractor and will be deducted from the payment of the Work.

50–07 AUTOMATICALLY CONTROLLED EQUIPMENT. 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.

50–08 PLANS AND DRAWINGS. Supplement the approved Plans with shop or working drawings and computations as are necessary to adequately control the Work. Make no changes to the approved Plans except by direction of the Engineer. It is mutually agreed that all changes of the approved Plans will be in writing.

Furnish shop or working drawings that consist of detailed plans and computations as may be required for the prosecution of the Work and which are not included in the Plans furnished by the Engineer. These drawings will be subject to review by the Engineer. Plans for temporary structures, cribs, cofferdams, falsework, shoring, centering, and form work may also be required and in these cases will be signed and sealed by a registered professional engineer and may likewise be subject to review.

It is expressly understood that review by the Engineer of the Contractor's plans, shop or working drawings does not relieve the Contractor of responsibility for obtaining satisfactory results or for accuracy of dimensions and details or for conformity of the drawings with the approved Plans and Specifications.

The Contract Price shall include the cost of furnishing all working drawings, and the Contractor will be allowed no extra compensation for these.

50–09 AUTHORITY AND DUTIES OF RESIDENT ENGINEER. The Resident Engineer is the representative of the Engineer. The Resident Engineer has the authority to reject defective material, prohibit the use of inadequate or defective equipment, and to temporarily suspend Work that is being improperly performed.

50–10 AUTHORITY AND DUTIES OF INSPECTORS. Inspectors employed by the Engineer will be authorized to inspect all work done and all material furnished. An inspection may extend to all parts of the Work and to the preparation, fabrication, or manufacture of the materials to be used. Inspectors are not authorized to revoke, alter, or waive any provision of the Contract. Inspectors are not authorized to issue instructions contrary to the Plans and Specifications or to act as foreman for the Contractor.

Inspectors employed by the Department are authorized to notify the Contractor of failure of the Work or materials to conform to the requirements of the Contract, Plans, or Specifications and to reject nonconforming materials in question until the issues can be referred to the Engineer.

50–11 INSPECTION OF THE WORK. All materials and each part or detail of the Work is subject to inspection by the Engineer. The Engineer is allowed access to all parts of the Work and shall be furnished with information and assistance by the Contractor as is required to make a complete and detailed inspection.

If the Engineer requests it, at any time before acceptance of the Work, remove or uncover portions of the finished Work as directed. After examination, restore those portions of the Work to the standard required by the Specifications. Should this exposed or examined Work prove acceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed will be paid for as Extra Work. Should this exposed or examined Work prove unacceptable, the uncovering, or removing and replacing of the covering or making good of the parts removed will be at the Contractor's expense.

Work done or materials used without supervision or inspection by an authorized representative of the Department may be ordered removed and replaced at the Contractor's expense unless the Department's representative failed to inspect after having been given reasonable notice in writing that the Work was to be performed.

Should the Work include relocation, adjustment, or any other modification to existing facilities, not the property of the Sponsor, authorized representatives of the owners of such facilities will have the right to inspect this Work. The inspection will not make any facility owner a party to the Contract, and will in not interfere with the rights of the parties to this Contract.

50–12 REMOVAL OF UNACCEPTABLE AND UNAUTHORIZED WORK. As provided in Subsection 50-02, Conformity with Plans and Specifications, all Work which does not conform to the requirements of the Contract, Plans, and Specifications will be considered unacceptable, unless otherwise determined acceptable by the Engineer

In accordance with the provisions of the Subsection 70-14, Contractor’s Responsibility for Work, remove immediately and replace in an acceptable manner 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. Work that has been done contrary to the instructions of the Engineer, Work that has been done beyond the lines shown on the Plans or as given, except as herein specified, or Extra Work that has been done without authority, will be considered unauthorized and will not be paid for under the provisions of the Contract. If the Work is done it may be ordered removed or replaced at the Contractor's expense.

Upon failure to comply promptly with orders 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, unauthorized Work to be removed, and to deduct the costs (incurred by the Department) from moneys due or to become due the Contractor.

50–13 LOAD RESTRICTIONS. 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 which may result from the moving of material or equipment.

The operation of equipment of such weight or so loaded as to cause damage to structures or to any other type of construction is not permitted. Hauling of materials over the base course or surface course under construction will be limited as directed. No loads will be permitted on a concrete pavement, base, or structure before the expiration of the curing period. The Contractor is responsible for all damage done by their hauling equipment and shall correct the damage at their expense.

Notify the Engineer in writing at least 48 hours in advance of contemplated hauling of materials required for the Work over public roads or streets that are not a part of the State Trunk Highway System.

50–14 MAINTENANCE DURING CONSTRUCTION. Maintain the Work during construction and until the Work is accepted. This maintenance constitutes 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.

In the case of a Contract for the placing of a course upon a course or subgrade previously constructed, maintain the previous course or subgrade during all construction operations.

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 the work.

50–15 FAILURE TO MAINTAIN THE WORK. Should the Contractor fail to maintain the Work as provided in Subsection 50-14, Maintenance During Construction, the Engineer will immediately notify the Contractor of noncompliance. The notification will specify a reasonable time within which the Contractor will be required to remedy the unsatisfactory maintenance condition. The time specified will give due consideration to the urgency that exists.

Should the Contractor fail to respond to the Engineer's notification, the Engineer may suspend Work as necessary for the Department to correct the unsatisfactory maintenance condition, depending on the urgency exists. Maintenance costs incurred by the Department will be deducted from moneys due or to become due the Contractor.

50–16 PARTIAL ACCEPTANCE. If at any time during the prosecution of the Project the Contractor substantially completes a usable unit or portion of the Work, the occupancy of which will benefit the Sponsor, the Contractor may request the Engineer to make inspection of that unit. If the Engineer finds upon inspection that the unit has been satisfactorily completed in compliance with the Contract, the Engineer may accept it as being completed, and the Contractor may be relieved of further responsibility for that unit. Such partial acceptance and beneficial occupancy by the Sponsor will not void or alter any provision of the Contract.

50–17 FINAL ACCEPTANCE. Upon due notice from the Contractor of presumptive completion of the entire Project, the Engineer will make an inspection. If all construction provided for and contemplated by the Contract is found to be completed in accordance with the Contract, Plans, and Specifications, the inspection will constitute the final inspection. The Engineer will notify the Contractor in writing of final acceptance as of the date of the final inspection.

If, however, the inspection discloses Work, in whole or in part, as being unsatisfactory, the Engineer will give the Contractor the necessary instructions for correction of same, and the Contractor shall immediately comply with and execute the instructions. Upon correction of the Work, another inspection will be made which will constitute the final inspection, provided the Work has been satisfactorily completed. In that event, the Engineer will make the final acceptance and notify the Contractor in writing of this acceptance as of the date of final inspection.

In the event that the testing of materials is incomplete at the time of final inspection and the Work is satisfactorily completed, the Engineer will give a written notice of partial acceptance, pending receipt of satisfactory test reports, whereupon a final acceptance will be given without additional inspection.

50–18 CLAIMS FOR ADJUSTMENT AND DISPUTES. Notify the Engineer in writing of intentions to claim additional compensation for Work or materials not clearly provided for in the Contract, Plans, or Specifications or previously authorized as Extra Work before beginning the work on which the claim is based. If such notification is not given or the Engineer is not afforded proper opportunity by the Contractor for keeping strict account of actual cost as required, then the Contractor hereby agrees to waive claims for such additional compensation. This notice by the Contractor and the fact that the Engineer has kept account of the cost of the Work will not be construed as proving or substantiating the validity of the claim. When the Work on which the claim for additional compensation is based has been completed, the Contractor shall, within 10 calendar days, submit a written claim to the Engineer who will present it to the Department for consideration in accordance with State and local laws or ordinances.

Nothing in this Subsection will be construed as a waiver of the Contractor's right to dispute final payment based on differences in measurements or computations.

50–19 COST REDUCTION INCENTIVE. The provisions of this Subsection will apply only to contracts awarded to the lowest bidder pursuant to competitive bidding.

On projects with original Contract amounts in excess of $100,000, the Contractor may submit to the Engineer, in writing, proposals for modifying the Plans, Specifications or other requirements of the Contract for the sole purpose of reducing the cost of construction. The cost reduction proposal shall not impair, in any manner, the essential functions or characteristics of the project, including but not limited to service life, economy of operation, ease of maintenance, desired appearance, design and safety standards. This provision will not apply unless the proposal submitted is specifically identified by the Contractor as being presented for consideration as a value engineering proposal.

Not eligible for cost reduction proposals are changes in the basic design of a pavement type, runway and taxiway lighting, visual aids, hydraulic capacity of drainage facilities, or changes in grade or alignment that reduce the geometric standards of the project.

As a minimum, submit the following information with each proposal:

a. A description of both existing Contract requirements for performing the Work and the proposed changes, with a discussion of the comparative advantages and disadvantages of each;

b. An itemization of the Contract requirements that must be changed if the proposal is adopted;

c. A detailed estimate of the cost of performing the Work under the existing Contract and under the proposed changes;

d. A statement of the time by which a Change Order adopting the proposal must be issued;

e. A statement of the effect adoption of the proposal will have on the time for completion of the Contract; and

f. The Contract Items of Work affected by the proposed changes, including any quantity variation attributable to them.

The Contractor may withdraw, in whole or in part, any cost reduction proposal not accepted by the Engineer, within the period specified in the proposal. The provisions of this Subsection will not be construed to require the Engineer to consider any cost reduction proposal that may be submitted.

Continue to perform the Work in accordance with the requirements of the Contract until a Change Order incorporating the cost reduction proposal has been issued. If a Change Order has not been issued by the date upon which the Contractor's cost reduction proposal specifies that a decision should be made, or another date as the Contractor may subsequently have requested in writing, the cost reduction proposal will be deemed rejected.

The Engineer will be the sole judge of the acceptability of a cost reduction proposal and of the estimated net savings from the adoption of all or any part of the proposal. In determining the estimated net savings, the Engineer may disregard the Contract Bid Prices if, in the Engineer's judgment the prices do not represent a fair measure of the value of the Work to be performed or deleted.

The Department may require the Contractor to share in the Department's costs of investigating a cost reduction proposal submitted by the Contractor as a condition of considering the proposal. Where this condition is imposed, acknowledge acceptance of it in writing. This acceptance constitutes full authority for the Department to deduct the cost of investigating a cost reduction proposal from amounts payable to the Contractor under the Contract.

If the Contractor's cost reduction proposal is accepted in whole or in part, the acceptance will be by a Contract Change Order that will specifically state that it is executed pursuant to this Subsection. This Change Order will:

a. Incorporate the changes in the Plans and Specifications that are necessary to permit the cost reduction proposal or the part of it that has been accepted and shall include any conditions upon which the Engineer's approval is based.

b. Set forth the estimated net savings attributable to the cost reduction proposal. The net savings will be determined as the difference in costs between the original Contract costs for the involved Work Items and the costs occurring as a result of the proposed change.

c. Establish the net savings agreed upon and will provide for adjustment in the Contract Price that will divide the net savings equally between the Contractor and the Department.

The Contractor's 50 percent share of the net savings constitutes compensation to the Contractor for the cost reduction proposal and the performance of the Work.

Acceptance of the cost reduction proposal and performance of the cost reduction work will not extend the time of completion of the Contract unless specifically provided for in the Contract Change Order.

NOTE TO SPECIFIER:
Use of this Subsection in project specifications is the normal practice of the Bureau.

Delete the Specification by Special Provision if the project does not lend itself to value engineering.

SECTION 60. CONTROL OF MATERIALS

60–01 SOURCE OF SUPPLY AND QUALITY REQUIREMENTS. The materials used on the Work shall conform to the requirements of the Contract, Plans, and Specifications. Unless otherwise specified, materials that are manufactured or processed shall be new (as compared to used or reprocessed).

In order to expedite the inspection and testing of materials, furnish complete statements to the Engineer as to the origin, composition, and manufacture of all materials to be used in the Work. Furnish these statements promptly after execution of the Contract and, in all cases, prior to delivery of the materials.

Only previously tested and approved materials shall be incorporated in the Work. However, some manufactured products (normally used in large quantities immediately upon, or soon after, delivery to the Project) may, with permission of the Engineer, be incorporated in the Work before they have been tested when they are furnished from sources deemed by the Engineer to have a proven record of furnishing materials complying with specification requirements. The permitted use of an untested material shall not, however, be construed as implied approval of the material, and its use will be at the Contractor's risk, pending completion of subsequent tests made on representative samples of the material.

Fabricated materials obtained from commercial sources and the manufacturer and supplier will, at the Engineer's discretion, be subject to the Engineer’s approval before delivery of the material to the job site. Furthermore, the Contractor may be required to obtain material from another approved source, if it is determined that the product of a manufacturer or supplier is not of satisfactory uniformity or consistent quality.

In the case of materials obtained or produced from natural deposits, either commercially or by the Contractor, obtain the Engineer's preliminary approval of the source.

Furnish samples as required, representative of the material proposed for the Work, in sufficient time to permit testing to establish a basis for approval. Obtain the samples under the observation of, and with methods approved by the Engineer.

Tests will be made on these preliminary samples and reports rendered, but it is to be understood that such tests are for information only and that any preliminary approval will not be construed as a guaranty of acceptance of material that may be delivered later for incorporation into the Work.

Only the materials actually delivered for the Work will be evaluated, and their acceptance or rejection will be based solely on the results of the tests prescribed in the Specifications.

The Contractor will assume full responsibility for the production of uniform and satisfactory materials from local deposits, and will indemnify and save harmless the Department and Sponsor from any and all claims for loss or damages resulting from the opening and operation thereof, or from the failure of the deposit after development to produce acceptable materials.

Unless otherwise provided in the Contract and when all other factors are substantially equal, furnish materials that are manufactured to the greatest extent in the United States. The determination of the conformance of the materials with this requirement will be in accordance with the provisions of Section 16.754 of the Wisconsin Statutes.

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. In accordance with FAA Advisory Circular (AC) 150/5345–53, Appendix 3, Approved Airport Equipment, that is in effect on the date of advertisement; and,

b. Produced by the manufacturer qualified to produce such specified and listed equipment.

Furnish airport lighting equipment required for this Contract in accordance with requirements of the Specifications.

NOTE TO SPECIFIER:
To avoid errors, the design Engineer should furnish a listing of those specifications cited on the plans or in the special provisions. Both the individual FAA material specifications and the AC 150/5345–1, Approved Airport Equipment, should be listed to indicate the edition that is effective on the date the contract is advertised.

60–02 SAMPLES, TESTS, AND CITED SPECIFICATIONS. All materials used in the Work will be subject to inspection, testing, and approval by the Engineer before incorporation in the Work. Work in which untested materials are used without approval or written permission of the Engineer will be performed at the Contractor's risk. Materials found to be unacceptable and unauthorized will not be paid for and, if directed by the Engineer, removed at the Contractor's expense.

To ascertain if materials comply with Contract requirements, samples will, at the discretion of the Engineer, be taken at the source or at the job destination, as often as the Engineer deems it advisable or necessary. Sampling will be in accordance with the standard practices of the Department, except where methods and procedures for sampling a material are otherwise set forth in the Specifications.

Furnish all samples required by the Engineer without charge and afford any facilities as may be required for collecting and forwarding them.

When requested by the Engineer, furnish a written statement giving the origin, composition or process of manufacture of a material.

In the case of manufactured products or assemblies the Engineer may, at his discretion, accept the manufacturer's Certified Report of Test or Analysis or a Certificate of Compliance instead of performing tests on samples. The kind of document required will be designated elsewhere in these Specifications for the specific material involved. The Engineer will specify the number of copies of each document. The samples for the tests or analyses reported on, in the Certified Report of Test or Analysis, may be:

a. those normally obtained in a formal product quality control program,

b. obtained to represent the specific lot of material furnished when no formal control program is in effect, or,

c. those required to be obtained by the Specifications.

Unless otherwise provided in the Contract, it is the intent of these Specifications that conformity of materials to the specified requirements will be at the time, or just prior to the time, they are incorporated in the Work.

All tests will be made in accordance with the methods described and designated herein or in the Contract Documents. References to:

a. ASTM Specifications will be understood to mean the Standards or Tentative Standards of the American Society for Testing and Materials.

b. AREA Specifications will be understood to mean the specifications contained in the American Railway Engineering Association's Manual.

c. AASHTO Specifications will be understood to mean the Standard or Interim Specifications for Transportation Materials and Methods of Sampling and Testing of the American Association of State Highway and Transportation Officials.

Unless otherwise designated, references to various standard specifications and test methods mean the specification or test method that is current on the date of the initial Advertisement for Bids.

The Department has on file copies of the above specifications that may be examined by Contractors, Bidders, or the suppliers of materials; however, the Department will not furnish copies.

Tests performed by the Department are intended to provide a basis for acceptance of materials and workmanship. Conduct additional tests for quality assurance. Determine quality control testing requirements unless specific requirements from Section 100 and the technical specifications apply. Test results obtained on samples of materials furnished by the Contractor will be available to the Contractor.

The Department reserves the right to deduct from moneys that are due or may become due the Contractor costs incurred in the sampling and testing of materials not used under the Contract.

60–03 CERTIFICATION OF COMPLIANCE. The Engineer may permit the use, prior to sampling and testing, of certain materials or assemblies when accompanied by manufacturer's Certificates of Compliance stating that the materials or assemblies fully comply with the requirements of the Contract. The certificate will be signed by the manufacturer. Each lot of these materials or assemblies delivered to the Work must be accompanied by a Certificate of Compliance in which the lot is clearly identified.

Materials or assemblies used on the basis of Certificates of Compliance may be sampled and tested at any time and if found not to conform with Contract requirements will be subject to rejection whether in place or not.

The form and distribution of Certificates of Compliance will be as approved by the Engineer.

When a material or assembly is specified by "brand name or equal" and the Contractor elects to furnish the specified "brand name," the Contractor will be required to furnish the manufacturer's Certificate of Compliance for each lot of such material or assembly delivered to the Work. Such Certificate of Compliance will clearly identify each lot delivered and will 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.

Should the Contractor propose to furnish an "or equal" material or assembly, they will furnish the manufacturer's Certificates of Compliance as described for the specified brand name material or assembly. However, the Engineer will be the sole judge as to whether the proposed "or equal" is suitable for use in the Work.

The Engineer reserves the right to refuse permission for use of materials or assemblies on the basis of Certificates of Compliance.

NOTE TO SPECIFIER:
When it is necessary to specify a material or assembly by brand names or equal, the technical requirements (performance, testing, quality, or dimensions) must be accurately described in enough detail to ensure a suitable product while not restricting competition unduly. An alternative would be to list two or three brand names or equal.

60–04 PLANT INSPECTION. The Engineer or an authorized representative may inspect, at its source, specified materials or assemblies to be used in the Work. Manufacturing plants may be inspected periodically to determine compliance with specified manufacturing methods or materials to be used in the Work and to obtain samples required for acceptance of the materials or assemblies.

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

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

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

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

d. Give the Engineer sufficient advance notice of production schedules to permit making necessary arrangements.

It is understood and agreed that the Department has the right to retest material that has been tested and approved at the source of supply after it has been delivered to the site. The Engineer has the right to reject only material that, when retested, does not meet the requirements of the Contract, Plans, or Specifications.

60–05 ENGINEER'S FIELD OFFICE AND LABORATORY. When specified and provided for as a Contract Item, furnish a facility on site for the exclusive use of the Engineer as a field office and field testing laboratory. Furnish and maintain the facility as specified. It will become the property of the Contractor when the Contract Work is completed.

NOTE TO SPECIFIER:
Requirements for specifying the Engineer's field office and laboratory should be coordinated with the Department and the Engineer since such facilities are not needed for all airport construction projects. A Specification and Pay Item for field office and laboratory are included in the Specifications.

60–06 STORAGE OF MATERIALS. Store materials to assure preservation of their quality and suitability for the Work. Stored materials, even though approved before storage, may again be inspected prior to their use in the Work. Locate stored materials to facilitate their prompt inspection. Coordinate the storage of materials with the Engineer. Materials to be stored on Airport property shall not create an obstruction to air navigation nor 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 will be approved by the Engineer. Private property will not be used for storage purposes without written permission of the owner or lessee of such property. Make all arrangements and bear all expenses for the storage of materials on private property. Upon request, furnish the Engineer a copy of the property owner's permission.

Restore storage sites on private or Airport property to their original condition at Contractor's expense, except as otherwise agreed upon in writing by the owner or lessee of the property.

60–07 UNACCEPTABLE MATERIALS. Materials or assemblies that do not conform to the requirements of the Contract, Plans, or Specifications will be considered unacceptable and rejected. Remove rejected materials or assemblies from the site of the Work, unless otherwise instructed by the Engineer.

No rejected material or assembly, the defects of which have been corrected by the Contractor, will be returned to the site of the Work until the Engineer has approved it's used in the Work.

60–08 SPONSOR FURNISHED MATERIALS. Furnish all materials required to complete the Work, except those specified herein (if any) to be furnished by the Sponsor. Sponsor–furnished materials shall be made available to the Contractor at the location specified.

Include all costs of handling, transportation from the specified location to the Work site, storage, and installing Sponsor–furnished materials in the unit price bid for the Contract Item in which such Sponsor–furnished material is used.

After Sponsor–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 Sponsor–furnished material. The Department will deduct from any moneys due or to become due the Contractor costs incurred by the Department or Sponsor in making good such loss due to the Contractor's handling, storage, or use of Sponsor–furnished materials.

60–09 CORRECTION OF WORK AFTER PAYMENT. The final payment nor any provision in the Contract Documents will not relieve the Contractor of the responsibility for negligence of faulty materials or workmanship within the extent and period provided by law. Upon written notice remove defects due and pay for damage to other resulting work that shall appear within 1 year after date of completion and acceptance.

SECTION 70. LEGAL REGULATIONS AND RESPONSIBILITY TO PUBLIC

70–01 LAWS TO BE OBSERVED. Stay fully informed of all Federal, State, and local laws, ordinances and regulations, and all orders and decrees of bodies having jurisdiction or authority, which affect those engaged or employed on the Work, or which affect the conduct of the Work. Observe and comply with all the laws, ordinances, regulations, orders, and decrees; and protect and indemnify the Department and the Department's officers, agents, or servants against all claims or liability arising from or based on the violation of the law, ordinance, regulation, order, or decree, whether by Contractor or Contractor's employees. Regulate, in accordance with the provisions of the Wisconsin Statutes, the movement of vehicles or equipment which is necessary for the prosecution of the Work, over public highways to the Project

70–02 PERMITS, LICENSES, AND TAXES. Procure all permits and licenses, pay all charges, fees, and taxes, and give all notices necessary and incidental to the due and lawful prosecution of the Work. Comply with all permit requirements, whether the permit is issued to the Contractor, the State, or the maintaining authority.

70–03 PATENTED DEVICES, MATERIALS, AND PROCESSES. If the Contractor is required or desires to use any design, device, material, or process covered by letters of patent or copyright, they shall provide for its use by suitable legal agreement with the patentee or owner. The Contractor and the Surety will indemnify and save harmless the Department, Sponsor, any third party, or political subdivision from all claims for infringement by reason of the use of the patented design, device, material or process, or any trademark or copyright, and will indemnify the Department for any costs, expenses, and damages that it may be obliged to pay by reason of an infringement, at any time during the prosecution or after the completion of the Work.

70–04 RESTORATION OF SURFACES DISTURBED BY OTHERS. The Department 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 this construction, reconstruction, or maintenance has been coordinated with the Department, this authorized work (by others) is indicated in the Special Provisions.

Except as provided in the Special Provisions, do not permit any individual, firm, or corporation to excavate or otherwise disturb the utility services or facilities located within the limits of the Work without the written permission of the Engineer.

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 the utility service or facility during the progress of the Work, cooperate with the owners by arranging and performing the Work in this Contract so as to facilitate the construction, reconstruction or maintenance by others, whether or not the work by others is listed above. When ordered as Extra Work by the Engineer, make all necessary repairs to the Work that are due to the authorized work by others, unless otherwise provided for in the Contract, Plans, or Specifications. It is understood and agreed that the Contractor cannot make any claim for damages due to the authorized work by others or for any delay to the Work resulting from this authorized work.

NOTE TO SPECIFIER:
It is the intention of this subsection to provide for both foreseen and unforeseen work by owners of utility services and other facilities on the airport. Such owners have legal rights and obligations under some form of easement with the airport owner. Every effort should be made, during the initial design phase, to coordinate the proposed contract work with such owners so that their rights and obligations are provided for the in the contract, plans, and specifications. Where there is conflict between an existing utility service (or facility) and the proposed work or where the owner of the utility or facility must perform work to construct, reconstruct, or maintain his/her utility or facility, such work should be identified in the special provision and provided for in the contract, plans and specifications. In addition, all known utility services or facilities that are within the limits of the proposed work should be shown on the plans (regardless of whether or not there is a conflict of work to be performed by the owner) with enough detailed information to indicate the lack of conflicts.

70–05 FEDERAL AID PARTICIPATION. For AIP contracts, the United States Government has agreed to reimburse the Department for some portion of the Contract costs. In consideration of the United States Government's (FAA's) agreement with the Department, the Department has included provisions in this Contract pursuant to the requirements of the Airport Improvement Act of 1982, as amended by the Airport and Airway Safety and Capacity Expansion Act of 1987 and Subsequent Acts, and the Rules and Regulations of the FAA that pertain to the Work.

As required by the Act, the Contract Work is subject to the inspection and approval of duly authorized representatives of the Administrator, FAA, and is further subject to those provisions of the rules and regulations that are cited in the Contract, Plans, or Specifications.

No requirement of the Act, the rules and regulations implementing the Act, or this Contract will be construed as making the Federal Government a party to the Contract nor will any such requirement interfere, in any way, with the rights of either party to the Contract.

70–06 SANITARY, HEALTH, AND SAFETY PROVISIONS. Provide and maintain in a neat, sanitary condition accommodations for the use of Contractor's employees as necessary to comply with the requirements and regulations of the State or local Department of Health, or of other agencies having jurisdiction.

Attention is directed to Federal, State, and local laws, rules and regulations concerning construction safety and health standards. Do not require any worker to work in surroundings or under conditions that are unsanitary, hazardous, or dangerous to health or safety.

70–07 PUBLIC CONVENIENCE AND SAFETY. Control construction operations and those of subcontractors and all suppliers to assure the least inconvenience to the traveling public. Under all circumstances, safety is the most important consideration.

Equip vehicles with tailgates and adequate sideboards that will be traveling on public roads or streets hauling materials to, from, or on the Work that are subject to spillage, due either to wind or vibration. Use covers and other protective devices as necessary to prevent spillage.

Remove immediately debris or spillage falling on the traveled way that interferes with or creates a hazard for traffic.

When Work involves excavation adjacent to any building or wall along the Work, give property owners due and sufficient notice. The Contractor and their Surety will hold the State and the municipality in which the Work is done harmless from any damage to the building or wall resulting from the loss of lateral support or from other causes.

Do not operate motorized construction equipment from 10 p.m. until 6 a.m. of the following day, without prior written approval of the Engineer.

Maintain the free and unobstructed movement of aircraft and vehicular traffic with respect to construction operations and those of subcontractors and all suppliers in accordance with Subsection 40–05, Maintenance of Traffic, and limit these operations for the convenience and safety of the traveling public as specified in Subsection 80–04, Limitations of Operations.

70–08 BARRICADES, WARNING SIGNS, AND HAZARD MARKINGS. 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, suitably illuminate such barricades, warning signs, and hazard markings.

For vehicular and pedestrian traffic, furnish, erect, and maintain barricades, warning signs, lights, and other traffic control devices in reasonable conformity with the Manual of Uniform Traffic Control Devices for Streets and Highways (published by the United States Government Printing Office).

When the Work requires closing an air operations area of the Airport or portion of the area, furnish, erect, and maintain temporary markings and associated lighting conforming to the requirements of FAA Advisory Circular, Standards For Airport Marking, latest version.

Furnish, erect, and maintain markings and associated lighting of open trenches, excavations, temporary stock piles, and parked construction equipment that may be hazardous to the operation of emergency fire–rescue or maintenance vehicles on the Airport in reasonable conformance to provisions contained in the Plans and Specifications.

Identify each motorized vehicle or piece of construction equipment in reasonable conformance with requirements contained on the Construction Operations Sheet of the Plans or the Special Provisions.

Furnish and erect all barricades, warning signs, and markings for hazards prior to commencing work. Maintain the barricades, warning signs, and markings for hazards until their dismantling is directed by the Engineer.

Open–flame type lights are not permitted within the air operations areas of the Airport.

NOTE TO SPECIFIER:
To ensure that the contract contains current information as to barricades and warning signs, marking of paved areas on airports, and safety on airports during construction, the latest editions of the cited publications should be reviewed. The provisions of the cited publications (AC 150/5370–2) that are applicable should be included in the Construction Operations Sheet of the Plans or in the Special Provisions.

70–09 USE OF EXPLOSIVES. When the use of explosives is necessary for the prosecution of the Work, exercise the utmost care not to endanger life or property, including new Work. The Contractor will be responsible for all damage resulting from the use of explosives.

Store all explosives securely and comply with all laws and ordinances. Mark clearly all of these storage places. The methods of use, storing, and handling of explosives and highly flammable materials shall conform with all State and local laws and regulations, including the rules of the Department of Workforce Development.

Notify each property owner and public utility company having structures or facilities in proximity to the site of the Work of the schedule for use of explosives. Give adequate, prior notice to enable them to take such steps as they may deem necessary to protect their property from injury.

The use of electrical blasting caps is not be permitted on or within 1,000 feet (300 m) of the Airport property.

70–10 PROTECTION AND RESTORATION OF PROPERTY AND PROPERTY MARKS. Notify, in writing, the owners of all corporate or private property that interferes with the Work, advising them of the nature of the interference, and arrange with them for the disposition of the property. Upon request, provide the Engineer with copies of all these notifications and final agreements.

Use every reasonable precaution to prevent damage to or destruction of public or private property such as:

a. poles, trees, shrubbery, crops and fences adjacent to or interfering with the Work;

b. all overhead structures such as wires and cables;

c. all underground structures such as water or gas shut–off boxes, water meters, pipes, conduits, and utilities.

Protect and carefully preserve all known property, survey marks, and land monuments. Notify the Engineer of the nature and location of these markers. Do not disturb or destroy these markers until the Engineer has arranged for their referencing or perpetuation.

The Contractor is responsible for the damage or destruction of property resulting from neglect, misconduct, or omission in the manner or method of execution or non–execution of the Work, or caused by defective work or the use of unacceptable materials. The Contractor shall restore the property to a condition similar or equal to that existing before damage or injury was done, by repairing, rebuilding, or replacing it as may be directed, or they will otherwise make compensation for such damage or destruction. If they fail to do so, the Engineer may, after the expiration of a period of 48 hours after giving notice to the Contractor in writing, proceed to repair, rebuild or otherwise restore the property as may be deemed necessary. The cost will be deducted from any compensation due or which may become due the Contractor under their Contract.

The Contractor shall be liable for all damages caused by fires and will under no consideration start fires without first securing the necessary permits and the approval of the Department of Natural Resources Area Forest Ranger, Town Fire Warden, Town Chairman, or other authority having jurisdiction even though they may be ordered or required to do the burning. Burning shall comply with Sections NR154 and NR155 of the Wisconsin Administrative Code and any applicable City, Township, County, Regional, State, or Federal Ordinances. In burning brush, stumps, or rubbish, take care not to damage any standing trees, shrubs, or other property.

70–11 RESPONSIBILITY FOR DAMAGE CLAIMS. The Contractor shall indemnify and save harmless the State, the Sponsor, and the Engineer and their officers, agents, employees, and other authorized representative from the following:

a. all suits, actions, or claims of any character brought because of any injuries or damage received or sustained by any person, persons, or property on account of the operations of the Contractor;

b. on account of or in consequence of neglect in safeguarding the Work;

c. through use of unacceptable materials in constructing the Work;

d. because of acts of omission, neglect, or misconduct of said Contractor;

e. because of claims or amounts recovered from any infringements of patent, trademark, or copyright;

f. from claims or amounts arising or recovered under the "Workmen's Compensation Act," or other laws, ordinances, orders, or decrees.

Money due the Contractor under and by virtue of the Contract as may be considered necessary by the Department for that purpose may be retained for the use by the Department or, in case no money is due, Contractor's Surety may be held until the suit or suits, action or actions, claim or claims for injuries or damages as aforesaid have been settled and suitable evidence to that effect furnished to the Department, except that money due the Contractor will not be withheld when the Contractor produces satisfactory evidence that they are adequately protected by public liability and property damage insurance.

The identification obligations of the Contractor under this subsection shall not extend to the liability of the Engineering consultant, officers, directors, employees or agents caused by professional negligence, errors, or omissions of any of them.

Provide and maintain during the effective life of the Contract, public liability and property damage liability insurance. This insurance shall provide protection to the Contractor and their construction subcontractors from claims for damages due to personal injury, accidental

death, and damage to property, which may arise from operations under the Contract, whether these operations be by anyone directly or indirectly employed by either of them.

Do not begin Work under this Contract until insurance coverage is obtained as specified hereafter. The insurance coverage specified will be maintained for the life of the Contract, as

a. Unemployment and Social Security, as required by current Federal and State laws.

b. Worker's Compensation Insurance, as required by Wisconsin statutes.

c. Employer's Liability Insurance. Not less than $100,000 coverage for each occurrence.

d. Public Liability and Property Damage Insurance. The Contractor will as a minimum provide the following coverage for the performance of Work under this Contract by their own forces or those of any subcontractor.

(1) Damages for personal injury, including accidental death.
(2) Property damages that may arise from operations under this Contract.
(3) Comprehensive General Liability coverage for:
  (a) Premises and operations
  (b) Independent contractors (subcontractors)
  (c) Completed operations during construction and for 1 year after final acceptance of the project.
  (d) Contractual coverage per Subsection 70-11, Responsibility for Damage Claims
(4) Broad Form Property Damage coverage shall have the "XCU" Exclusions removed (explosions, collapse, underground property damage) on all contracts except pavement marking work.
(5) Limits of Liability:

Public Liability (Bodily Injury)	
Each Occurrence	$250,000
Aggregate	$500,000
Property Damage	
Each Occurrence	$100,000
Aggregate	$300,000

(6) Vehicle Liability and Property Damage, including coverage for owned, hired, and non–owned vehicles.

Bodily Injury	
Each Person	$250,000
Each Occurrence	$500,000
Property Damage	
Each Occurrence	$100,000

(7) Umbrella or Excess Liability Insurance in the amount of $4,000,000 will be required above the Contractor's basic policy (follow through form).

e. Certificate of Insurance. A certificate of insurance will be submitted to the Department upon execution of the Contract and will contain:

(1) Title and location of property or project covered.
(2) Policy numbers, date of expiration, terms, limits, and types of coverages.
(3) A notice of cancellation clause stating that the insurance company will notify the Department, in writing, 30 days prior to cancellation of the policy.

f. Suspension of Work. In the event insurance coverage is canceled, expires, or is found to be inadequate, suspend all Work under this Contract until evidence of adequate coverage is obtained. Construction time lost due to insufficient insurance will not be eligible for Contract time extension.

70–12 THIRD PARTY BENEFICIARY CLAUSE. It is specifically agreed between the parties executing the Contract that it is not intended by any of the provisions of any part of the Contract to create the public or any member thereof a third party beneficiary 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.

The State will not be liable to the Contractor for damages or delays resulting from work by third parties. The State will also be 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.

70–13 OPENING SECTIONS OF THE WORK TO TRAFFIC. Should it be necessary to complete portions of the Contract Work for the beneficial occupancy of the Sponsor prior to completion of the entire Contract, the "phasing" of the Work will be specified and indicated on the

Plans. When so specified, complete those portions of the Work on or before the date specified, or as otherwise specified. Make an estimate of the difficulties involved in arranging the Work to permit the beneficial occupancy by the Sponsor as indicated on the Plans.

NOTE TO SPECIFIER:
The Sponsor's requirements for "phasing" the work should be coordinated with certain agencies having an interest in operational capability of the airport. Such coordination must be accomplished at the earliest possible time. See AC 150/5300–9, Predesign, Prebid, and Preconstruction Conferences for Airport Grant Projects, for more information. Phasing should be shown on the Construction Operations Sheet.

Upon completion of any portion of the Work listed above, that portion will be accepted by the Department in accordance with Subsection 50-16, Partial Acceptance.

Do not open any portion of the Work for public use until Engineer provides a written order. If it becomes necessary to open a portion of the Work to public traffic on a temporary or intermittent basis, those openings will be made when, in the opinion of the Engineer, that portion of the Work is in an acceptable condition to support the intended traffic. Temporary or intermittent openings are considered to be inherent in the Work and will constitute either acceptance of the portion of the Work so opened or a waiver of any provision of the Contract. Damage to the portion of the Work so opened that is not attributable to traffic which is permitted by the Department will be repaired by the Contractor at no cost to the Department.

Make an estimate of the inherent difficulties involved in completing the Work under the conditions described. Do not claim any added compensation by reason of delay or increased cost due to opening a portion of the Contract Work.

70–14 CONTRACTOR'S RESPONSIBILITY FOR WORK. Until the Engineer's final written acceptance of the entire completed Work, excepting only those portions of the Work accepted in accordance with Subsection 50-16, Partial Acceptance, the Contractor has the charge and care thereof and shall:

a. Take every precaution against injury or damage to any part due to the action of the elements or from any other cause, whether arising from the execution or from the nonexecution of the Work.

b. Rebuild, repair, restore, and make good all injuries or damages to any portion of the Work occasioned by any of the above causes before final acceptance.

c. Bear the expense thereof, except damage to the Work due to unforeseeable causes beyond the control of and without fault or negligence, including but not restricted to acts of God such as earthquake, tidal wave, tornado, hurricane or other cataclysmic phenomenon of nature, or acts of the public enemy or of government authorities.

If the Work is suspended for any cause whatever, the Contractor will be responsible for the Work and will take such precautions necessary to prevent damage to the Work. Provide for normal drainage and erect necessary temporary structures, signs, or other facilities. During such period of suspension of Work, properly and continuously maintain, in an acceptable growing condition, all living material in newly established planting, seedings, and soddings furnished under the Contract. Take adequate precautions to protect new tree growth and other important vegetative growth against injury.

70–15 CONTRACTOR'S RESPONSIBILITY FOR UTILITY SERVICE AND FACILITIES OF OTHERS. As provided in Subsection 70-4, Restoration of Surfaces Disturbed by Others, 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 Sponsor to construct, reconstruct or maintain the utility services or facilities during the progress of the Work. In addition, control construction operations to prevent the unscheduled interruption of such utility services and facilities.

To the extent that these 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 on the Plans or in the Special Provisions.

NOTE TO SPECIFIER:

It is intended that the plans will show the approximate location of the utilities or facilities known to exist within the limits of the Contract Work. It is also intended that the proposed Contract Plans and Specifications be coordinated with the various owners at the earliest possible time to avoid overlooking utility conflicts in the design and to obtain the best possible information needed to protect such utility services or facilities from damage resulting from the Contractor's operations. Where conflicts are indicated during the coordination, they should be resolved by the Airport Owner and the utility owner, in accordance with existing legal agreements, by providing for work in the proposed contract or by the utility owner. In such cases of conflict, regardless of how the conflict is resolved, the Airport Owner and utility owner should also be advised of the need to furnish the best information possible as to location of the utility service or facility to ensure protection during the proposed contract work. The utility name, address, telephone number, and person to contact should be on the plans or in the Special Provisions.

It is understood and agreed that the Department does not guaranty 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 this information will not relieve the Contractor of responsibility to protect these existing features from damage or unscheduled interruption of service.

It is also understood and agreed that the Contractor shall, upon execution of the Contract, notify the owners of all utility services or other facilities of Contractor's plan of operations. Such notification shall be in writing addressed to THE PERSON TO CONTACT as provided in the Contract Documents. Give a copy of each notification to the Engineer.

In addition to the general written notification provided, the Contractor is responsible for keeping individual owners advised of changes in the plan of operations that would affect such owners.

Before beginning the Work in the general vicinity of an existing utility service or facility, again notify each owner of the plan of operation. If, in the Contractor's opinion, the owner's assistance is needed to locate the utility service or facility, or the presence of a representative of the owner is desirable to observe the work, include this advice in the notification. Expedite notification to reach the utility owner's PERSON TO CONTACT no later than 3 working days before beginning operations in the general vicinity. Furnish a written summary of the notification to the Engineer.

Where the outside limits of an underground utility service have been located and staked on the ground, use excavation methods acceptable to the utility within 3 feet (900 mm) of the outside limits or at a distance as required to ensure protection from damage due to the Contractor's operations.

Should damage or interruption of the operation of a utility service or facility by accident or otherwise occur, immediately notify the proper authority and the Engineer. Take all reasonable measures to prevent further damage or interruption of service. Cooperate with the utility service or facility owner and the Engineer until the damage has been repaired and service restored to the satisfaction of the utility or facility owner.

The Contractor will bear all costs of damage and restoration of service to utility services or facilities due to Contractor's operations whether or not due to negligence or accident. The Department reserves the right to deduct these costs from any moneys due or which may become due the Contractor, or the Contractor's Surety.

70–16 FURNISHING RIGHTS–OF–WAY. The Department is responsible for furnishing all rights–of–way upon which the Work is to be constructed in advance of the Contractor's operations.

70–17 PERSONAL LIABILITY OF PUBLIC OFFICIALS. In carrying out the Contract provisions or in exercising power or authority granted by this Contract, there will be no liability upon the Department, as agent for the Sponsor, the Engineer, the Engineer's authorized representatives, or any officials of the Sponsor either personally or as an official of the Sponsor. It is understood that in such matters they act solely as agents and representatives of the Department and Sponsor.

70–18 NO WAIVER OF LEGAL RIGHTS. Upon completion of the Work, the Department will expeditiously make final inspection and notify the Contractor of final acceptance. Such final acceptance, however, will not prevent or stop the Department from correcting measurements, estimates, or certificates made before or after completion of the Work, nor will the Department be prevented or estopped from recovering from the Contractor or the Contractor's Surety, or both, such overpayment as may be sustained, or by failure on the part of the Contractor to fulfill their obligations under the Contract. A waiver on the part of the Department of any breach of the Contract will not be held to be a waiver of any other or subsequent breach.

The Contractor, without prejudice to the terms of the Contract, will be liable to the Department and the Sponsor for potential defects, fraud, or such gross mistakes as may amount to fraud, or as regards the Department’s and the Sponsor's rights under any warranty or guaranty.

70–19 ENVIRONMENTAL PROTECTION. Comply with all Federal, State, and local laws and regulations controlling pollution of the environment.

Comply with the pertinent requirements of these laws relating to solid waste disposition and air pollution and control and minimize the dispersion of dust and particulate matter and other pollutants into the atmosphere. Take all necessary precautions to prevent pollution of streams, lakes, marshes, and reservoirs with fuels, oils, bitumens, calcium chloride, paint, or other harmful materials. Conduct and schedule operations so as to avoid or minimize siltation of streams, lakes, and reservoirs.

Fording of live streams will not be permitted unless the Contractor's plan for this operation meets the approval of the Engineer and results in minimum siltation to the streams. Unless otherwise approved by the Engineer, do not operate mechanized equipment in live streams except as required to construct channel changes and temporary or permanent structures.

When work areas or pits are located in or adjacent to live streams, lakes, or wetlands, separate these 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.

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

70–20 CONSTRUCTION OVER OR ADJACENT TO NAVIGABLE WATERS. For the purposes of this Subsection, the term "governmental authority" will mean 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 required by this Specification.

All Work over, on, or adjacent to navigable waters shall be so conducted that free navigation of the waterways will not be impeded and existing navigable depths will not be impaired except as allowed by permit issued by the governmental authority. Do not start construction until all permits have been received.

Procure all permits required by Subsection 70-02, Permits, Licenses, and Taxes. Submit applications for U.S. Coast Guard and Wisconsin Department of Natural Resources permits to WisDNR, Bureau of Law Enforcement, Boating Law Administrator. Provide one copy of each permit to the project Engineer for posting at the field office prior to commencing construction activities that affect navigation.

All construction and related operations will be subject to such supervision by the governmental authority as is customary for operations in navigable waters, and will conform to special requirements or directions from the governmental authority.

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.

If the governmental authority issues directions or orders affecting the operations or order of procedure during progress of the Work, promptly file a written copy of the directions or orders with the Engineer. Should the Contractor, during the progress of the Work, lose, dump, throw overboard, sink, or misplace any 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 such obstructions, to the governmental authority, and when required, mark or buoy these obstructions until the obstructions are removed. Should the Contractor refuse, neglect, or delay compliance with the above requirements, these obstructions may be removed by the governmental authority. The cost of the removal may be deducted from any money due or to become due to the Contractor, or may be recovered under bond deposited by the Contractor.

During construction, provide temporary lights, waterway markers, other devices, or combination thereof, as specified and required by the governmental authority.

All expenses incurred by the Contractor in connection with the maintenance of navigation will be incidental to the cost of the Contract and no additional payment will be made.

NOTE TO SPECIFIER:
For AIP contracts, the contract provisions required to mitigate the environmental consequences of the contract work should be specified in the contract specifications as required generally and specifically by the Environmental Impact Statement or Assessment Report for the particular AIP project.

70–21 EROSION CONTROL. Perform the temporary and permanent erosion control measures and the storm water management measures required by Chapter Trans 401 of the Wisconsin Administrative Code, the Plans, Specifications, and Contract Documents and as directed by the Engineer.

Coordinate temporary erosion control measures with the permanent erosion control measures to assure economical, effective, and continuous erosion control.

Prepare and submit an erosion control implementation plan (ECIP) for the project, including borrow sites and material disposal sites, in accordance with Chapter Trans 401 requirements.

The area of erosive land exposed to the elements by grubbing, excavation, borrow, or fill operations at any one time is subject to the approval of the Engineer. The duration of the exposure prior to final trimming, finishing and seeding, or application of temporary erosion control measures shall be brief.

Perform construction in and adjacent to rivers, streams, lakes, or other waterways to avoid washing, sloughing or deposition of materials into the waterways which would obstruct or impair the flow, thus endangering the Work or stream banks, or which would result in undue or avoidable contamination, pollution, or siltation of such waterways.

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 any temporary erosion control measures ordered by the Engineer.

Perform grubbing and grading operations in proper sequence with other work to minimize erosion. Construct intercepting ditches or dikes when practical after clearing and grubbing operations are completed and prior to or during excavating of the cuts. Where erosion is likely to be a problem, follow permanent erosion control measures immediately after the grading operations, if conditions permit, unless the Engineer authorizes temporary erosion control measures.

Temporary and permanent erosion control will be measured and paid for as provided for the various Pay Items included for the control in the Contract or as Extra Work, unless temporary erosion control is required because of the Contractor's negligence, carelessness, or failure to install permanent controls.

Except as limited by Subsections 156-4.3 and 156-5.12 for Borrow Sites and Material Disposal Sites, temporary and permanent erosion control will be measured and paid for as provided for the various items of work included for the control in the Contract, or as Extra Work, unless temporary erosion control is required because of the Contractor's negligence, carelessness, or failure to install permanent controls.

70–22 USE OF FIRE HYDRANTS. If the use of water from public hydrants is desired, apply to the proper authorities and conform to the city ordinances, rules, and regulations concerning their use.

Have Fire hydrants accessible at all times to the fire department. Do not place material or other obstructions closer to a fire hydrant than permitted by ordinances, rules, or regulations, or within 5 feet of a fire hydrant in the absence of ordinances, rules, or regulations.

70–23 ARCHAEOLOGICAL AND HISTORICAL FINDINGS. Unless otherwise specified in this Subsection, the site of the Work is not within any property, district, or site, and does not contain any building, structure, or object listed in the current National Register of Historic Places published by the United States Department of Interior.

If any building, part of a building, structure, or object is encountered during construction operations that is incongruous with its surroundings, immediately cease operations in that location and notify the Engineer. The Engineer will immediately investigate the Contractor's finding and will direct the Contractor to either resume operations or to suspend operations as directed.

Should the Engineer order suspension of the Contractor's operations in order to protect an archaeological or historical finding, or order the Contractor to perform Extra Work, it will be covered by an appropriate Contract Change Order as provided in Subsection 40-04, Extra Work, and Subsection 90-05, Payment for Extra Work and Force Account Work. If appropriate, the Contract Modification will include an extension of Contract Time in accordance with the Subsection 80-07, Determination and Extension of Contract Time.

NOTE TO SPECIFIER:
The contract language suggested in subsection 70–23 is intended to remind owners of airports that proper planning will prevent construction delays that may be caused when objects of archaeological or historical significance are encountered in the work. Airport owners should include in their planning the coordination with state and local planning bodies as may be required by state and local laws pertaining to the National Historic Preservation Act of 1966.

As a general rule, disposition of known archaeological or historic objects that are situated on the site of the work should be covered by a separate contract when such disposition is required as a part of FAA project approval.

70–24 ANTITRUST ASSIGNMENT CLAUSE. The Contractor hereby assigns to the State any and all claims for overcharges resulting from antitrust violations as to goods and materials purchased in connection with this Contract, except as to overcharges which 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 their first tier suppliers and subcontractors shall assign any and all of these claims to the State subject to the aforementioned exception.

70-25 HAZARDOUS SUBSTANCE. Whenever construction operations encounter or expose abnormal conditions that may indicate the presence of a hazardous substance, immediately discontinue the construction operations in the vicinity of the abnormal condition, and notify the Engineer. Do not resume construction operations in this area until directed by the Engineer. Work may be continued in other areas of the project unless otherwise directed by the Engineer.

Treat 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.

Minimize the spread of the hazardous substance into an uncontaminated area.

Dispose of hazardous substances in accordance with requirements and regulations of the responsible State Agencies. Work required to dispose of a hazardous substance, and not provided for in the Contract, will be compensated as Extra Work. If special procedures are required for the disposal, the Department will arrange with qualified persons to dispose of the substance.

SECTION 80. PROSECUTION AND PROGRESS

80–01 SUBLETTING OF CONTRACT. The Department will not recognize any subcontractor on the Work. When Work is in progress, the Contractor shall be represented either in person, by a qualified superintendent, or by another designated, qualified representative who is duly authorized to receive and execute orders of the Engineer.

Should the Contractor elect to assign the Contract, the assignment will be concurred in by the surety, shall be presented for the consideration and approval of the Department, and will be consummated only on the written approval of the Department. In case of approval, file copies of all subcontracts with the Engineer.

Do not sublet, sell, transfer, assign or otherwise dispose of the Contract or any portion, right, title, or interest, without written consent of the Department.

Consent to sublet any portion of the Contract shall not be construed to relieve the Contractor of any responsibility for the fulfillment of the Contract or to release the Contractor of their liability under the Contract and Contract Bonds.

In case consent is given, the Contractor will be permitted to sublet a portion thereof, but shall perform with their own organization Work amounting to at least 30 percent of the original Contract amount, except for building construction for which the Contractor must perform at least 10 percent of the original Contract amount, unless a larger portion is specified in the Contract, except that any items designated in the Contract as "specialty items" may be performed by subcontract, and the cost of any such specialty items performed may be deducted from the original Contract amount before computing the amount of Work to be sublet.

Write requests for permission to sublet any portion of the Contract. The Department may require proof that the organization that will perform the Work is particularly experienced and equipped for the Work. The Department may also require each request be accompanied by a copy of the proposed subcontract. Any subsequent change in the terms of the subcontract will be subject to separate approval.

Work by a subcontractor cannot proceed until the request for permission to sublet the Work is approved.

If the Contractor proposes to have Work performed by a person or firm other than a subcontractor, inform the Engineer in writing, if required, of the specific arrangement under which the Work will be performed so that it may be established whether or not the arrangement constitutes subcontracting.

The Engineer may also require the Contractor to submit a copy of any agreement that a subcontractor or other person or organization has with any other person or organization for performing Work under the Contract.

80–02 NOTICE TO PROCEED. The Notice to Proceed will state the date on which the Contractor will begin the construction and from which date Contract Time will be charged. Begin the Work to be performed under the Contract within 10 days of the date set by the Department in the written Notice to Proceed, and notify the Engineer at least 72 hours in advance of the time actual construction operations will begin.

80–03 PROSECUTION AND PROGRESS. Unless otherwise specified, submit a progress schedule for the Engineer's approval within 10 days after the effective date of the Notice to Proceed. When approved by the Engineer, the progress schedule may be used to establish major construction operations and to check on the progress of the Work. Provide sufficient materials, equipment, and labor to guaranty the completion of the Project in accordance with the Plans and Specifications within the time set forth in the Proposal.

Prepare the schedule as a network diagram in Critical Path Method (CPM), PERT, or other format, or as otherwise specified in the Contract. As a minimum, provide information on the sequence of Work activities, milestone dates, and activity duration.

Maintain the Work schedule and provide an update and analysis of the progress schedule on a twice monthly basis, or as otherwise specified in the Contract. Submission of the Work schedule will not relieve the Contractor of overall responsibility for scheduling, sequencing, and coordinating all Work to comply with the requirements of the Contract.

In the event Work is prosecuted during adverse weather conditions, the Contractor will be required to exercise precautions necessary to produce satisfactory Work, and shall protect the finished Work from the elements. It is agreed and understood that the cost thereof has been included in the unit prices bid for the various items of Work in the Contract and that no extra compensation will be allowed.

If the Contractor falls significantly behind the submitted schedule, upon the Engineer's request, submit a revised schedule for completion of the Work within the Contract Time and modify construction operations to provide the additional materials, equipment, and labor necessary to meet the revised schedule. Notify the Engineer at least 72 hours in advance of changes in schedule of operations, or suspension of Work and subsequent resumption of operations.

Do not commence any actual construction prior to the date on which the Notice to Proceed is issued by the Department.

Engineering costs incurred on the Project as the result of the Contractor's failure to notify the Engineer of a schedule change as outlined above, will be charged against the Contractor at the discretion of the Department. Work done in the absence of the Engineer or the Engineer's authorized representative, as the result of the Contractor's failure to give adequate notice of schedule change, will not be measured and paid for and, at the discretion of the Engineer, will be removed and replaced at the Contractor's expense.

The provisions of this Subsection will not make the Contractor liable for Engineering costs incurred when Work is suspended due to adverse weather conditions, providing that the Contractor notifies the Engineer immediately following the decision to suspend Work.

NOTE TO SPECIFIER:
It is important that the owner (sponsor) issue the Notice to Proceed for AIP contracts because any actual construction Work, performed prior to the execution of a grant agreement, (between the sponsor and the FAA) would be ineligible for FAA participation in its cost.

80–04 LIMITATION OF OPERATIONS. Control construction operations and the operations of subcontractors and all suppliers to provide for the free and unobstructed movement of aircraft in the Air Operations Areas (AOA) of the Airport.

When the Work requires the Contractor to conduct operations within an AOA of the Airport, coordinate the Work with Airport management (through the Engineer) at least 48 hours prior to commencement of the Work. Do not close an AOA until authorized by the Engineer and until the necessary temporary marking and associated lighting is in place as provided in Subsection 70-08, Barricades, Warning Signs, and Hazard Markings.

When the Contract Work requires Work within an AOA of the Airport on an intermittent basis (intermittent opening and closing of the AOA), maintain constant communications as follows:

a. Immediately obey all instructions to vacate the AOA

b. Immediately obey all instructions to resume Work in the AOA.

Failure to maintain the specified communications or to obey instructions will be cause for suspension of the Contractor's operations in the AOA until the satisfactory conditions are provided. AOA’s which cannot be closed to operating aircraft to permit the Contractor's operations on a continuous basis are indicated on the Plans or in the Special Provisions.

NOTE TO SPECIFIER:
It is intended that the Contract provisions which limit the Contractor's operations be specified for all Air Operations Areas of the airport that are not intended to be closed to permit continuous construction operations. These Contract provisions vary widely from airport to airport and require careful coordination (during the early stages of designing the work) with the owner, FAA, and the users of the airport. AC 150/5300–9, Predesign, Prebid, and Preconstruction Conferences for Airport Grant Projects, contains additional information on this subject. Indicate AOA on Construction Operations Sheet or in the Special Provisions.

80–05 CHARACTER OF WORKERS, METHODS, AND EQUIPMENT. Employ sufficient labor and equipment for prosecuting the Work to full completion in the manner and time required by the Contract, Plans, and Specifications.

NOTE TO SPECIFIER:
Special security requirements, such as 5–year background checks, may be added to the Special Provisions.

Have sufficient skilled and experienced workers to perform properly the Work assigned to them. Workers engaged in special Work or skilled Work shall have sufficient experience in the Work and in the operation of the equipment required to perform the Work satisfactorily.

Equipment to be used on the Work shall be of sufficient size and in a mechanical condition as to meet requirements of the Work and to produce quality work. Equipment used on the Work shall be such that no injury to previously completed Work, adjacent property, or existing Airport facilities will result from its use.

When the methods and equipment to be used in accomplishing the Work are not prescribed in the Contract, use any methods or equipment that will accomplish the Work in conformity with the requirements of the Contract, Plans, and Specifications.

When the Contract specifies the use of certain methods and equipment, use those methods and equipment unless others are authorized by the Engineer. Request authority from the engineer to use a method or type of equipment other than specified in the Contract. Write the request and

include a full description of the methods and equipment proposed and of the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor be fully responsible for producing Work in conformity with Contract requirements. If, after trial use of the substituted methods or equipment, the Engineer determines that the Work produced does not meet Contract requirements, discontinue the use of the substitute method or equipment and complete the remaining Work with the specified methods and equipment. Remove deficient Work and replace it with Work of specified quality, or take such other corrective action as the Engineer may direct. No change will be made in basis of payment for the Contract Items involved nor in Contract Time as a result of authorizing a change in methods or equipment under this Subsection.

Should workers or equipment fail to meet the requirements of this Subsection, the Engineer may withhold payments for affected portions of the Work.

80–06 TEMPORARY SUSPENSION OF THE WORK. The Engineer has the authority to suspend the Work wholly, or in part, due to:

a. unsuitable weather,

b. other conditions as are considered unfavorable for the prosecution of the Work, or,

c. such time as is necessary due to the failure to carry out orders given or perform any or all provisions of the Contract.

In the event the Engineer orders, in writing, to suspend Work for some unforeseen cause not otherwise provided for in the Contract and over which the Contractor has no control, the Contractor may be reimbursed for actual money expended on the Work during the period of shutdown. No allowance will be made for anticipated profits. The period of shutdown shall be computed from the effective date of the Engineer's order to suspend Work to the effective date of the Engineer's order to resume the Work. File claims for this compensation with the Engineer within the time period stated in the Engineer's order to resume Work. Accompany the claim with information substantiating the amount shown on the claim. The Engineer will forward the Contractor's claim to the Department for consideration. No provision of this article will be construed as entitling the Contractor to compensation for delays due to inclement weather, for suspensions made at the request of the Contractor, or for other delays provided for in the Contract, Plans, or Specifications.

If it should become necessary to suspend Work for an indefinite period, store all materials so they will not become an obstruction nor become damaged. Take every precaution to prevent damage or deterioration of the Work performed and provide for normal drainage of the Work. Erect temporary structures where necessary to provide for traffic on, to, or from the Airport.

80–07 DETERMINATION AND EXTENSION OF CONTRACT TIME. The time for completion of the Work contemplated under the Contract will be specified in the Proposal as:

a. a specific number of calendar days including Saturdays, Sundays and holidays;

b. a specific number of working days, excluding Sundays, Saturdays, New Year’s Day, Martin Luther King Jr. Day, Good Friday, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Christmas Eve Day, Christmas Day, New Year’s Eve Day and the period from November 16 through March 31, both dates inclusive;

c. a given calendar date on or before which Work shall be completed.

The completion of the Work within the time as specified is an essential part of the Contract.

Pursue the Work effectively and diligently to completion. Failure to begin operations, or to diligently prosecute the Work within the intent of this Subsection, may be considered as a breach of Contract and render the Contractor liable to action under default of Contract, or cause the revocation or suspension of the Contractor’s privilege to bid additional work, or both.

The Contract starting date, for purposes of determining Contract Time and extensions, is defined as: When the Contract provides for starting Work not later than 10 days after the date of written notification from the Department to do so, or not later than 10 days after the date of official notification to the Contractor of the final execution of the Contract, the Contract starting date will be construed to be the date construction operations are started or the 10th day following the date of such notification, whichever is earlier.

Contract Time may be extended in an amount that is mutually agreed upon by the Department and the Contractor on the following basis:

a. Contract Change Orders involving alterations in the Contract affecting the prosecution of Work, or

b. Extra or additional Work, when such alterations are necessary for the purposes or convenience of the Department, or

c. when such Extra or additional Work is of such character or is ordered to be done at such a time that the amount of time reasonably necessary to perform such Work is disproportionate to the Contract Time originally set up in the Proposal.

If Contract Time is extended by Contract Change Order, the agreement for extended time on this account shall be reached concurrently with and as a part of consideration for the specific alteration, Extra or additional Work covered by that Order. If no specific mention is made in the Order, the value of the Extra or additional Work will be included in the computation of extension of Contract Time for increased value of Work as set forth.

If the money value of Work completed (exclusive of the Extra or additional Work for which additional time had been agreed) is in excess of the amount of the original Contract, the Contract Time will be extended proportionately in an amount, computed to the nearest whole day, in the ratio that the final cost of the Work (exclusive of the final cost of the extra or additional Work for which additional time had been agreed) bears to the total amount of the original Contract. When a Contract completion date is stipulated, the equivalent Contract Time for this purpose will be the total elapsed calendar days between the Contract starting date and the Contract completion date.

Should the Contractor find it impossible to complete the Work on or before the completion date as specified in the Contract, or extended as previously specified, at any time prior to 30 days after completion of Work under the Contract, the Contractor may submit a written request to the Department for an extension of time, setting forth in the request the reasons that they believe will justify the granting of the request.

If the Department finds that the Work was delayed because of conditions beyond the control of the Contractor, it may grant an extension of time for completion in such amounts as found to be warranted and justified; however, no liability will accrue to the Department due to granting an extension for increased costs incurred by the Contractor because of such delay.

80–08 LIQUIDATED DAMAGES. Should the Contractor fail to complete the Work within the time agreed upon in the Contract or within such extra time as may have been allowed by extensions, there will be deducted from any moneys due or that may become due the Contractor, for each and every calendar day for calendar day Contracts and completion date Contracts, or working day for working day contracts, that the Work shall remain uncompleted, a sum specified as follows:

Original Contract Amount		*Daily Charge*	
From More Than	*To and Including*	*Calendar Day*	*Working Day*
0	$100,000	$170.00	$340.00
100,000	300,000	270.00	540.00
300,000	500,000	440.00	880.00
500,000	1,000,000	660.00	1,320.00
1,000,000	—	990.00	1,980.00

This sum will be considered and treated not as a penalty but as fixed, agreed, and liquidated damages due the State from the Contractor by reason of inconvenience to the public, added cost of engineering and supervision, maintenance of detours and other items that have caused an expenditure of public funds resulting from the Contractor's failure to complete the work within the time specified in the Contract.

Permitting the Contractor to continue and finish the Work or any part of it after the time fixed for its completion, or after the date to which the time for completion may have been extended, will in no way operate as a wavier on the part of the Department of any of its rights under the Contract.

NOTE TO SPECIFIER:
The Contract Time is an essential part of each Contract for construction on airports and should be considered carefully in the preparation of plans and specifications.

In selecting the method of specifying the Contract Time (working days, or a specified completion date), the primary consideration should be the impact on the operations of the airport should the Contractor be unable to complete the Work within the time specified. These considerations should be coordinated with the airport users as indicated in AC 150/5300–9, Predesign, Prebid, and Preconstruction Conferences for Airport Grant Projects.

Generally speaking, Contract Time is based on working days when completion is not critical to operation of the airport. Use of a specified completion date should be used only in cases where the construction operations require long–range rescheduling of airport operations.

80–09 DEFAULT AND TERMINATION OF CONTRACT. The Contractor shall be considered in default of the Contract and such default will be considered as cause for the Department to terminate the Contract for any of the following reasons if the Contractor:

a. fails to begin the Work under the Contract within the time specified in the Notice to Proceed.

b. fails to perform the Work or fails to provide sufficient workers, equipment, or materials to assure completion of Work in accordance with the terms of the Contract,

c. performs the Work unsuitably or neglects or refuses to remove materials or to perform anew such Work as may be rejected as unacceptable and unsuitable,

d. discontinues the prosecution of the Work,

e. fails to resume Work which has been discontinued within a reasonable time after notice to do so,

f. becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency,

g. allows any final judgment to stand against them unsatisfied for a period of 48 hours,

h. makes an assignment for the benefit of creditors,

i. is determined to be in violation of the provisions of the Contract relative to hours of labor, wages, equal opportunity, character and classification of works employed, or

j. for any other cause, fails to carry on acceptable Work.

Should the Engineer consider the Contractor in default of the Contract for any reason, written notice will be given immediately to the Contractor and the Contractor's Surety as to the reasons for considering the Contractor in default and the Department's intentions to terminate the Contract.

If the Contractor or Surety, within a period of 10 days after such notice, does not proceed in accordance therewith, then the Department will, upon written notification from the Engineer of the facts of the delay, neglect, or default, and the Contractor's failure to comply with such notice, have full power and authority without violating the Contract, to take the prosecution of the Work out of the hands of the Contractor. The Department may appropriate or use acceptable materials and equipment that have been mobilized for use in the Work and may enter into an agreement for the completion of the Contract according to the terms, or use other methods as in the opinion of the Engineer will be required for the acceptable completion of the Contract,

All costs and charges incurred by the Department and Sponsor, together with the cost of completing the Work under Contract, will be deducted from any moneys due or which may become due the Contractor. If the expense exceeds the sum which would have been payable under the Contract, then the Contractor and the Surety will be liable and shall pay to the Department the amount of such excess.

80–10 TERMINATION OF THE CONTRACTOR'S RESPONSIBILITY. Whenever the improvement contemplated and covered by the Contract has been completely performed by the Contractor and all parts of the Work have been accepted by the Engineer and approved by the Department according to the Contract, and final estimate paid, the Contractor's obligation will be considered fulfilled except as provided in Subsection 60–07, Unacceptable Materials, and Subsection 70–18, No Waiver of Legal Rights.

80–11 EMERGENCY DEFERMENT OR CANCELLATION OF CONTRACT. The Department may, by written order, defer or cancel the Contract or any part thereof as provided, upon finding that for reasons beyond the control of the Department or the Contractor, the Contractor is unable to proceed with or complete the construction Contract and that such deferral or cancellation is in the public interest. Such reasons for deferral or cancellation may include, but need not be limited to:

a. a national emergency that creates a shortage of materials, labor or equipment, by reason of war conditions involving the United States, or by reason of orders of the United States Government or its duly authorized agencies, or executive order with respect to prosecution of war or national defense,

b. orders from duly constituted authorities related to energy conservation,

c. in the event 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.

In all cases where the construction is deferred, it will be done by written order of the Department. The Contractor will be paid for 95 percent of the amount of Work already completed, at Contract unit prices, or agreed prices when no unit prices are included in the Contract. Upon written request of the Contractor, and approval of the Contractor's Surety, such percent may be increased at the discretion of the Department.

Where the Contract, or any portion thereof, is definitely terminated or canceled, and the Contractor is released before all the Pay Items included in the Contract have been completed, payment will be made for the value of the actual Pay Items completed at Contract unit prices, or agreed prices where no unit prices are contained in the Contract, and no claim for loss of anticipated profits will be considered.

Acceptable materials, obtained by the Contractor for the Work, that have been inspected, tested, and accepted by the Engineer, and that are not incorporated in the Work, may, at the option of the Department, be purchased from the Contractor at actual cost as shown on receipted bills at such points of delivery as may be designated by the Engineer.

80–12 WORKING DAY CONTRACTS.

a. Schedule of Operations. When the Contract provides for a specific number of working days to complete the Work, 5 days prior to the pre–construction conference, submit to the Engineer a satisfactory progress schedule which shows the proposed sequence of the Work and the plan for completing the various items of Work within the number of working days in the Contract. Update and resubmit the schedule when required by the Engineer.

The schedule will be used for establishing the controlling item and for checking the Work progress.

b. Assessment Of Charges.

(1) General. Contract Time on the working day basis will not be charged during periods of complete suspension of operations resulting from an order by the Engineer suspending operations as elsewhere established or when provided for in the Special Provisions or a Contract Change Order.

No working day charges will be assessed on Saturdays, Sundays, New Year's Day, Martin Luther King Jr. Day, Good Friday, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Christmas Eve Day, Christmas Day, and New Year's Eve Day, nor the period from November 16 through March 31, both dates inclusive, even though Work is performed on the controlling item, or on other days or times specified in the Special Provisions when Work on the controlling item is prohibited, except that work day charges will be assessed after November 15 for those Contracts not completed to the stage required by the Contract to be completed by November 16.

The Contractor shall not be entitled to claim Contract time adjustment or other damages if the Engineer determines Work shall not proceed during the period from November 16 through March 31.

A whole working day will be assessed for any day on which the controlling item can be prosecuted for 8 hours or more with full and normal efficiency.

A fractional working day of 1/4, ½, or 3/4 will be assessed when weather conditions, job conditions caused by weather, or other conditions beyond the control of the Contractor prevent the prosecution of Work on the controlling item for at least 8 hours with full and normal efficiency. Fractional working day charges will not be assessed for days on which Work cannot be prosecuted on the controlling Pay Item for at least 2 hours.

(2) Avoidable Delays. Delays which the Contractor can foresee or are within their power to control or prevent. Working day charges will not be waived or reduced for avoidable delays. The following conditions will be considered avoidable delays due to or caused by:

(a) conditions on the Project that could be foreseen at the time of bidding, including curing time for concrete, drying time for paint, traffic conditions, and similar delays.

(b) the failure of the Contractor to prosecute the Work or to provide sufficient forces and equipment to maintain satisfactory progress on the controlling item when conditions are otherwise satisfactory.

(c) slow delivery of materials from a supplier or fabricator due to priority, late ordering, financial considerations or other cause within the power of the Contractor to avoid.

(d) failure or breakdown of plant or equipment.

(e) strikes or job actions against the Contractor and within their power to settle, or due to shortages of labor in specific classifications.

(f) local material shortages.

(g) failure of subcontractors or suppliers to adequately perform.

(3) Unavoidable Delays. Unavoidable delays are delays that the Contractor cannot foresee or control and are without their fault or negligence. Working day charges will not be assessed when Work on the controlling item cannot be prosecuted due to unavoidable delays. The following conditions will be considered unavoidable delays due to or caused by:

(a) adverse weather or job conditions caused by recent weather which prevent Work on the controlling item.

(b) extraordinary delays in the delivery of materials, resulting from strikes, lockouts, freight embargoes, governmental acts, or sudden disaster of a nature beyond the power of the Contractor or their supplier to foresee and forestall.

(c) acts of the government or a political subdivision, or of the public enemy, or from fires, epidemics or strikes not caused by improper acts or omissions of the Contractor and beyond their power to settle.

(d) earthquake, flood, cloudburst, cyclone, tornado, or other cataclysmic phenomenon of a nature beyond the power of the Contractor to foresee and avoid.

(e) the Department or other parties such as commercial manufacturers and fabricators who are the sole source of supply, the actions or non–actions of which are not within the power of the Contractor to control or overcome.

(f) non–completion of Work being done by other contractors or utilities, or due to other unforeseeable interferences not the fault of the Contractor.

c. Weekly Statement. The Engineer will furnish the Contractor a weekly statement showing the number of days charged to the Contract for the preceding week. The Contractor will be allowed 1 week in which to review and approve the statement or to resolve, with the Engineer, disagreements concerning the working days' charges; otherwise, the statement will be deemed to have been accepted by the Contractor.

80-13 CALENDAR DAY AND COMPLETION DATE CONTRACTS.

a. General. Contract time on the Calendar Day and Completion Date basis will not be charged during periods of complete suspension resulting from an order by the Engineer suspending operations as elsewhere herein set forth or when provided for in the Special Provisions, or when authorized by Contract Change Order.

b. Avoidable Delays. Avoidable delays are delays that the Contractor can foresee or are within the Contractor's power to control or prevent. The conditions set forth in Subsection 80-12(2) will be considered avoidable delays for Calendar Day and Completion Date Contracts, and as such will not be sufficient basis for consideration of an adjustment of the time allowed for Contract completion.

c. Unavoidable Delays. Unavoidable delays are delays that the Contractor cannot foresee or control and are without the Contractor's fault or negligence. The following conditions will be considered unavoidable delays for Calendar Day and Completion Date Contracts, and as such will be sufficient basis for consideration of an adjustment of the time allowed for Contract completion when work on the controlling item cannot be prosecuted due to these unavoidable delays.

(1) Extraordinary delays due to adverse weather or job conditions caused by recent weather that prevent work on the controlling item.

(2) Extraordinary delays in the delivery of materials, resulting from strikes, lockouts, freight embargoes, governmental acts, or sudden disaster of a nature beyond the power of the Contractor or the Contractor's supplier to foresee and forestall.

(3) Delays due to acts of the Government or a political subdivision, or of the public enemy, or from fires, epidemics or strikes not caused by improper acts or omissions of the Contractor and beyond the Contractor's power to settle.

(4) Delays caused by an earthquake, flood, cloudburst, cyclone, tornado, or other cataclysmic phenomenon of a nature beyond the power of the Contractor to foresee and avoid.

(5) Delays caused by the Department or other parties such as commercial manufacturers and fabricators who are the sole source of supply, the actions or non-actions of whom are not within the power of the Contractor to control or overcome.

(6) Delays caused by noncompletion of work being done by other contractors or utilities, or due to other unforeseeable interferences not the fault of the Contractor.

SECTION 90. MEASUREMENT AND PAYMENT

90–01 MEASUREMENT OF QUANTITIES. The Engineer, or the Engineer's authorized representative, will measure all Work completed under the Contract using United States Customary Units of Measurement.

The method of measurement and computations to be used in determination of quantities of material furnished and of Work performed under the Contract will be those methods generally recognized as conforming to good engineering practice.

Unless otherwise specified, longitudinal measurements for area computations will be made horizontally, and no deductions will be made for individual fixtures (or leave–outs) having an area of 9 square feet or less. Transverse measurements for area computations will be the actual dimensions shown on the Plans or ordered in writing by the Engineer.

Structures will be measured according to actual lines shown on the Plans or as altered to fit field conditions.

Unless otherwise specified, measure all Contract Pay Items that are measured by the linear foot such as electrical ducts, conduits, pipe culverts, underdrains, and similar items along or parallel to their in–place location.

In computing volumes of excavation the average end area method or other acceptable methods will be used.

The thickness of plates and galvanized sheet used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing will be specified and measured in decimal fraction of inches.

The term "ton" will mean the short ton consisting of 2,000 pounds avoirdupois. Weigh all materials that are measured or proportioned by weights on accurate, approved scales by competent, qualified personnel at locations designed by the Engineer. If material is shipped by rail, the car weight may be accepted provided that only the actual weight of material be paid for. However, car weights will not be acceptable for material to be passed through mixing plants. Weigh daily empty trucks used to haul material being paid for by weight when the Engineer directs. Each truck shall bear a plainly legible identification mark.

Haul materials to be measured by volume in approved vehicles, will be measured at the point of delivery. Vehicles for this purpose may be of any size or type acceptable to the Engineer, provided that the body is of a shape that the actual contents may be readily and accurately determined. Load all vehicles to at least their water level capacity, and level all loads when the vehicles arrive at the point of delivery.

When mutually agreed to in writing, material specified to be measured by the cubic yard may be weighed, and will be converted to cubic yards for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined by the Engineer and shall be agreed to by the Contractor before the method of measurement of pay quantities is used.

Bituminous materials will be measured by the gallon or ton. When measured by volume, such volumes will be measured at 60 degrees F or will be corrected to the volume at 60 degrees F using ASTM D 1250 for asphalts or ASTM D 633 for tars.

Net certified scale weights or weights based on certified volumes in the case of rail shipments will be used as a basis of measurement, subject to correction when bituminous material has been lost from the car or the distributor, wasted, or otherwise not incorporated in the Work.

When bituminous materials are shipped by truck or transport, net certified weights by volume, subject to correction for loss or foaming, may be used for computing quantities.

Cement will be measured by the ton or hundredweight.

Timber will be measured by the thousand feet board measure (M.F.B.M.) actually incorporated in the structure. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.

The term "lump sum" when used as the basis of payment for a Pay Item will mean complete payment for the Work described in the Contract.

When a complete structure or structural unit (in effect, "lump sum" work) is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

Rental of equipment will be measured by time in hours of actual working time and necessary traveling time of the equipment within the limits of the Work. Special equipment ordered by the Engineer in connection with force account work will be measured as agreed in the Change Order authorizing such force account work as provided in the Subsection 90-05, Payment for Extra and Force Account Work. Equipment rental rates contained in the Rental Rate Blue Book, published by Dataquest, Inc., San Jose, California, will be used, unless otherwise provided, to compute the equipment expense rate for contractor–owned machinery used on Extra Work to be paid for on a force account basis or the cost of major

Pay Items for the purpose of adjusting unit prices thereof. The rental rates in effect on April 1 of each year will be used for work throughout the season. Rental rates will be adjusted to account for regional differences in cost.

The Rate Adjustment Tables contained in the Rental Rate Blue Book to determine the adjusted Blue Book rates for federally funded projects will be used to determine the equipment expense rates on all projects.

The equipment expense rate will be the sum of the monthly rental rate expressed on an hourly basis and the hourly operating cost, and will be determined as follows: The monthly rental rate will be divided by 176 to obtain the monthly–hourly rate.

When Contractor–owned equipment is required to "stand–by," only one half of the monthly–hourly rate adjusted for regional differences will apply. The stand–by rate will be allowed during the hours work is actually in progress on the force account items when the equipment is idle but specifically required by the Engineer to remain on the site for later use on the force account items.

Such expense rates will apply to all Contractor–owned equipment. The rate for rented equipment or any specialized equipment not listed in the Rental Rate Blue Book must be approved by the Engineer prior to use.

Apply the equipment expense rate to travel time when the equipment is moved under its own power. When equipment is transported, the expense rate will be allowed for the transporting vehicle only. Moves by commercial haulers will be at established freight rates.

Items of equipment having a replacement value of $100 or less will be considered small tools and no allowance will be made for their use.

When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gage, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.

Scales for weighing materials that are required to be proportioned or measured and paid for by weight shall be furnished, erected, and maintained by the Contractor, or be certified permanently installed commercial scales.

Scales shall be accurate within 1/2 percent of the correct weight throughout the range of use. Have the scales checked under the observation of the inspector before beginning work and when requested. Space the intervals uniformly throughout the graduated or marked length of the beam or dial and do not exceed 1/10th of 1 percent of the nominal rated capacity of the scale, but not less than 1 pound. The use of spring balances will not be permitted.

Arrange beams, dials, platforms, and other scale equipment so that the operator and the inspector can safely and conveniently view them.
Have available at scale installations ten standard 50–pound weights for testing the weighing equipment or suitable weights and devices for other approved equipment.

Scales must be tested for accuracy and serviced before use at a new site. Install and maintain platform scales with the platform level and rigid bulkheads at each end.

Scales "overweighing" (indicating more than correct weight) will not be permitted to operate, and all materials received subsequent to the last previous correct weighting–accuracy test will be reduced by the percentage of error in excess of 1/2 of 1 percent.

In the event inspection reveals the scales have been "underweighing" (indicating less than correct weight), they shall be adjusted, and no additional payment to the Contractor will be allowed for materials previously weighed and recorded.

Include the following in the Contract prices for the various Pay Items of the project weighing of materials for proportioning or payment:

a. All costs in connection with furnishing, installing, certifying, testing, and maintaining scales;

b. All costs for furnishing check weights and scale house; and,

c. All costs for all other items specified in this Subsection

When the estimated quantities for a specific portion of the Work are designated as the pay quantities in the Contract, they will be the final quantities for which payment for the specific portion of the Work will be made, unless the dimensions of the portions of the Work shown on the Plans are revised by the Engineer. If revised dimensions result in an increase or decrease in the quantities of the Work, the final quantities for payment will be revised in the amount represented by the authorized changes in the dimensions.

90–02 SCOPE OF PAYMENT. Receive and accept compensation provided for in the Contract as full payment for furnishing all materials, for performing all Work under the Contract in a complete and acceptable manner, and for all risk, loss, damage, or expense of whatever character arising out of the nature of the Work or the prosecution thereof, subject to the provisions of Subsection 70-18, No Waiver of Legal Rights.

When the "basis of payment" Subsection of a technical specification requires that the Contract Price (price bid) include compensation for certain Work or material essential to the item, this same Work or material will not also be measured for payment under any other Contract Item which may appear elsewhere in the Contract, Plans, or Specifications.

90–03 INCREASED OR DECREASED QUANTITIES. When the accepted quantities of Work vary from the quantities in the Proposal, accept as payment-in-full (so far as Contract Items are concerned) payment at the original Contract Price for the accepted quantities of Work actually completed and accepted. No allowance, except as provided for in Subsection 40-02, Alternation of Work and Quantities, will be made for any increased expense, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the Contractor which results directly from such alterations or indirectly from Contractor's unbalanced allocation of overhead and profit among the Contract Items, or from any other cause.

90–04 PAYMENT FOR OMITTED ITEMS. As specified in the Subsection 40-03, Omitted Items, the Engineer will have the right to omit from the Work any Contract Item in the best interest of the Department and Sponsor.

Should the Engineer omit or order nonperformance of a Contract Item or a portion of the Item from the Work, accept payment-in-full at the Contract prices for Work actually completed and acceptable prior to the Engineer's order to omit or nonperform the Contract Item.

Acceptable materials ordered by the Contractor or delivered on the Work prior to the date of the Engineer's order shall be paid for at the actual cost to the Contractor and will then become the property of the Sponsor.

In addition to the reimbursement provided, the Contractor will be reimbursed for all actual costs incurred for the purpose of performing the omitted Contract Item prior to the date of the Engineer's order. The additional costs incurred by the Contractor must be directly related to the deleted Contract Item and shall be supported by certified statements by the Contractor as to the nature of the amount of such costs.

90–05 PAYMENT FOR EXTRA AND FORCE ACCOUNT WORK. Extra Work, performed in accordance with the Subsection 40-04, Extra Work, will be paid for at the Contract Prices or agreed prices specified in the Change Order authorizing the Extra Work. When the Change Order requires that it be done by force account, the force account will be measured and paid for based on expended labor, equipment, and materials plus a negotiated and agreed upon allowance for overhead and profit.

a. The Contractor and the Engineer will compare records of the cost of force account work at the end of each day. Agreement will be indicated by signature of the Contractor and the Engineer or their duly authorized representatives.

b. Statement. No payment will be made for Work performed on a force account basis until the Contractor has furnished the Engineer with duplicate itemized statements of the cost of the force account work detailed as follows:

(1) For all labor and foremen in direct charge of the specific Work, the Contractor will receive the rate of wage agreed upon in writing before beginning Work, for each and every hour that the labor and foremen are actually engaged in such Work.

The Contractor will Receive the actual costs paid to, or on behalf of, workers by reason of subsistence and travel allowances, health, and welfare benefits required to be paid.

An amount equal to 35 percent of the above items will be added to the cost of these items.

(2) For property damage, liability, the worker's compensation insurance premiums, unemployment insurance contributions and social security taxes on the force account work, the Contractor will receive the actual cost, to which cost will be added an amount equal to 15 percent of the sum thereof. Furnish satisfactory evidence of the rate or rates paid.

(3) For materials accepted by the Engineer and used, the Contractor will receive the actual cost of such materials delivered to the Work including transportation charges paid by the Contractor (exclusive of machinery rentals as hereinafter set forth), to which cost will be added an amount equal to 15 percent of the sum thereof.

(4) For any machinery or special equipment (other than small tools) including fuel and lubricants, the use of which has been authorized by the Engineer, receive the rental rates agreed upon in writing before the work is begun, for the actual time that such equipment is in operation on the Work, and to which rental sum no percentage shall be added.

(5) No additional allowance will be made for general superintendence, the use of small tools, or other costs of which no specific allowance is herein provided.

(6) For administration costs when Work is performed by an approved subcontractor, the Contractor will receive an amount equal to 5 percent of the total costs of the Work computed as previously stated.

(7) The Contractor will receive the compensation as set forth above as payment in full for Extra Work done on a force account basis. At the end of each day, compare records with the Inspector of the cost of work done as ordered on a force account basis.

(8) No payment will be made for work performed on a force account basis until the Contractor furnishes to the Engineer duplicate itemized statements of the cost of such force account work, detailed as to the following:

(a) Name, classification, dates, daily hours, total hours, rate and extension of each laborer and foreman.

(b) Designation, dates, daily hours, total hours of actual operation and standby operation (if any), applicable expense rate and extension for each truck and other machinery and equipment. The designation must include the manufacturer's name or trademark, model number, and year of manufacture.

(c) Quantities of materials, prices and extensions.

(d) Transportation of materials.

(e) Cost of property damage, liability and worker's compensation insurance premiums, unemployment insurance contributions and social security tax.

Accompany and support statements with a receipted invoice for all materials used and transportation charges. However, if materials used on the force account work are not specifically purchased for the Work but are taken from the Contractor's stock, then in lieu of the invoices furnish an affidavit certifying that these materials were taken from stock, that the quantity claimed was actually used, and that the price and transportation claimed represent the actual cost to the Contractor.

90–06 PARTIAL PAYMENTS. Partial payments will be made at least once each month as the Work progresses. Payments will be based upon estimates prepared by the Engineer of the value of the Work performed and materials complete in place in accordance with the Contract, Plans, and Specifications. Such partial payments may also include the delivered actual cost of those materials stockpiled and stored in accordance with the Subsection 90-07, Payment for Materials on Hand.

No partial payment will be made when the amount due the Contractor since the last estimate amounts to less than $500.

From the total of the amount determined to be payable on a partial payment, the retainage will be an amount equal to 10 percent of the estimate until 50 percent of the Work has been completed. At 50 percent completion, further partial payments will be made to the Contractor and no additional amounts will be retained unless the Engineer certifies that the job is not proceeding satisfactorily, but amounts previously retained will not be paid to the Contractor. At 50 percent completion or any time thereafter when the progress of the Work is not satisfactory, additional amounts may be retained but in no event shall the total retainage be more than 10 percent of the value of the Work completed.

Upon substantial completion of the Work, an amount retained may be paid to the Contractor. When the Work has been substantially completed, except for Work that cannot be completed because of weather conditions, lack of materials or other reasons which, in the judgment of the Department, are valid reasons for non–completion, the Department may make additional payments, retaining at all times an amount sufficient to cover the estimated cost of the Work still to be completed or, in the alternative, may pay out the entire amount retained and receive from the Contractor guaranties in the form of a bond or other collateral sufficient to ensure completion of the job.

Additional amounts will be retained from each partial payment to provide for the recovery of liquidated damages assessable against the Contract and as required to cover any claims against the Contract that have been filed with the Department pursuant to Chapter 779 of the Wisconsin Statutes prior to payment of the estimate.

It is understood and agreed that the Contractor is not entitled to demand or receive partial payment based on quantities of Work in excess of those provided in the Proposal or covered by approved Change Orders, except when the excess quantities have been determined by the Engineer to be a part of the final quantity for the Pay Item of Work in question.

No partial payment will bind the Department to the acceptance of materials or Work in place as to quality or quantity. All partial payments are subject to correction at the time of final payment as provided in the Subsection 90-10, Acceptance and Final Payment.

90–07 PAYMENT FOR MATERIALS ON HAND. Partial payments may be made to the extent of the delivered cost of materials to be incorporated in the Work, provided that such materials meet the requirements of the Contract, Plans, and Specifications and are delivered to acceptable sites on the Airport property or at other sites in the vicinity that are acceptable to the Department. The delivered costs of stored or stockpiled materials may be included in the next partial payment after the following conditions are met:

a. The material has been stored or stockpiled in a manner acceptable to the Engineer at or on an approved site.

b. The Contractor has furnished the Engineer with acceptable evidence of the quantity and quality of such stored or stockpiled materials.

c. The Contractor has furnished the Engineer with satisfactory evidence that the material and transportation costs have been paid.

d. The Contractor has furnished the Department legal title (free of liens or encumbrances of any kind) to the material so stored or stockpiled.

e. The Contractor has furnished the Department evidence that the material so stored or stockpiled is insured against loss by damage to or disappearance of such materials at anytime prior to use in the Work.

It is understood and agreed that the transfer of title and the Department's payment for such stored or stockpiled materials will in no way relieve the Contractor of Contractor's responsibility for furnishing and placing such materials in accordance with the requirements of the Contract, Plans, and Specifications.

In no case will the amount of partial payments for materials on hand exceed the Contract Price for such materials or the Contract Price for the Contract Item in which the material is intended to be used.

No partial payment will be made for stored or stockpiled living or perishable plant materials.

The Contractor shall bear all costs associated with the partial payment of stored or stockpiled materials in accordance with the provisions of this Subsection.

90–08 ASSIGNMENT OF PAYMENTS. All moneys payable under the Contract, or any part thereof, will be paid to the Contractor in accordance with the provisions of this Section, and no assignment or order executed by the Contractor directing payment of any portion or all these funds to any persons will be recognized by the Department unless such assignment or order specifies the amount to be so paid. The purpose for which the assignment or order is given shall have attached, by endorsement or otherwise, the consent of the Surety. No such assignment or order will be binding on the Department.

90–09 DIFFERING SITE CONDITIONS. During the progress of Work, if subsurface or latent physical conditions are encountered at the site differing materially from those indicated in the Contract, or if unknown physical conditions or an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the Work provided for in the Contract, are encountered at the site, the party discovering the conditions shall promptly notify the other party in writing of the specific differing conditions before the conditions are disturbed and before the affected Work is performed.

Upon written notification, the Engineer will investigate the conditions, and if the Engineer determines the conditions materially differ and cause an increase or decrease in the cost or time required for the performance of Work under the Contract, an adjustment, excluding loss of anticipated profits, will be made and the Contract modified in writing accordingly. The Engineer will notify the Contractor whether or not an adjustment of the Contract is warranted.

No Contract adjustment that results in a benefit to the Contractor will be allowed unless the Contractor has provided the required written notice.

90–10 ACCEPTANCE AND FINAL PAYMENT. When the Contract Work has been accepted in accordance with the requirements of Subsection 50, Final Acceptance, the Engineer will prepare the final estimate of the Pay Items of Work actually performed. The Contractor can approve the Engineer's final estimate or advise the Engineer of objections to the final estimate that are based on disputes in measurements or computations of the final quantities to be paid under the Contract as amended by Change Order. The Contractor and the Engineer shall resolve disputes in the measurement and computation of final quantities to be paid within 30 calendar days of the Contractor's receipt of the Engineer's final estimate. If, after the 30–day period, a dispute still exists, the Contractor may approve the Engineer's estimate under protest of the quantities in dispute, and the disputed quantities will be considered by the Department as a claim in accordance with Subsection 50-18, Claims for Adjustment and Disputes.

After the Contractor has approved, or approved under protest, the Engineer's final estimate, final payment will be processed based on the entire sum, or the undisputed sum in case of approval under protest, determined to be due the Contractor less all previous payments and all amounts to be deducted under the provisions of the Contract. All prior partial estimates and payments will be subject to correction in the final estimate and payment.

If the Contractor has filed a claim for additional compensation under the provisions of Subsection 50-18, Claims for Adjustments and Disputes, or under the provisions of this Subsection, such claims will be considered by the Department in accordance with local laws or ordinances. Upon final adjudication of such claims, any additional payment determined to be due the Contractor will be paid pursuant to a supplemental final estimate.

SECTION 100. CONTRACTOR QUALITY CONTROL PROGRAM

100–01 GENERAL. When the Specifications require a Contractor Quality Control Program, establish, provide, and maintain an effective Quality Control Program that details the methods and procedures to be taken to assure that all materials and completed construction required by this Contract conform to Contract Plans, 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 herein and elsewhere in the Contract Specifications, assume full responsibility for accomplishing the stated purpose.

The intent of this Section is to enable the Contractor to establish a necessary level of control that will:

a. Adequately provide for the production of acceptable quality materials.

b. Provide sufficient information to assure both the Contractor and the Engineer that the Specification requirements can be met.

c. Allow the Contractor as much latitude as possible to develop their own standard of control.

Be prepared to discuss and present, at the preconstruction conference, the Contractor's understanding of the quality control requirements. Do not begin any construction or production of materials to be incorporated into the completed Work until the Quality Control Program has been reviewed 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.

The quality control requirements contained in this Section and elsewhere in the Contract Specifications are in addition to and separate from the acceptance testing requirements. Acceptance testing requirements are the responsibility of the Engineer.

100–02 DESCRIPTION OF PROGRAM.

a. General Description. Establish a Quality Control Program to perform inspection and testing of all items of Work required by the Specifications, including those performed by subcontractors. This Quality Control Program shall:

(1) ensure conformance to applicable Specifications and Plans with respect to materials, workmanship, construction, finish, and functional performance.

(2) be effective for control of all construction Work performed under this Contract and shall specifically include surveillance and tests required by the 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.

b. Quality Control Program. Describe the Quality Control Program in a written document that will be reviewed by the Engineer prior to the start of any production, construction, or off–site fabrication. Submit the written Quality Control Program shall be submitted to the Engineer for review at least 7 calendar days before the preconstruction meeting.

NOTE TO SPECIFIER:
Submittal of the written Quality Control Program prior to the preconstruction conference will allow the Engineer to review the contents and make suggestions at the preconstruction meeting.

Organize the Quality Control Program to address, as a minimum, the following items:

(1) Quality control organization;

(2) Project progress schedule;

(3) Submittals schedule;

(4) Inspection requirements;

(5) Quality control testing plan;

(6) Documentation of quality control activities; and

(7) Requirements for corrective action when quality control and/or acceptance criteria are not met.

The Contractor is encouraged to add any additional elements to the Quality Control Program that are deemed necessary to adequately control all production and/or construction processes required by this Contract.

100–03 QUALITY CONTROL ORGANIZATION. Implement the Quality Control Program by the establishment of an autonomous quality control organization. Develop an organizational chart showing all quality control personnel and how these personnel integrate with other management/production and construction functions and personnel.

Identify on the organizational chart all quality control staff by name and function, and indicate the total staff required to implement all elements of the Quality Control Program, including inspection and testing for each item of Work. If necessary, different technicians can be utilized 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 Quality Control Program, the personnel assigned shall be subject to the qualification requirements of Subsection 100–03a and 100–03b. Indicate on the organizational chart which personnel are Contractor employees and which are provided by an outside organization.

The quality control organization shall consist of the following minimum personnel:

a. Program Administrator. A full–time employee of the Contractor, or a consultant engaged by the Contractor, with a minimum of 5 years of experience in airport and/or highway construction and prior quality control experience on a project of comparable size and scope as the Contract.

Additional qualifications for the Program Administrator include at least one of the following requirements:

(1) Professional engineer with 1 year of airport paving experience acceptable to the Engineer.

(2) Engineer–in–training with 2 years of airport paving experience acceptable to the Engineer.

(3) An individual with 3 years of highway and/or airport paving experience acceptable to the Engineer, with a Bachelor of Science Degree in Civil Engineering, Civil Engineering Technology or Construction.

(4) Construction materials technician certified at Level III by the National Institute for Certification in Engineering Technologies (NICET).

(5) Highway materials technician certified at Level III by NICET.

(6) Highway construction technician certified at Level III by NICET.

(7) A NICET certified engineering technician in Civil Engineering Technology with 5 years of highway and/or airport paving experience acceptable to the Engineer.

The Program Administrator:

(1) Shall have full authority to institute any and all actions necessary for the successful implementation of the Quality Control Program to ensure compliance with the Contract Plans and Specifications.

(2) Shall report directly to a responsible officer of the construction firm.

(3.) May supervise the Quality Control Program on more than one project provided that person can be at the job site within 2 hours after being notified of a problem.

NOTE TO SPECIFIER:
If, in the opinion of the Engineer, the project is of sufficient scope and size to warrant a full time, on–site Program Administrator, paragraph 100–03a should be modified by Special Provision

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b. Quality Control Technicians. Provide a sufficient number of quality control technicians necessary to adequately implement the Quality Control Program. These personnel shall be certified for the appropriate testing area in accordance with the Wisconsin Department of Transportation Highway Technician Certification Program.

The quality control technicians report directly to the Program Administrator and shall perform the following functions:

(1) Inspection of all materials, construction, plant, and equipment for conformance to the technical specifications, and as required by Subsection 100–06, Inspection Requirements.

(2) Performance of all quality control tests as required by the technical specifications and Subsection 100–07, Quality Control Testing Plan. Certification at an equivalent level, by a state or nationally recognized organization will be acceptable in lieu of NICET certification.

c. Staffing Levels. 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, provide separate plant and field technicians 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. State in the Quality Control Program where different technicians will be required for different work elements.

100–04 PROJECT PROGRESS SCHEDULE. Submit a coordinated construction schedule for all Work activities in accordance with Subsection 80–03, Prosecution and Progress.

100–05 SUBMITTALS SCHEDULE. Submit a detailed listing of all submittals (e.g., mix designs, material certifications) and shop drawings required by the Specifications. The listing can be developed in a spreadsheet format and should include:

a. specification number;

b. pay item description;

c. description of submittal;

d. specification paragraph requiring submittal; and

e. scheduled date of submittal.

100–06 INSPECTION REQUIREMENTS. Organize quality control inspections to provide inspections for all definable features of Work, as detailed below. Document all inspections by the Contractor as specified by Subsection 100–07, Quality Control Testing Plan.

Perform inspections daily to ensure continuing compliance with Contract requirements until completion of the particular feature of Work. These include the following minimum requirements:

a. During plant operation for material production, utilize quality control test results and periodic inspections 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. Inspect all equipment utilized in proportioning and mixing to ensure its proper operating condition. Detail in the Quality Control Program how these and other quality control functions shall be accomplished and utilized.

b. During field operations, utilize quality control test results and periodic inspections to ensure the quality of all materials and workmanship. Inspect all equipment utilized in placing, finishing, and compacting to ensure its proper operating condition and to ensure that all such operations are in conformance to the Specifications and are within the Plan dimensions, lines, grades, and tolerances specified. Document in the Quality Control Program how these and other quality control functions will be accomplished and utilized.

100–07 QUALITY CONTROL TESTING PLAN. As a part of the overall Quality Control Program, implement a quality control testing plan, as required by the Specifications. Include in the testing plan the minimum tests and test frequencies required by each Specification Item, as well as any additional quality control tests that the Contractor deems necessary to adequately control production and/or construction processes.

The testing plan can be developed in a spreadsheet fashion and shall, as a minimum, include the following:

a. specification number (e.g., P–401);

b. pay item description (e.g., Plant Mix Bituminous Pavements);

c. test type (e.g., gradation, grade, asphalt content);

d. test standard (e.g., ASTM or AASHTO test number, as applicable);

e. test frequency (e.g., as required by technical specifications or minimum frequency when requirements are not stated);

f. responsibility (e.g., plant technician); and

g. control requirements (e.g., target, permissible deviations).

The testing plan shall contain a statistically–based procedure of random sampling for acquiring test samples in accordance with ASTM D 3665. Provide the Engineer the opportunity to witness quality control sampling and testing. Document all quality control test results as required by Subsection 100–08, Documentation.

100–08 DOCUMENTATION. Maintain current quality control records of all inspections and tests performed. Include in these records:

a. factual evidence that the required inspections or tests have been performed, including 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; and

e. corrective actions taken.

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. Furnish legible copies of these records 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 Contractor's Program Administrator.

Specific Contractor quality control records required for the Contract shall include, but are not necessarily limited to, the following records:

a. Daily Inspection Reports. Each Contractor quality control technician shall maintain a daily log of all inspections performed for both Contractor and subcontractor operations on a form acceptable to the Engineer. 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:

(1) specification number and description;
(2) compliance with approved submittals;
(3) proper storage of materials and equipment;
(4) proper operation of all equipment;
(5) adherence to Plans and technical specifications;
(6) review of quality control tests; and
(7) safety inspection.

Identify in the daily inspection reports inspections conducted, results of inspections, location and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed.

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.

b. Daily Test Reports. Establish a system which will record all quality control test results. Document in the daily test reports the following information:

(1) specification number and description;
(2) test designation;
(3) location;
(4) date of test;
(5) control requirements;
(6) test results;
(7) causes for rejection;
(8) recommended remedial actions; and
(9) retests.

Submit to the Engineer prior to the start of the next day’s work period test results from each day's work period. When required by the Specifications, maintain statistical quality control charts. The daily test reports shall be signed by the responsible quality control technician and the Program Administrator.

100–09 CORRECTIVE ACTION REQUIREMENTS. Indicate in the Quality Control Program 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 include both general requirements for operation of the Quality Control Program as a whole, and for individual items of Work contained in the Specifications.

Detail in the Quality Control Program how the results of quality control inspections and tests will be used for determining the need for corrective action, 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.

When applicable or required by the Specifications, establish and utilize statistical quality control charts for individual quality control tests. Link the requirements for corrective action to the control charts.

100–10 SURVEILLANCE BY THE ENGINEER. All items of material and equipment will 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 herein and the applicable Specifications and Plans. In addition, all items of materials, equipment and Work in place will be subject to surveillance by the Engineer at the site for the same purpose.

Surveillance 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.

100–11 NONCOMPLIANCE.

a. The Engineer will notify the Contractor of noncompliance with the foregoing requirements. After receipt of this notice, immediately take corrective action. Any notice, when delivered by the Engineer or Engineer's authorized representative to the Contractor or Contractor's authorized representative at the site of the work, is considered sufficient notice.

b. In cases where quality control activities do not comply with either the Contractor's Quality Control Program or the Contract provisions, or where the Contractor fails to properly operate and maintain an effective Quality Control Program, as determined by the Engineer, the Engineer may:

(1) Order the Contractor to replace ineffective or unqualified quality control personnel or subcontractors.

(2) Order the Contractor to stop operations until appropriate corrective actions is taken.

SECTION 110. METHOD OF ESTIMATING PERCENTAGE OF MATERIAL WITHIN SPECIFICATION LIMITS (PWL)

110–01 GENERAL. When the Specifications provide for material to be sampled and tested on a statistical basis, the material will be evaluated for acceptance in accordance with this Section. All test results for a lot will be analyzed statistically, using procedures to determine the total estimated percent of the lot that is within Specification limits. This concept, termed percent within limits (PWL), is a statistically based evaluation method, whereby the PWL is computed on a lot basis, using the average (X) and standard deviation (S_n) of the specified number (n) of sublot tests 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(s) (Q_L for Lower Quality Index and/or Q_U for Upper Quality Index) is computed and the PWL for the specified n is determined from Table 1.

110–02 METHOD FOR COMPUTING PWL. The computational sequence for computing the PWL is as follows:

a. Divide the lot into **n** sublots in accordance with the acceptance requirements of the Specification.

b. Locate the sampling position within the sublot in accordance with the random sampling 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. Average all sublot values within the lot to find **X** by using the following formula:

$$\mathbf{X} = (x_1 + x_2 + x_3 + \ldots x_n) / n$$

Where:

X = Average of all sublot values within a lot

x_1, x_2 = Individual sublot values

n = Number of sublots

e. Find the standard deviation **Sn** by use of the following formula:

$$\mathbf{S_n} = [(d_1^2 + d_2^2 + d_3^2 + \ldots d_n^2) / n–1]^{0.5}$$

Where:

$\mathbf{S_n}$ = standard deviation of the number of sublot values in the set

$\mathbf{d_1}$, $\mathbf{d_2}$ = deviations of the individual sublot values X_1, X_2 . . . from the average value X

that is: $\mathbf{d_1} = (x_1 – X)$, $d_2 = (x_2 – X)$ . . $d_n = (x_n – X)$

n = number of sublots

f. For single sided specification limits (i.e., **L** only), compute the Lower Quality Index $\mathbf{Q_L}$ by use of the following formula:

$$\mathbf{Q_L} = (X – L) / S_n$$

Where:

L = specification lower tolerance limit

Estimate the percentage of material within limits (PWL) by entering Table 1 with $\mathbf{Q_L}$, using the column appropriate to the total number (**n**) of measurements. If the value of $\mathbf{Q_L}$ falls between values shown on the table, use the next higher value of PWL.

g. For double sided specification limits (i.e. **L** and **U**), compute the Quality Indexes $\mathbf{Q_L}$ and $\mathbf{Q_U}$ by use of the following formulas:

$\mathbf{Q_L} = (X - L) / S_n$ and $Q_U = (U - X) / S_n$

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 $\mathbf{Q_L}$ and $\mathbf{Q_U}$, using the column appropriate to the total number (**n**) of measurements, and determining the percent of material above $\mathbf{P_L}$ and percent of material below $\mathbf{P_U}$ for each tolerance limit. If the values of $\mathbf{Q_L}$ fall between values shown on the table, use the next higher value of $\mathbf{P_L}$ or $\mathbf{P_U}$. Determine the PWL by use of the following formula:

$\mathbf{PWL} = (P_U + P_L) - 100$

Where:

$\mathbf{P_L}$ = percent within lower specification limit
$\mathbf{P_U}$ = 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–l	96.60
A–2	97.55
A–3	99.30
A–4	98.35

n = 4

2. Calculate average density for the lot.

$\mathbf{X} = (x_1 + x_2 + x_3 + . . x_n) / n$

$\mathbf{X} = (96.60 + 97.55 + 99.30 + 98.35) / 4$

X = 97.95 percent density

3. Calculate the standard deviation for the lot.

$$\mathbf{S_n} = [((96.60 - 97.95)^2 + (97.55 - 97.95)^2 + (99.30 - 97.95)^2 + (98.35 - 97.95)^2) / (4 - 1)]^{0.5}$$

$\mathbf{S_n} = [(1.82 + 0.16 + 1.82 + 0.16) / 3]^{0.5}$

$\mathbf{S_n}$= 1.15

4. Calculate the Lower Quality Index Q_L for the lot. (L=96.3)

$\mathbf{Q_L} = (X - L) / S_n$

$\mathbf{Q_L}$ = (97.95 – 96.30)/ 1.15

$\mathbf{Q_L}$ = 1.4384

5. Determine **PWL** by entering Table 1 with $\mathbf{Q_L}$ = 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–l	5.00
A–2	3.74
A–3	2.30
A–4	3.25

2. Calculate the average air voids for the lot.

$\mathbf{X}$ = $(x_1 + x_2 + x_3 \ldots n) / n$

$\mathbf{X}$ = (5.00 + 3.74 + 2.30 + 3.25)/ 4

$\mathbf{X}$ = 3.57 percent

3. Calculate the standard deviation Sn for the lot.

$\mathbf{S_n}$ = $[((3.57 – 5.00)^2 + (3.57 – 3.74)^2 + (3.57 – 2.30)^2 + (3.57 – 3.25)^2) / (4 – 1)]^{0.5}$

$\mathbf{S_n}$ = $[(2.04 + 0.03 + 1.62 + 0.10) / 3]^{0.5}$

$\mathbf{S_n}$ = 1.12

4. Calculate the Lower Quality Index Q_L for the lot. (L= 2.0)

$\mathbf{Q_L}$ = $(X – L) S_n$

$\mathbf{Q_L}$ = (3.57 – 2.00) / 1.12

$\mathbf{Q_L}$ = 1.3992

5. Determine $\mathbf{P_L}$ by entering Table 1 with $\mathbf{Q_L}$ = 1.40 and **n** = 4.

$\mathbf{P_L}$ = 97

6. Calculate the Upper Quality Index $\mathbf{Q_U}$ for the lot. (**U**= 5.0)

$\mathbf{Q_U}$ = $(U – X) / S_n$

$\mathbf{Q_U}$ = (5.00 – 3.57) / 1.12

$\mathbf{Q_U}$ = 1.2702

7. Determine $\mathbf{P_U}$ by entering Table 1 with $\mathbf{Q_U}$ = 1.27 and **n** = 4.

$\mathbf{P_U}$ = 93

8. Calculate Air Voids **PWL**

PWL = $(P_L + P_U) – 100$
PWL = (97 + 93) – 100 = 90

TABLE 1. TABLE FOR ESTIMATING PERCENT OF LOT WITHIN LIMITS (PWL)

Percent Within Limits	Positive Values of Q (Q_L and Q_U)									
(P_L and P_U)	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10	n=11	n=12
99	1.1541	1.4700	1.6714	1.8008	1.8888	1.9520	1.9994	2.0362	2.0656	2.0897
98	1.1524	1.4400	1.6016	1.6982	1.7612	1.8053	1.8379	1.8630	1.0828	1.0989
97	1.1496	1.4100	1.5427	1.6181	1.6661	1.6993	1.7235	1.7420	1.7566	1.7684
96	1.1456	1.3800	1.4897	1.5497	1.5871	1.6127	1.6313	1.6454	1.6566	1.6655
95	1.1405	1.3500	1.4407	1.4887	1.5181	1.5381	1.5525	1.5635	1.5721	1.5790
94	1.1342	1.3200	1.3946	1.4329	1.4561	1.4716	1.4829	1.4914	1.4981	1.5035
93	1.1269	1.2900	1.3508	1.3810	1.3991	1.4112	1.4199	1.4265	1.4316	1.4358
92	1.1184	1.2600	1.3088	1.3323	1.3461	1.3554	1.3620	1.3670	1.3709	1.3741
91	1.1089	1.2300	1.2683	1.2860	1.2964	1.3032	1.3081	1.3118	1.3148	1.3172
90	1.0982	1.2000	1.2290	1.2419	1.2492	1.2541	1.2576	1.2602	1.2623	1.2640
89	1.0864	1.1700	1.1909	1.1995	1.2043	1.2075	1.2098	1.2115	1.2129	1.2141
88	1.0736	1.1400	1.1537	1.1587	1.1613	1.1630	1.1643	1.1653	1.1661	1.1668
87	1.0597	1.1100	1.1173	1.1191	1.1199	1.1204	1.1208	1.1212	1.1215	1.1218
86	1.0448	1.0800	1.0817	1.0808	1.0800	1.0794	1.0791	1.0789	1.0788	1.0787
85	1.0288	1.0500	1.0467	1.0435	1.0413	1.0399	1.0389	1.0382	1.0377	1.0374
84	1.0119	1.0200	1.0124	1.0071	1.0037	1.0015	1.0000	0.9990	0.9982	0.9976
83	0.9939	0.9900	0.9785	0.9715	0.9672	0.9643	0.9624	0.9610	0.9599	0.9591
82	0.9749	0.9600	0.9452	0.9367	0.9325	0.9281	0.9258	0.9241	0.9228	0.9219
81	0.9550	0.9300	0.9123	0.9025	0.8966	0.8928	0.8901	0.8882	0.8868	0.8857
80	0.9342	0.9000	0.8799	0.8690	0.8625	0.8583	0.8554	0.8533	0.8517	0.8505
79	0.9124	0.8700	0.8478	0.8360	0.8291	0.8245	0.8214	0.8192	0.8175	0.8161
78	0.8897	0.8400	0.8160	0.8036	0.7962	0.7915	0.7882	0.7858	0.7840	0.7826
77	0.8662	0.8100	0.7846	0.7716	0.7640	0.7590	0.7556	0.7531	0.7513	0.7498
76	0.8417	0.7800	0.7535	0.7401	0.7322	0.7271	0.7236	0.7211	0.7192	0.7177
75	0.8165	0.7500	0.7226	0.7089	0.7009	0.6958	0.6922	0.6896	0.6877	0.6861
74	0.7904	0.7200	0.6921	0.6781	0.6701	0.6649	0.6613	0.6587	0.6567	0.6551
73	0.7636	0.6900	0.6617	0.6477	0.6396	0.6344	0.6308	0.6282	0.6262	0.6247
72	0.7360	0.6600	0.6316	0.6176	0.6095	0.6044	0.6008	0.5982	0.5962	0.5947
71	0.7077	0.6300	0.6016	0.5878	0.5798	0.5747	0.5712	0.5686	0.5667	0.5651
70	0.6787	0.6000	0.5719	0.5583	0.5504	0.5454	0.5419	0.5394	0.5375	0.5360
69	0.6490	0.5700	0.5423	0.5290	0.5213	0.5164	0.5130	0.5105	0.5086	0.5072
68	0.6187	0.5400	0.5129	0.4999	0.4924	0.4877	0.4844	0.4820	0.4002	0.4787
67	0.5878	0.5100	0.4836	0.4710	0.4638	0.4592	0.4560	0.4537	0.4520	0.4506
66	0.5563	0.4800	0.4545	0.4424	0.4354	0.4310	0.4280	0.4257	0.4241	0.4227
65	0.5242	0.4500	0.4255	0.4139	0.4073	0.4031	0.4001	0.3980	0.3964	0.3951
64	0.4916	0.4200	0.3967	0.3856	0.3793	0.3753	0.3725	0.3705	0.3690	0.3678
63	0.4586	0.3900	0.3679	0.3575	0.3515	0.3477	0.3451	0.3432	0.3418	0.3407
62	0.4251	0.3600	0.3392	0.3295	0.3239	0.3203	0.3179	0.3161	0.3148	0.3137
61	0.3911	0.3300	0.3107	0.3016	0.2964	0.2931	0.2908	0.2892	0.2880	0.2870
60	0.3568	0.3000	0.2822	0.2738	0.2691	0.2660	0.2639	0.2624	0.2613	0.2604
59	0.3222	0.2700	0.2537	0.2461	0.2418	0.2391	0.2372	0.2358	0.2348	0.2339
58	0.2872	0.2400	0.2254	0.2186	0.2147	0.2122	0.2105	0.2093	0.2084	0.2076
57	0.2519	0.2100	0.1971	0.1911	0.1877	0.1855	0.1840	0.1829	0.1821	0.1814
56	0.2164	0.1800	0.1688	0.1636	0.1607	0.1592	0.1575	0.1566	0.1559	0.1553
55	0.1806	0.1500	0.1408	0.1363	0.1338	0.1322	0.1312	0.1304	0.1298	0.1293
54	0.1447	0.1200	0.1125	0.1090	0.1070	0.1057	0.1048	0.1042	0.1038	0.1034
53	0.1087	0.0900	0.0843	0.0817	0.0802	0.0792	0.0786	0.0781	0.0778	0.0775
52	0.0725	0.0600	0.0562	0.0544	0.0534	0.0528	0.0524	0.0521	0.0518	0.0516
51	0.0363	0.0300	0.0281	0.0272	0.0267	0.0264	0.0262	0.0260	0.0259	0.0258
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 1. TABLE FOR ESTIMATING PERCENT OF LOT WITHIN LIMITS (PWL)

Percent Within Limits	Negative Values of Q (Q_L and Q_U)									
(P_L and P_U)	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10	n=11	n=12
49	–0.0363	–0.0300	–0.0281	–0.0272	–0.0267	–0.0264	–0.0262	–0.0260	–0.0259	–0.0258
48	–0.0725	–0.0600	–0.0562	–0.0544	–0.0534	–0.0528	–0.0524	–0.0521	–0.0518	–0.0516
47	–0.1087	–0.0900	–0.0843	–0.0817	–0.0802	–0.0792	–0.0786	–0.0781	–0.0778	–0.0775
46	–0.1447	–0.1200	–0.1125	–0.1090	–0.1070	–0.1057	–0.1049	–0.1042	–0.1037	–0.1034
45	–0.1806	–0.1500	–0.1408	–0.1363	–0.1338	–0.1322	–0.1312	–0.1304	–0.1298	–0.1293
44	–0.2164	–0.1800	–0.1688	–0.1636	–0.1607	–0.1592	–0.1575	–0.1566	–0.1559	–0.1553
43	–0.2519	–0.2100	–0.1971	–0.1911	–0.1877	–0.1855	–0.1840	–0.1829	–0.1821	–0.1814
42	–0.2872	–0.2400	–0.2254	–0.2186	–0.2147	–0.2122	–0.2105	–0.2093	–0.2084	–0.2076
41	–0.3222	–0.2700	–0.2537	–0.2461	–0.2418	–0.2391	–0.2372	–0.2358	–0.2348	–0.2339
40	–0.3568	–0.3000	–0.2822	–0.2738	–0.2691	–0.2660	–0.2639	–0.2624	–0.2613	–0.2604
39	–0.3911	–0.3300	–0.3107	–0.3016	–0.2964	–0.2931	–0.2908	–0.2892	–0.2880	–0.2870
38	–0.4251	–0.3600	–0.3392	–0.3295	–0.3239	–0.3203	–0.3179	–0.3161	–0.3148	–0.3137
37	–0.4586	–0.3900	–0.3679	–0.3575	–0.3515	–0.3477	–0.3451	–0.3432	–0.3418	–0.3407
36	–0.4916	–0.4200	–0.3967	–0.3856	–0.3793	–0.3753	–0.3725	–0.3705	–0.3690	–0.3678
35	–0.5242	–0.4500	–0.4255	–0.4139	–0.4073	–0.4031	–0.4001	–0.3980	–0.3964	–0.3951
34	–0.5563	–0.4800	–0.4545	–0.4424	–0.4354	–0.4310	–0.4280	–0.4257	–0.4241	–0.4227
33	–0.5878	–0.5100	–0.4836	–0.4710	–0.4638	–0.4592	–0.4560	–0.4537	–0.4520	–0.4506
32	–0.6187	–0.5400	–0.5129	–0.4999	–0.4924	–0.4877	–0.4844	–0.4820	–0.4802	–0.4787
31	–0.6490	–0.5700	–0.5423	–0.5290	–0.5213	–0.5164	–0.5130	–0.5105	–0.5087	–0.5072
30	–0.6787	–0.6000	–0.5719	–0.5583	–0.5504	–0.5454	–0.5419	–0.5394	–0.5375	–0.5360
29	–0.7077	–0.6300	–0.6016	–0.5878	–0.5798	–0.5747	–0.5712	–0.5686	–0.5667	–0.5651
28	–0.7360	–0.6600	–0.6316	–0.6176	–0.6095	–0.6044	–0.6008	–0.5982	–0.5962	–0.5947
27	–0.7636	–0.6900	–0.6617	–0.6477	–0.6396	–0.6344	–0.6308	–0.6282	–0.6262	–0.6247
26	–0.7904	–0.7200	–0.6921	–0.6781	–0.6701	–0.6649	–0.6613	–0.6587	–0.6567	–0.6551
25	–0.8165	–0.7500	–0.7226	–0.7089	–0.7009	–0.6958	–0.6922	–0.6896	–0.6876	–0.6861
24	–0.8417	–0.7800	–0.7535	–0.7401	–0.7322	–0.7271	–0.7236	–0.7211	–0.7192	–0.7177
23	–0.8662	–0.8100	–0.7846	–0.7716	–0.7640	–0.7590	–0.7556	–0.7531	–0.7513	–0.7498
22	–0.8897	–0.8400	–0.8160	–0.8036	–0.7962	–0.7915	–0.7882	–0.7858	–0.7840	–0.7026
21	–0.9124	–0.8700	–0.8478	–0.8360	–0.8291	–0.8245	–0.8214	–0.8192	–0.8175	–0.8161
20	–0.9342	–0.9000	–0.8799	–0.8690	–0.8625	–0.8583	–0.8554	–0.0533	–0.8517	–0.8505
19	–0.9550	–0.9300	–0.9123	–0.9025	–0.8966	–0.8928	–0.8901	–0.8882	–0.8868	–0.8057
18	–0.9749	–0.9600	–0.9452	–0.9367	–0.9325	–0.9281	–0.9258	–0.9241	–0.9228	–0.9219
17	–0.9939	–0.9900	–0.9785	–0.9715	–0.9672	–0.9643	–0.9624	–0.9610	–0.9599	–0.9591
16	–1.0119	–1.0200	–1.0124	–1.0071	–1.0037	–1.0015	–1.0000	–0.9990	–0.9982	–0.9976
15	–1.0288	–1.0500	–1.0467	–1.0435	–1.0413	–1.0399	–1.0389	–1.0382	–1.0377	–1.0374
14	–1.0448	–1.0800	–1.0817	–1.0808	–1.0800	–1.0794	–1.0791	–1.0789	–1.0788	–1.0787
13	–1.0597	–1.1100	–1.1173	–1.1191	–1.1199	–1.1204	–1.1208	–1.1212	–1.1215	–1.1217
12	–1.0736	–1.1400	–1.1537	–1.1587	–1.1613	–1.1630	–1.1643	–1.1653	–1.1661	–1.1668
11	–1.0864	–1.1700	–1.1909	–1.1995	–1.2043	–1.2075	–1.2098	–1.2115	–1.2129	–1.2141
10	–1.0982	–1.2000	–1.2290	–1.2419	–1.2492	–1.2541	–1.2576	–1.2602	–1.2623	–1.2640
9	–1.1089	–1.2300	–1.2683	–1.2860	–1.2964	–1.3032	–1.3081	–1.3118	–1.3148	–1.3172
8	–1.1184	–1.2600	–1.3088	–1.3323	–1.3461	–1.3554	–1.3620	–1.3670	–1.3709	–1.3741
7	–1.1269	–1.2900	–1.3508	–1.3810	–1.3991	–1.4112	–1.4199	–1.4265	–1.4316	–1.4358
6	–1.1342	–1.3200	–1.3946	–1.4329	–1.4561	–1.4716	–1.4829	–1.4914	–1.4981	–1.5035
5	–1.1405	–1.3500	–1.4407	–1.4887	–1.5181	–1.5381	–1.5525	–1.5635	–1.5721	–1.5790
4	–1.1456	–1.3800	–1.4897	–1.5497	–1.5871	–1.6127	–1.6313	–1.6454	–1.6566	–1.6655
3	–1.1496	–1.4100	–1.5427	–1.6181	–1.6661	–1.6993	–1.7235	–1.7420	–1.7566	–1.7684
2	–1.1524	–1.4400	–1.6016	–1.6982	–1.7612	–1.8053	–1.8379	–1.8630	–1.8828	–1.8989
1	–1.1541	–1.4700	–1.6714	–1.8008	–1.8888	–1.9520	–1.9994	–2.0362	–2.0657	–2.0897

SPECIFICATION P–151. CLEARING AND GRUBBING

DESCRIPTION

151–1.1 This Work consists of clearing, clearing and grubbing, clearing for isolated trees, or topping trees, including disposal of materials, for all locations designated on the Plans.

Clearing consists of cutting and removal of all trees, down timber and uprooted stumps, brush, logs, hedges, and removal of debris and other loose or projecting material from the designated areas. Grubbing stumps and roots will not be required.

Clearing for isolated trees consists of the cutting and removal of isolated single trees or isolated groups of trees. Cut all the trees of this classification according to the requirements for the area being cleared, as shown on the Plans, or as directed by the Engineer. Trees are considered isolated when they are 40 feet (12 m) or more apart, with an exception for a small clump of approximately five trees or less. Clearing for isolated trees includes grubbing stumps and roots.

Clearing and grubbing consists 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 material that 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.

Topping consists of removal of a specified portion of the top of designated trees and disposal of removed material.

CONSTRUCTION METHODS

NOTE TO SPECIFIER:
If there are fences and other structures to be removed, include contract items as listed under Removing Miscellaneous Structures or add Special Provisions.

151–1.2 OFFSITE WORK. 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. Keep workforces informed of conditions or special considerations affecting off site Work, including, but not limited to:

a. Disposition of timber,

b. Wood,

c. Salvaged or waste materials, and

d. Site restoration requirements.

Contractors and subcontractors cannot enter into agreements with land owners to change the conditions of the Contract without written approval of the Engineer.

151–1.3 ENVIRONMENTAL CONSIDERATIONS. 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.

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 any other region where such burning may be prohibited.

Do not burn timber and debris until the Contractor has obtained a burning permit from the appropriate local authorities. 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.

151–2.1 GENERAL. Areas denoted on the Plan to be cleared or cleared and grubbed will be staked by the Engineer. Complete clearing and grubbing in advance of the grading operations, according to the approved schedule.

Dispose of spoil materials, resulting from clearing or clearing and grubbing, by burning, when permitted by local laws, or by removal to approved disposal areas. When burning of material is permitted, burn it under the constant care of competent watchmen so that the surrounding vegetation and other adjacent property will not be jeopardized. Burn according to all applicable laws, ordinances, and regulations. The location and schedule for burning on Airport property, must have the approval of the Airport Manager. Provide notice to agencies having jurisdiction before starting burning operations.

When indicated on the Plans or in the Special Provisions, spoil material or debris from open burning may be buried 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.

Chip, burn, or bury under at least 1 foot (0.3 m) of earth elm wood consisting of trees, logs, stumps, stubs, branches or windfalls with adhering bark and all elm bark and debris encountered within clearing and grubbing limits or resulting from clearing and grubbing operations

Debark elm logs salvaged and 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 1 and September 30, perform the final disposal of elm wood, bark, or debris within 30 days, except that when the material is thoroughly sprayed with No. 1 fuel oil, the time period for its disposal is extended to 50 days. For clearing and grubbing operations performed between October 1 and March 31, perform the final disposal of elm material before the succeeding May 1.

Paint promptly and completely with asphalt base tree paint all cut surfaces and abrasions sustained by healthy oak trees and saplings between April 11 and September 30 as a result of the Contractor's operations. Paint the cut surfaces of the stumps of all healthy oak trees and saplings, whether they are to remain in place or are to be grubbed.

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.

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. The timber may be disposed of by the Contractor off the Airport at locations provided by the Contractor.

Private owners, holding underlying title to lands acquired or reserved for Airport purposes by easement or by use, 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. Negotiate with property owners relative to disposal of trees cut on their land. Remove those trees or portions thereof not claimed by the owners from the property and dispose of them in a manner that will not be unsightly.

NOTE TO SPECIFIER:
When the land owner has kept rights to timber, a description of these rights should be included in the special provisions.

Blasting to remove stumps must be in accordance with all laws and regulations. Do not endanger life or property.

Unless otherwise shown on the Plans, local agencies will remove existing structures and utilities required to permit orderly progress of Work. Whenever a telephone or telegraph pole, pipeline, conduit, sewer, roadway, or other utility is encountered and must be removed or relocated advise the Engineer who will notify the proper local authority or owner and attempt to secure prompt action.

151–2.2 CLEARING. Clear the staked or designated areas of all objectionable materials. Cut up, remove, and dispose of trees unavoidably falling outside the specified limits. Minimize damage to trees to remain, by felling toward the center of area being cleared. Preserve and protect from injury all trees not to be removed. Cut trees, stumps, and brush to a height less than 12 inches (300 mm) above the ground. Grubbing of stumps and roots will not be required under the Pay Item for Clearing.

When isolated trees are designated for clearing, the trees will be classed in accordance with the butt diameter size as measured at a point 18 inches (450 mm) above the ground level.

Grubbing stumps and roots is required under the Pay Item for Clearing for Isolated Trees.

151–2.3 CLEARING AND GRUBBING. In areas designated to be cleared and grubbed, remove all stumps, roots, buried logs, brush, grass, and other unsatisfactory materials, except where embankments exceeding 6 feet (1.8 m) in depth are to be constructed outside of paved areas.

Grub tap roots and other projections over 1–1/2 inches (38 mm) in diameter out to a depth of at least 18 inches (450 mm) below the finished subgrade or slope elevation. In embankment areas greater than 6 feet (1.8 m) in depth, outside of paved areas, remove unsatisfactory materials; however, sound trees, stumps, and brush can be cut off within 6 inches (150 mm) above the ground and allowed to remain.

Break down sides of all holes remaining after the grubbing operation in embankment areas to flatten out the slopes, and fill them with acceptable material, moistened and properly compacted in layers to the density required in Specification P–152, Excavation and Embankment. Apply the same construction procedure to all holes remaining after grubbing in excavation areas where the depth of holes exceeds the depth of the proposed excavation.

151–2.4 TOPPING. Complete topping for trees designated on the Plans. Remove tree trunks 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.

METHOD OF MEASUREMENT

151–3.1 Quantities of clearing or clearing and grubbing as shown on the Plans are 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 will be measured as a complete unit for each area designated.

Isolated trees designated for clearing will be categorized by butt diameter, according to the schedule of sizes as follows:

Less than 2 feet, butt diameter
From 2 to 4 feet, butt diameter
Greater than 4 feet, butt diameter

Topping will be measured on a unit basis for each tree designated on the Plans to be topped.

BASIS OF PAYMENT

151–4.1 CLEARING. Payment will be made at Contract price per lump sum for a designated area, or at the Contract unit price per acre for clearing. This price will be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the Work.

151–4.2 CLEARING ISOLATED TREES AND TOPPING TREES. Payment will be made at the Contract unit price per each for clearing isolated trees or for topping trees. This price will be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the Work.

151–4.3 CLEARING AND GRUBBING. Payment will 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 is full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P15101	Clearing, per acre
Pay Item P15102 through P15119	Clearing for Area No. ____, per lump sum
Pay Item P15120	Clearing and Grubbing, per acre
Pay Item P15121 through P15139	Clearing and Grubbing for Area No. ____, per lump sum
Pay Item P15140	Clearing for Isolated trees, less than 2 feet diameter, per each
Pay Item P15141	Clearing for Isolated trees, from 2 to 4 feet diameter, per each
Pay Item P15142	Clearing for Isolated trees, greater than 4 feet diameter, per each
Pay Item P15150	Topping Trees, per each

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.

NOTES TO SPECIFIER:

1. P15101 – Clearing. Use this item in areas where grubbing is not possible (e.g., marshes), necessary (e.g., in embankment areas where fill height exceeds 6 feet), or cost effective (e.g., large areas outside of safety areas, OFZ, etc., when budget is a consideration).

2. P15102–P15119 – Clearing for Area No. _____. Use when a lump sum is desirable. Show areas on plan.

3. P15121–P15139 – Clearing and Grubbing for Area No. _____. Use when a lump sum bid is desirable. Show area on plan. Can be used for fence lines containing groups of trees, stones and debris (fence removal is a separate item).

4. P15150 & P15151 – Topping. When the Pay Item Topping Trees is used, it is anticipated that the location, type of tree, height of topping required, and elevation above which topping is required will be shown on the Plans. If bidding topping per each is not appropriate, a Special Provision should be written to address any special situations. For topping over 20 feet or special cases, use P15155–P15179. Put a topping schedule with individual topping heights and locations on plan.

5. P15155–P15179 – Topping tree No. _____. Show location, tree number and height to top on plans.

SPECIFICATION P–152. EXCAVATION AND EMBANKMENT

DESCRIPTION

152–1.1 This Work covers excavation, disposal, placement, and compaction of all materials within the limits shown on the Plans required to construct runway safety areas, runways, taxiways, aprons, drainage facilities, building sites, access roads, parking facilities, or other purposes in accordance with these Specifications and in conformity to the dimensions and typical sections shown on the Plans.

NOTE TO SPECIFIER:
Special Provisions will usually be required to change the percent of maximum density and depth of compaction in 152–2.2(f) and 152–2.6 and the ASTM method for determining maximum density in 152–2.11.

The Specifier should note that the Standard Specifications are written to pay for salvaged topsoil in the same manner as WisDOT Highways. The Specifier should check to determine if a portions

of the quantity of EBS will need to be added to the excavations quantity, or if EBSit will be entirely removed to provide under the Salvaged Topsoil Pay Item.

152–1.2 CLASSIFICATION. All material excavated will be classified as defined below:

a. Unclassified Excavation. Unclassified Excavation consists of the excavation and placement of all material, regardless of its nature.

b. Rock Excavation. Rock Excavation includes all solid rock in ledges, in bedded deposits, in unstratified masses, and conglomerate deposits that are so firmly cemented they cannot be removed without blasting or using rippers. Boulders containing a volume of more than 1 cubic yard (0.8 cubic meter) will be classified as Rock Excavation.

c. Common Excavation. Common Excavation consists of the excavation and placement of all material, regardless of is nature, except Rock Excavation as defined herein.

d. Marsh Excavation. Marsh Excavation, when required, will be measured and paid as Unclassified Excavation or as Common Excavation, unless a Pay Item for Marsh Excavation is included in the Schedule of Prices, in which case it will be measured separately and paid as Marsh Excavation. Marsh Excavation consists of excavation below the original ground level of marshes and swamps underlying proposed embankments, located within the limits indicated on the Plans. Material of whatever nature encountered below the original ground elevations within areas designated on the Plans will be classified as Marsh Excavation.

e. Borrow Excavation. Borrow Excavation, when required, will be measured and paid as Unclassified Excavation or 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 consists of approved material required for the construction of embankment or for other portions of the Work in excess of the quantity of usable material available from required excavations. Obtain borrow material from areas within the limits of the Airport property but outside the normal limits of necessary grading, or from areas outside the Airport.

NOTE TO SPECIFIER:
All material excavated shall be considered "unclassified" unless the Engineer includes other classifications in the Schedule of Prices. If rock excavation is a Pay Item, include Common Excavation instead of Unclassified Excavation.

152–1.3 UNSUITABLE EXCAVATED MATERIAL. Consider material containing vegetable or organic matter, such as muck, peat, organic silt, or sod as unsuitable for use in embankment construction that will support pavement. Material, when approved by the Engineer as suitable to support vegetation, may be used on the embankment slope.

152-1.4 SUBGRADE SUPPORTING PAVEMENT. Subgrade supporting pavement means the portion of the subgrade (located in excavation or embankment) located beneath the pavement that carries the loads imposed on the pavement, including the adjacent soil located within the limits of a 45 degree (measured from horizontal) angle of repose projected outward from the outside edges of the pavement. Pavement in this context includes the subbase, base, and surface course.

CONSTRUCTION METHODS

152–2.1 GENERAL. Before beginning excavation, grading, and embankment operations, clear and grub the area in accordance with Specification P–151, Clearing and Grubbing. Remove and dispose of vegetation greater than 1 foot (0.3 m) in height prior to breaking ground for excavation or placing embankments.

Suitability of material to be placed in embankments is subject to approval by the Engineer. Dispose of unsuitable excavated material at locations shown on the Plans. Grade disposal areas for excess excavated material to allow positive drainage of the area and of adjacent areas. Do not extend the surface elevation of disposal areas above the surface elevation of adjacent usable areas of the Airport, unless specified on the Plans.

NOTE TO SPECIFIER:
Disposal areas for excess excavation material should be shown on the Construction Layout Sheet or other appropriate locations on the Plans. Topsoiling, seeding, fertilizing, and mulching Pay Items should be measured for disposal areas.

When the excavating operations encounter artifacts of historical or archaeological significance, temporarily discontinue operations. At the direction of the Engineer, excavate the site in a manner as to preserve the artifacts encountered and allow for their removal. This excavation will be paid for as Extra Work.

Scarify and disc those areas outside of the pavement areas in which the top layer of soil material has become compacted, due to hauling or other construction activities, to a depth of 4 inches (100 mm), in order to loosen and pulverize the soil.

If it is necessary to interrupt existing surface drainage, sewers or under–drainage, conduits, utilities, or similar underground structures take necessary precautions to preserve them or provide temporary services. When such facilities are encountered, notify the Engineer, who will arrange for their removal if necessary. Repair or pay the cost of all damage to these facilities or structures that may result from Contractor operations during the period of the Contract.

152–2.2 EXCAVATION. Do not start excavation until the Work has been staked. Use suitable excavated material to construct embankments, subgrade, or for other purposes shown on the Plans. Dispose of unsuitable material at locations shown on the Plans.

When the volume of the excavation exceeds that required to construct the embankments to the grades indicated, use the excess to grade the areas of ultimate development or dispose of as directed. When the volume of excavation is not sufficient for constructing the fill to the grades indicated, obtain the deficiency from borrow areas.

Maintain the grade so the surface is well drained at all times. When necessary, provide temporary drains and drainage ditches to intercept or divert surface water affecting the Work.

a. Selective Grading. When selective grading is indicated on the Plans or directed by the Engineer, use the more suitable material as designated by the Engineer 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, stockpile it in approved areas until it can be placed. Rehandling is considered part of the Work and include the cost in the Contract price.

b. Undercutting. Excavate rock, shale, hardpan, loose rock, boulders, or other material unsatisfactory for runway safety areas, subgrades, roads, shoulders, or areas intended for turfing to a minimum depth of 12 inches (300 mm), or to the depth specified on the Plans, below the finished grade. Dispose of materials at locations shown on the Plans. This excavated material will be paid for at the Contract unit price per cubic yard for Unclassified Excavation or Rock Excavation or Common Excavation. Refill the excavated area with suitable material, obtained from the grading operations or borrow areas and compact in accordance with this Specification. Refilling constitutes a part of the embankment. Where rock cuts are made and refilled with selected material, drain pockets created in the rock surface in accordance with details shown on the Plans.

c. Excavation Below Subgrade (EBS). 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 will support pavement, as specified elsewhere, 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.

NOTE TO SPECIFIER:
The designer should estimate the quantity of EBS and add this quantity to the excavation quantities in the Schedule of Prices.

The Engineer shall specify the appropriate class of excavation in the Schedule of Prices.

The plans shall show details for draining pockets created in rock cuts.

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d. Overbreak Overbreak (including slides) is that portion of material displaced or loosened beyond the finished Work as planned or authorized by the Engineer. The Engineer will determine if the displacement of such material was unavoidable and Engineer's decision is final. Grade or remove and dispose of overbreak as directed; however, payment will not be made for the removal and disposal of overbreak that the Engineer determines as avoidable. Unavoidable overbreak will be classified as Unclassified Excavation or Common Excavation.

e. Removal of Utilities. Removal of existing structures and utilities required to permit the orderly progress of Work will be accomplished by someone other than the Contractor. Excavate the remaining foundations for at least 2 feet (0.6 m) below the top of subgrade or as indicated on the Plans, dispose of the material, and backfill foundations thus excavated with suitable material compacted as specified herein.

f. Requirements. Compact the subgrade supporting pavement to the target densities (expressed as a percentage of maximum density) and lower specifications' limits (L) specified in the Special Provisions.

NOTE TO SPECIFIER:
Change in lot and sublot sizes can be made by Special Provision after coordination with WBOA and FAA. However, in general, the lot size should not exceed 5,000 square yards.

Subgrade supporting pavement within the limits of cut areas will be accepted for density on a lot basis. A lot consists of a 5,000 square yard (4,180 square meter) area. The width and length of lots will be determined by the Engineer. Each lot will be divided into 8 equal sublots. Testing and acceptance will be in accordance with 152–2.11, Acceptance and Testing for Density.

No separate payment or measurement for payment will be made for materials removed, manipulated, and replaced in order to obtain the required density within the top 9 inches (225 mm) of the subgrade. Removal, manipulation, aeration, replacement, recompaction of materials within the top 9 inches (225 mm) of subgrade to obtain required density is considered incidental to excavation and embankment operations and the costs included in the Contract prices for excavation. Subgrade compaction in areas where subgrade materials are required to be removed, manipulated, aerated, replaced, and recompacted to a depth greater than 9 inches (225 mm) below subgrade will be measured and paid separately.

Remove stones or rock fragments larger than 4 inches (100 mm) in their greatest dimension from the top 6 inches (150 mm) of the subgrade beneath pavement. The finished grading operations, conforming to the typical cross section, shall be completed and maintained ahead of the paving operations a distance to minimize erosion while maintaining the project schedule.

Remove loose or protruding rocks on the back slopes of cut areas to finished grade. Dress cut–and–fill slopes uniformly to the slope, cross section, and alignment shown on the Plans or as directed by the Engineer.

Blasting will be permitted only when proper precautions are taken for the safety of all persons, the Work, and property. Repair and pay for damage done to the Work or property. Operations of the Contractor in connection with the transportation, storage, and use of explosives shall conform to all state and local regulations and explosive manufacturers' instructions.

Where blasting is proposed, employ a vibration consultant, approved by the Department, to advise on explosive charge weights per delay and to analyze records from seismograph recordings. The seismograph must be capable of producing a permanent record of the three components of the motion in terms of particle velocity, and be capable of internal dynamic calibration.

In each distinct blasting area, where pertinent factors affecting blast vibrations and their effects in the area remain the same, prepare a blasting plan of the initial blasts. 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 any depth of overburden Do not increase the maximum explosive charge weights per delay included in the Plan without the approval of the Department.

Keep a record of each blast fired; blast dates, blast times, blast locations, the amount of explosives used, maximum explosive charge weight per delay period, and, where necessary, seismograph records identified by instrument number and location.

Make available these records to the Engineer on a monthly basis or in tabulated form at other times as required.

152–2.3 BORROW EXCAVATION. Borrow area(s) within the Airport property are indicated on the Plans. Borrow excavation can be made only at these designated locations and within the horizontal and vertical limits as staked or as directed.

NOTE TO SPECIFIER:
Show borrow areas on the Plans. Quantities of salvaged topsoil, seeding, fertilizer, and mulch required to restore borrow areas shall be measured and paid separately.

When borrow sources are outside the boundaries of Airport property, locate and obtain the supply, subject to the approval of the Engineer. Notify the Engineer, at least 15 days prior to beginning the excavation, so necessary measurements and tests can be made. Dispose of all unsuitable material. Open the borrow pits to expose the vertical face of various strata of acceptable material to enable obtaining a uniform product. Excavate borrow pits to regular lines to permit accurate measurements, and drain and leave the site in a neat, presentable condition with all slopes dressed uniformly.

152–2.4 DRAINAGE EXCAVATION Drainage excavation consists of excavating for drainage ditches, intercepting ditches and other drainage ways, temporary levee, berm or siltation pond construction; and all other types of drainage facilities designed or shown on the Plans. Perform the Work in the proper sequence. Place satisfactory material in fills and unsuitable material in disposal areas. Construct intercepting ditches prior to starting adjacent excavation operations. Perform Work to secure a finish true to line, elevation, and cross section.

Maintain ditches constructed on the project to the required cross section and keep them free of debris or obstructions until the project is accepted.

152–2.5 PREPARATION OF EMBANKMENT AREA. Where an embankment is to be constructed to a height of 4 feet (1.2 m) or less, remove sod, topsoil, and vegetable matter from the area underlying the proposed embankment and within the limits of imaginary lines extending outward at one-to-one slopes from the outside edges of the lowest pavement course to the intersection with the existing ground, and break up the cleared surface by plowing or scarifying to a minimum depth of 6 inches (150 mm). Compact this area as indicated in Subsection 152–2.6.

When the height of fill is greater than 4 feet (1.2 m), remove sod, topsoil, and vegetable matter from the area underlying the proposed embankment and within the limits of imaginary lines extending outward at one-to-one slopes from the outside edges of the lowest pavement course to the intersection with the existing ground. Thoroughly disc and recompact the area to the density of the surrounding ground before constructing the embankment.

Salvage all suitable topsoil from areas beneath embankments as designated above and stockpile for use as salvaged topsoil. If salvaged topsoil is in excess of the quantities required for topsoiling, dispose of the excess in disposal areas specified or indicated on the Plans. Determine the quantities necessary to stockpile and to dispose of to avoid rehandling the material.

Where embankments are to be placed on natural slopes steeper than 3 to 1, construct horizontal benches as shown on the Plans.

NOTE TO SPECIFIER:
The Engineer shall include benching details on the plans based on the type of material, degree of consolidation of the material, and the degree of homogeneity of the material. The minimum width of the bench shall be sufficient to accommodate construction equipment.

No measurement will be taken nor direct payment made for the Work performed under this Section. Clearing and grubbing and the quantity of excavation removed will be paid for under the respective Pay Items.

152–2.6 FORMATION OF EMBANKMENTS. Form embankments in successive horizontal layers of not more than 8 inches (200 mm) loose depth for the full width of the cross section, unless otherwise approved by the Engineer.

Conduct grading operations, and place the various soil strata to produce a soil structure as shown on the typical cross section or as directed. Do not incorporate materials such as brush, hedge, roots, stumps, grass and other organic matter in the embankment.

Suspend operations on earthwork when satisfactory results cannot be obtained due to rain, freezing, or other unsatisfactory conditions of the field. Drag, blade, or slope the embankment to provide proper surface drainage.

The material in the layer must be within ±2 percent of optimum moisture content before rolling to obtain the prescribed compaction, unless it can be demonstrated in the field that required densities can be obtained at lower moisture contents. In order to achieve a uniform moisture content throughout the layer, wetting or drying of the material and manipulation shall be required when necessary. Should the material be too wet to permit proper compaction or rolling, all work on the affected portions of the embankment shall be delayed until the material has dried to the required moisture content. Sprinkling of dry material to obtain the proper moisture content shall be done with approved equipment that will sufficiently distribute the water. Provide equipment to furnish the required water at all times. Samples of all embankment materials for testing will be taken for acceptance and testing. Based on these tests, the Contractor shall make the necessary corrections and adjustments in methods, materials or moisture content in order to achieve the correct embankment density.

NOTE TO SPECIFIER:
Prepare a Special Provision that specifies the required target densities and lower specification limits for embankments. The target densities should conform to FAA criteria, and Table 1 and related notes found in a previous Note to Specifier under Subsection 152-2.2(f.).Lower specification limits (L) shall be 4.5% less than the target densities listed in Table 1.

Continue rolling operations until the embankment (subgrade) supporting pavement is compacted to the target densities (expressed as a percent of maximum density) and the lower specification limits (L) specified in the Special Provisions.

NOTE TO SPECIFIER:
The lot size for acceptance and testing of embankment under pavement will be 4000 cubic yards. The Engineer may specify other values as appropriate to the job size. If it is necessary (because of the presence of expansive soils or other unusually sensitive soils) to apply special controls to the moisture content of the soil during or after compaction to ensure strength, the Engineer shall

specify the appropriate moisture content. The moisture limitations shall be specified using acceptable moisture ranges as determined by ASTM D 698 or ASTM D 1557:

Embankment is accepted for density on a lot basis. A lot consists of 4,000 cubic yards of embankment. Each lot will be divided into 8 equal sublots. The Engineer will determine the dimensions and locations of the lots and sublots. Testing and acceptance will be in accordance with Subsection 152–2.11, Acceptance and Testing for Density.

On areas not supporting pavement, continue rolling operations until the embankment is compacted to a target density not less than 95 percent of maximum density and a lower specification limit (L) not less than 90.5 percent of maximum density, or to the requirements previously specified for embankment beneath pavement, whichever is less. Accept for density on a lot basis embankment not supporting pavement. A lot consists of 8,000 cubic yards of embankment. Each lot will be divided into 8 equal sublots. The Engineer will determine the location and dimension of lots and sublots. Testing and acceptance will be in accordance with Subsection 152–2.11, Acceptance and Testing for Density. On all areas outside of the pavement areas, no compaction is required on the top 4 inches (100 mm).

NOTE TO SPECIFIER:
For embankments that do not support pavement, the percent of maximum density can be changed by special provision to 90 percent and the lower specification limit (L) changed to not less than 85.5 percent for embankments constructed with cohesive soils. Normally only one percentage is specified for a particular site project.

Keep compaction areas separate, and do not cover a layer with another until the proper density is obtained.

During construction of the embankment, route equipment at all times, both when loaded and when empty, over the layers as they are placed and distribute the travel evenly over the entire width of the embankment. Operate equipment in a manner that will break up hardpan, cemented gravel, clay, or other chunky soil material into small particles and incorporate them with other material in the layer.

Begin embankment layer placement in the deepest portion of the fill; as placement progresses, construct layers approximately parallel to the finished pavement grade line.

When rock and other embankment material are excavated at approximately the same time, incorporate the rock into the outer portion of the embankment and incorporate the acceptable material under areas, which will support pavement. Do not place stones or fragmentary rock larger than 4 inches (100 mm) in their greatest dimensions in the top 6 inches (150 mm) of the subgrade. Place rockfill in layers as specified or as directed and exert every effort to fill the voids with the finer material to form a dense, compact mass. Do not dispose of rock or boulders outside excavation or embankment areas, except at places and in the manner designated by the Engineer.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in layers of the prescribed thickness without crushing, pulverizing or further breaking down the pieces, place such material in the embankment as directed in layers not exceeding 2 feet (600 mm) in thickness. Level and smooth each layer with suitable leveling equipment and by distribution of spalls and finer fragments of rock. Do not construct these rock fragment type lifts closer than 4 feet (1.2 m) from the finished subgrade. Density requirements do not apply to portions of embankments constructed of materials which cannot be tested in accordance with specified methods.

Do not place frozen material in the embankment nor place material upon frozen embankment.

There will be no separate measurement of payment for compacted embankment, and all costs incidental to placing in layers, compacting, discing, watering, mixing, sloping, and other necessary operations for construction of embankments will be included in the Contract price for excavation, borrow, or other items.

152–2.7 FINISHING AND PROTECTION OF SUBGRADE. After the subgrade has been substantially completed, prepare the full width of the subgrade by removing any soft or other unstable material which will not compact properly. Bring resulting low areas and other holes or depressions to grade with suitable select material. Provide a thoroughly compacted subgrade shaped to the lines and grades shown on the Plans by scarifying, blading, and rolling.

Grade the subgrade so that it will drain readily. Take precautions necessary to protect the subgrade from damage. Limit hauling over the finished subgrade to essential construction operations only.

Smooth and recompact all ruts or rough places that develop in a completed subgrade.

Do not place subbase or surface course on the subgrade until the subgrade has been approved by the Engineer.

152–2.8 HAUL. All hauling will be considered a necessary and incidental part of the Work. Consider its cost and include it 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. In areas prepared for a subbase or base course, smooth the subgrade top to the extent that, when tested with a 16–foot (4.9 m) straightedge applied parallel and at right angles to the centerline, it does not show any deviation in excess of 1/2–inch (13 mm), or is not more than 0.05–foot (.015 m) from true grade as established by grade hubs or pins. Correct deviations in excess of these amounts by loosening, adding or removing materials, reshaping, and recompacting.

Do not vary surface smoothness on runway safety areas and intermediate and other designated areas more than 0.10 foot (0.03 m) from true grade as established by grade hubs. Correct deviations in excess of this amount by loosening, adding or removing materials, and reshaping.

152–2.10 SALVAGED TOPSOIL. Salvage topsoil from stripping or other grading operations when it is specified or required as shown on the Plans or under Specification T–905. Salvaged Topsoil shall meet the requirements of Specification T–905. If, at the time of excavation or stripping, Salvaged topsoil cannot be placed in its proper and final section of finished construction, stockpile the material at approved locations. Do not place stockpiles where they will be a hazard to airport operations and do not place it on areas which will require excavation or embankment. If, in the judgment of the Engineer, it is practical to place the Salvaged Topsoil at the time of excavation or stripping, place the material in its final position without stockpiling or further handling.

NOTE TO SPECIFIER:
The Engineer shall indicate appropriate runway and taxiway clearances in accordance with AC 150/5370–2, Operational Safety on Airports During Construction, Appendix 1 on the construction operations sheet.

Upon completion of grading operations, place stockpiled Salvaged Topsoil as directed, or as required in Specification T–905.

No direct payment will be made for Salvaged Topsoil under Specification P–152, Excavation and Embankment. The quantity removed and placed directly or stockpiled will be paid for at the Contract unit price per cubic yard for Unclassified Excavation or Common Excavation.

When stockpiling of topsoil and later rehandling of such material is directed by the Engineer, the rehandled material will be paid for at the Contract unit price for Salvaged Topsoil, as provided in Specification T–905, Topsoil and Salvaged Topsoil.

152–2.11 ACCEPTANCE AND TESTING FOR DENSITY. Excavation and embankment areas are accepted for density on a lot basis. Lot size, sublot size, and number of sublots are as required in specifications for excavation and embankment areas.

One in-place field density test will be made for each sublot. Test locations will be determined by the Engineer on a random basis in accordance with statistical procedures contained in ASTM D 3665. The percent compaction of each sampling location will be determined by dividing the in place field density of each sublot by the average laboratory maximum density of the lot. The in–place field density will be determined by the Engineer in accordance with ASTM D 2922 Method B Direct Transmission. 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. The nuclear gage will be calibrated in accordance with ASTM D 2922, Annex A1 and operated by a technician in accordance with the requirements of the manufacturer. The operator of the nuclear gage must show evidence of training and experience in the use of this instrument. The gage will be standardized daily in accordance with ASTM D 2922, paragraph 8. Use of ASTM D 2922 results in a wet unit weight and when using this method, ASTM D 3017 shall be used to determine the moisture content of the material. The moisture gage will be standardized daily in accordance with ASTM D 3017, paragraph 7.

Acceptance of each lot of in–place material for density will be based on the percentage of material within specification limits (PWL), calculated in accordance with the computational procedure, described in Section 110, Method of Estimating Percentage of Material within Specification Limits (PWL).

If the PWL of the lot equals or exceeds 90 percent, the lot is considered acceptable. If the PWL is less than 90, rework and recompact the lot.

After recompaction, the lot will be resampled and retested in accordance with the procedures above. A new PWL will be computed based on the retest results and the lot reevaluated for acceptance. This procedure will be repeated until the PWL is 90 or greater.

NOTE TO SPECIFIER:
If the Standard Proctor (ASTM D 698) is required to determine the maximum density, it should be changed by Special Provision.

Engineer shall specify ASTM D 698 for areas designated for aircraft with gross weights of 60,000 pounds (27,200 kg) or less and ASTM D 1557 for areas designated for aircraft with gross weights greater than 60,000 pounds (27,200 kg).

152-2.12 VERIFICATION TESTING. The Engineer will verify maximum laboratory density of material placed in the field for each lot. A minimum of one test will be made for each lot of material at the site. The verification process consists of:

a. Compacting the material and determining the dry density and moisture-density in accordance with ASTM D 1557 for aircraft over 60,000 pounds or ASTM D 698 for aircraft of 60,000 pound or less (whichever test is required for initial laboratory density testing), and

b. Comparing the results with the laboratory moisture-density curves, to select the maximum density and moisture content for the material being placed.

This verification process is commonly referred to as a "one point Proctor." If the material does not conform to existing moisture-density curves, the Engineer will establish the laboratory maximum density and moisture content for the material in accordance with ASTM D 1557 for aircraft over 60,000 pounds or ASTM D 698 for aircraft of 60,000 pounds or less (whichever test is required for initial laboratory density testing). Additional verification tests will be made, if necessary, to properly classify all materials placed in the lot.

NOTE TO SPECIFIER:
It is the intent that only one of the Pay Items from P15210 to P15215 be bid for areas requiring compaction below subgrade.

METHOD OF MEASUREMENT

152–3.1 The quantity of all classes of excavation to be paid for will be the number of cubic yards measured in its original position, computed by the method of average end areas, except as provided herein.

Where the quantity of Unclassified or Common Excavation to be excavated will be 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 will be determined to the nearest 1/10 cubic yard.

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.

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 and the cost included as part of the Pay Items for Topsoil or Salvaged Topsoil.

Marsh 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 will be based on the latter 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 marsh surface and the bottom of the placed fill determined by soundings taken during excavation of the marsh or by borings taken through the completed fill. Marsh material from outside the lateral limits defined above that is excavated or displaced by the fill will not be measured for payment.

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, these volumes may be computed by acceptable methods involving three–dimensional measurements as approved by the Engineer.

Excavation below subgrade (EBS) will be measured as Unclassified Excavation or Common Excavation, provided the Contractor requests these 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.

Measurement will 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 No separate measurement will be made for overhaul. The limits for free haul covers the entire Work unless otherwise shown on the Plans or specified in the Special Provisions.

152–3.3 For payment specified by the cubic yard, measurement for all excavation will 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 will be verified by means of field cross sections taken randomly at intervals not exceeding 500 linear feet subject to the following conditions.

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 determines verification is needed.

152-3.4 Measurement and payment will be made for Compaction Below Subgrade in Cut in areas where removal, manipulation, aeration, replacement, and recompaction of materials are necessary at depths greater than 9 inches below subgrade. Compaction Below Subgrade in Cut will be measured on a square yard or cubic yard basis. Measurement for payment will not exceed the quantity shown on the Plans unless ordered in writing by the Engineer. Compaction Below Subgrade in Cut will not be measured for payment in areas where excavation below subgrade, to remove unsuitable material, is measured and paid for under other Pay Items.

BASIS OF PAYMENT

152–4.1 Unclassified Excavation payment will be made at the Contract unit price per cubic yard. This price is full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the Work specified.

152–4.2 Rock Excavation payment will be made at the Contract unit price per cubic yard. This price is full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the Work specified.

152–4.3 Common Excavation payment will be made at the Contract unit price per cubic yard. This price is full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the Work specified.

152–4.4 Marsh Excavation payment will be made at the Contract unit price per cubic yard. This price is full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the Work specified.

152–4.5 Borrow Excavation payment will be made at the Contract unit price per cubic yard. This price is full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the Work specified.

152-4.6 Payment for Compaction Below Subgrade in Cut will be made at the Contract price per square yard or per cubic yard. This price will be full compensation for furnishing all materials, labor, tools, equipment, and incidentals necessary to remove, manipulate, aerate, replace, and recompact material to the depths required.

152-4.7 Excavation below subgrade (EBS) which is required after the rough grading operations are complete in the EBS area, and which requires that the Contractor return to perform the EBS, will be paid for at a unit price determined by multiplying the Contract unit price for Common Excavation or Unclassified Excavation by three, unless the total quantity for the project exceeds 100 cubic yards. When the total quantity for EBS required, after rough grading is complete, exceeds 100 cubic yards for the entire project, either party to the Contract may request that the unit price be revised. 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. The quantity of EBS will be measured as determined by Engineer.

152-4.8 Erosion control, fertilizing and seeding of material disposal sites will be paid for as provided in Subsection 156-4.3, Borrow Sites and Material Disposal Sites.

152-4.9 Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P15201	Unclassified Excavation, per cubic yard
Pay Item P15202	Rock Excavation, per cubic yard
Pay Item P15203	Common Excavation, per cubic yard
Pay Item P15204	Marsh Excavation, per cubic yard
Pay Item P15205	Borrow Excavation, per cubic yard
Pay Item P15210	Compaction Below Subgrade in Cut, to ___ inches, per square yard
Pay Item P15215	Compaction Below Subgrade in Cut, to ___ inches, per cubic yard

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 is included in the Pay Items contained in Schedule of Prices.

TESTING REQUIREMENTS

ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
ASTM D 1557	Test Method for Laboratory Compaction Characteristics Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN-m/m^3))
ASTM D 2922	Density of Soil and Soil–Aggregate In–Place by Nuclear Methods
ASTM D 3017	Moisture Content of Soil and Soil–Aggregate In–Place by Nuclear Methods
ASTM D 3665	Standard Practice for Random Sampling of Construction Materials

SPECIFICATION P–154. SUBBASE COURSE

DESCRIPTION

154–1.1 This Work consists 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.

MATERIALS

154–2.1 MATERIALS. Provide subbase material consisting of hard durable particles or fragments of granular aggregates. Mix or blend this material with fine sand, clay, stone dust, or other similar binding or filler materials produced from approved sources. Produce a uniform mixture in accordance with the requirements of these Specifications capable of being compacted into a dense and stable subbase. Provide material free from vegetable matter, lumps or excessive amounts of clay, and other objectionable or foreign substances. Pit–run material may be used, provided the material meets the requirements specified.

TABLE 1. GRADATION REQUIREMENTS

Sieve designation (square openings) as per ASTM C 136	*Percentage by weight passing sieves*
3 inch (75.0 mm)	100
No. 10 (2.0 mm)	20–100
No. 40 (0.450 mm)	5–60
No. 200 (0.075 mm)	0–15

Material passing the No. 40 (0.450 mm) sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than 6 when tested in accordance with ASTM D 4318.

Where frost penetration is a problem, the maximum amount of material finer than 0.02 mm in diameter shall be less than 3 percent.

154-2.2 SAMPLING AND TESTING. Furnish subbase material for preliminary testing 14 days prior to the start of construction. Initial tests on material submittals necessary to determine compliance with the specification requirements will be made by the Engineer at no expense to the Contractor.

Furnish samples of subbase material for initial tests and at intervals during construction. The Engineer will designate sampling points and intervals. The samples will be the basis of approval of specific lots of aggregates from the standpoint of the quality requirements of this Section.

In lieu of testing, the Engineer may accept certified State of Wisconsin Department of Transportation test results indicating that the subbase material meets Specification requirements.

The Engineer will take samples of subbase material to check gradation at least once daily. Sampling is in accordance with ASTM D 75, and testing will be in accordance with ASTM C 136 and C 117.

CONSTRUCTION METHODS

154–3.1 GENERAL. Place subbase course where designated on the Plans or as directed by the Engineer. Shape and thoroughly compact the material within the tolerances specified.

Mechanically stabilize granular subbases, which (due to grain sizes or shapes) are not sufficiently stable to support the construction equipment without movement. Mechanical stabilization includes addition of a fine–grained medium to bind the particles of the subbase material

sufficiently to furnish a bearing strength and to prevent deformation of the course under the traffic of the construction equipment. Addition of the binding medium to the subbase material shall not increase the soil constants of that material above the limits specified.

154–3.2 OPERATION IN PITS. Perform Work required to clear and strip pits, and handle unsuitable material encountered. Obtain subbase material from approved sources. Excavate, handle, stockpile and process material in the pits in a manner that will produce a uniform and satisfactory product.

154–3.3 PREPARING UNDERLYING COURSE. Prepare the underlying course before subbase material is placed. Do not begin placing and spreading operations until the course is checked and accepted by the Engineer.

Begin spreading the subbase along the centerline of the pavement on a crowned section or on the high side of pavements with a one–way slope to protect the subgrade and to ensure proper drainage.

154–3.4 MATERIALS ACCEPTANCE IN EXISTING CONDITION. When the entire subbase material is secured in a uniform and satisfactory condition and contains approximately the required moisture, the approved material may be moved directly to the spreading equipment for placing. The material may be obtained from gravel pits, stockpiles, or may be produced from a crushing and screening plant with the proper blending. The materials from these sources must meet the requirements for gradation, quality, and consistency. It is the intent of this Section to secure materials that will not require further mixing. Moisture content of the material shall be approximately that required to obtain maximum density. Minor deficiency or excess of moisture may be corrected by surface sprinkling or by aeration. In such instances, some mixing or manipulation may be required, immediately preceding the rolling, to obtain the required moisture content. The final operation is blading or dragging, if necessary, to obtain a smooth uniform surface true to line and grade.

154–3.5 PLANT MIXING. When materials from several sources are to be blended and mixed, process subbase material in a central or travel mixing plant. Thoroughly mix subbase material, together with any blended material with the required amount of water. After the mixing is complete, transport the material and spread on the underlying course without undue loss of the moisture content.

154–3.6 MIXED IN PLACE. When materials from different sources are to be proportioned and mixed or blended in place, the relative proportions of the components of the mixture shall be as designated by the Engineer.

Deposit subbase material and spread evenly to a uniform thickness and width. Then place the binder, filler or other material and spread evenly over the first layer. Add as many layers of materials as required to obtain the specified subbase mixture.

When the required amount of materials have been placed, thoroughly mix and blend by means of graders, disks, harrows, or rotary tillers, supplemented by other suitable equipment. Continue mixing until the mixture is uniform throughout. Correct areas of segregated material by the addition of binder or filler material and by thorough remixing. Uniformly apply water prior to and during the mixing operations to maintain the material at its required moisture content. When the mixing and blending has been completed, spread the material in a uniform layer which, when compacted, will meet the requirements of thickness and typical cross section.

154–3.7 GENERAL METHODS FOR PLACING. Construct the subbase course in layers. Layers are not less than 3 inches (75 mm) nor more than 8 inches (200 mm) of compacted thickness. Place and spread material to have uniform gradation with no pockets of fine or coarse materials. Do not spread more than 2,000 square yards (1,700 square meters) in advance of the rolling unless otherwise permitted by the Engineer. Keep sprinkling within this limit. Do not place material in snow or on a soft, muddy, or frozen course.

When more than one layer is required, the construction procedure described herein applies similarly to each layer.

Exercise caution during placing and spreading to prevent the contamination of the subbase course mixture by other materials.

154–3.8 FINISHING AND COMPACTING. After spreading or mixing, thoroughly compact the subbase material by rolling. Moisten the subbase material when necessary. Furnish sufficient rollers to adequately handle the rate of placing and spreading subbase course.

Compact subbase material in–place to a field target density of at least 100 percent and a lower specification limit (L) of at least 95.5 percent of the maximum density of laboratory specimens prepared from samples of the subbase material delivered to the job site. Compact and test laboratory specimens in accordance with ASTM D 1557. The moisture content of the material at the start of compaction shall not be below nor more than 1–1/2 percentage points above the optimum moisture content, unless it is demonstrated in the field that the required density can be obtained at a lower moisture percentage.

Subbase is accepted for density on a lot basis. A lot consists of a 5,000 square yard (4180 square meter) area. The width and length of lots will be determined by the Engineer. Each lot will be divided into 8 equal sublots. Testing and acceptance will be in accordance with Subsection 154–3.9, Acceptance and Testing for Density.

NOTE TO SPECIFIER:
The Engineer shall specify ASTM D 698 for areas designated for aircraft with gross weights of 60,000 pounds (27 200 kg) or less and ASTM D 1557 for areas designated for aircraft with gross

weights greater than 60,000 pounds (27 200 kg). If pavement is designed for gross aircraft weight of over 60,000 pounds or less, it should be indicated in the special provisions and the use of ASTM D 6981557 required.

Do not roll the subbase course when the underlying course is soft or yielding or when the rolling causes undulation in the subbase. When the rolling develops irregularities that exceed 1/2 inch (12 mm) when tested with a 16–foot (4.9 m) straightedge, loosen the irregular surface and refill with similar material as used in constructing the subbase course. Repeat rolling and reworking until the specified result is achieved.

Along places inaccessible to rollers, tamp subbase material thoroughly with mechanical or hand tampers.

Moisten the subbase material during rolling, if necessary, in a manner required to obtain specified density. Do not add water in a manner or quantity that reduces the supporting strength of an underlying layer.

154–3.9 ACCEPTANCE SAMPLING AND TESTING FOR DENSITY. Acceptance sampling and testing will be performed by the Engineer at no cost to the Contractor. The Subbase course will be accepted for density on a lot basis. Lot size, sublot size, and number of sublots will be determined as specified herein. One in-place field density test will be made for each sublot. Test locations will be determined on a random basis in accordance with statistical procedures contained in ASTM D 3665.

The percent compaction of each sampling location will be determined by dividing the in-place field density of each sublot by the average laboratory maximum density of the lot. The in–place field density will be determined in accordance with ASTM D 2922, Method B, Direct Transmission. The maximum density is the maximum density of laboratory specimens prepared from samples of material taken from the site and will be determined in accordance with ASTM D 1557. The nuclear gage will be calibrated in accordance with ASTM D 2922, Annex A1 and be operated by a technician in accordance with the requirements of the manufacturer. The operator of the nuclear gage must show evidence of training and experience in the use of this instrument. The gage will be standardized daily in accordance with ASTM D 2922, paragraph 8.

Use of ASTM D 2922 results in a wet unit weight, and when using this method, ASTM D 3017 will be used to determine the moisture content of the material. The moisture gage will be standardized daily in accordance with ASTM D 3017, paragraph 7.

Acceptance of each lot of in–place material for density will be based on the percentage of material within specification limits (PWL), calculated in accordance with the computational procedure described in Section 110, Method of Estimating Percentage of Material within Specification Limits (PWL).

If the PWL of the lot equals or exceeds 90 percent, the lot will be considered acceptable. If the PWL is less than 90, rework and recompact the lot.

After recompaction, the lot will be resampled and retested in accordance with the procedures above. A new PWL will be computed based on the retest results and the lot reevaluated for acceptance. This procedure will be repeated until the PWL is 90 or greater.

154-3.10 VERIFICATION TESTING. The Engineer will verify the maximum laboratory density of material placed in the field for each lot. A minimum of one test will be made for each lot of material at the site. The verification process consists of:

a. Compacting the material and determining the dry density and moisture-density in accordance with ASTM D 1557 for aircraft over 60,000 pounds (or ASTM D 698 for aircraft of 60,000 pounds or less, if this test is required for initial laboratory density testing), and

b. Comparing the results with the laboratory moisture-density curves, to select the maximum density and moisture content for the material being placed.

This verification process is commonly referred to as a “one point Proctor.” If the material does not conform to existing moisture-density curves, the Engineer will establish the laboratory maximum density and moisture content for the material in accordance with ASTM D 1557 for aircraft over 60,000 pounds (or ASTM D 698 for aircraft of 60,000 pounds or less, if this test is required for initial laboratory density testing). Additional verification tests will be made, if necessary to properly classify all materials placed in the lot.

154–3.11 SURFACE TEST. The finished subbase course surface cannot vary more than 1/2 inch (12 mm) when tested with a 16–foot (4.9 m) straightedge applied parallel with, and at right angles to, the centerline. After the subbase course is completed and compacted, test for smoothness and accuracy of grade and crown. If portions are found to lack the required smoothness or failing grade or crown requirements, scarify, reshape, recompact, and otherwise manipulate until the required smoothness and accuracy are obtained.

154–3.12 THICKNESS. The Engineer will determine the thickness of the completed subbase course by depth tests or cores taken at intervals so each test will represent no more than 500 square yards (420 square meters). When the deficiency in thickness is more than 1/2 inch (12 mm), correct such areas by scarifying, adding satisfactory mixture, rolling, sprinkling, reshaping, and finishing in accordance with these Specifications. Replace the subbase material where borings are taken for test purposes at no additional cost to the Department.

NOTE TO SPECIFIER:
Thickness tests are required on FAA funded projects for acceptance if the subbase course is bid by the cubic yard in place. However, if subbase course is bid by the ton, the Engineer may eliminate thickness testing from the testing program with the approval of the FAA and BOA project manager. Thickness tests are not required on projects funded entirely by the State.

154–3.13 PROTECTION. Do not construct subbase course when the ambient temperature is below freezing or when the subgrade is frozen or wet.

154–3.14 MAINTENANCE. Maintain the finished subbase course in the accepted condition throughout its entire length by the use of standard motor graders and rollers until construction of the next course is complete.

METHOD OF MEASUREMENT

154–4.1 MEASUREMENT BY CUBIC YARD. When a Pay Item per cubic yard is provided in the Schedule of Prices, the yardage of subbase course to be paid for is the number of cubic yards of subbase course material placed, compacted, and accepted in the completed course. The quantity of subbase course material will be measured in final position based upon depth tests or cores taken as directed by the Engineer, or at the rate of 1 depth test for each 500 square yards (420 square meters) of subbase course (minimum). On individual depth measurements, thickness more than 1/2 inch (12 mm) in excess of that shown on the Plans will be considered as the specified thickness plus 1/2 inch (12 mm) in computing the yardage for payment. Subbase materials will not be included in any other excavation quantities.

154–4.2 MEASUREMENT BY TON. When a Pay Item per ton is provided in the Schedule of Prices, measurement for payment for subbase course is 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.

154-4.3 MEASUREMENT FOR EROSION CONTROL. Erosion control, fertilizing and seeding of granular subbase pits and associated areas will be measured separately as provided in Subsection 156-4.3, Borrow Sites and Material Disposal Sites.

BASIS OF PAYMENT

154–5.1 Payment will 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 will be full compensation for furnishing all materials; for all preparation, hauling, and placing of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the Work as specified herein.

Erosion control, fertilizing and seeding of granular subbase pits and associated areas will be paid for separately as provided in Subsection 156-4.3, Borrow Sites and Material Disposal Sites.

Should excavation below subgrade be required in an area of completed granular subbase construction, restoration of the granular subbase 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 granular subbase Pay Item by three, unless the total quantity for the project exceeds 50 tons (25 cubic yards when the Pay Item is based on cubic yards). When the total quantity for subbase restoration exceeds 50 tons (25 cubic yards when the Pay Item is based on cubic yards), either party to the Contract may request revision of 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. The Engineer determines quantity of restored granular subbase

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P15401	Subbase Course, per ton
Pay Item P15402	Subbase Course, per cubic yard

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.

NOTE TO SPECIFIER:
It is normal WBOA policy to bid Subbase Course by the ton.

TESTING REQUIREMENTS

ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregate
ASTM D 422	Standard Test Method for Particle-Size Analysis
ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (23,400 ft-lbf/ft^3(600 kN-m/m^3))
ASTM D 1557	Test Method for Laboratory Compaction Characteristics Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN-m/m^3))
ASTM D 2922	Density of Soil and Soil–Aggregate in Place by Nuclear Methods
ASTM D 3017	Moisture Content of Soil and Soil–Aggregate in Place by Nuclear Methods
ASTM D 3665	Practice for Random Sampling of Construction Materials
ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils

SPECIFICATION P–156. TEMPORARY AIR AND WATER POLLUTION, SOIL EROSION, AND SILTATION CONTROL

DESCRIPTION

156–1.1 This Work consists of temporary control measures as shown on the Plans or as ordered by the Engineer during the life of the Contract to control water pollution, soil erosion, and siltation through the use of berms, dikes, sediment basins, fiber mats, mulches, grasses, silt fences, bales, and other erosion control devices or methods.

Coordinate temporary erosion control measures contained herein 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.

Temporary control may include Work outside the construction limits such as borrow pit operations, equipment and material storage sites, excess excavated material disposal areas, and temporary plant sites.

Temporary Seeding consists of furnishing and placing seeding in areas designated on the Plans or as directed.

Erosion Mat includes furnishing and placing protective covering mats or soil retention mats for erosion control on prepared planting areas of slopes, ditches, channels or shorelines, at locations designated on the Plans or directed by the Engineer.

Erosion Bales consists of furnishing, placing, maintaining, and removing bales of straw or hay to form checks or dikes to control erosion, at locations designated on the Plans or as directed.

Silt Fence consists of furnishing, erecting, maintaining and removing a geotextile fabric fence and suitable support structure for retention of silt at locations designated on the Plans or as directed.

Silt Screen consists of furnishing, installing, maintaining, and removing a silt screen barrier at locations designated on the Plans or directed by the Engineer.

Cleaning Sediment Basins consists of excavation and disposal of sediment from sediment basins.

Erosion Control Mobilization consists of the Work and operations necessary for the movement of personnel, equipment and materials to the project site to permit construction of erosion control items at the stages indicated in the Contract or directed by the Engineer. The delivery of materials provided for in specific Pay Items for delivery in the Contract is not a part of this Work.

Emergency Erosion Control Mobilization consists of the Work and operations necessary for the movement of personnel, equipment, and materials to the project site to permit installation of temporary erosion control items on an emergency basis as directed by the Engineer. Temporary erosion control items include those items identified as such in the Plans or Contract or by the Engineer. Delivery of temporary erosion control materials provided for in specific Pay Items for delivery in the Contract is not a part of this Work.

MATERIALS

156–2.1 SEED. Provide seed for Temporary Seeding in accordance with Specification T–901, Seeding.

156–2.2 EROSION MAT. Erosion mat products must be prequalified by the Department before use.

Select erosion mat products from the erosion mat Product Acceptability List (PAL) developed and maintained by the Department. The PAL identifies prequalified erosion mat products by class and type. Provide a copy of the PAL “on-site”. A copy of the PAL may be obtained from the Bureau of Highway Construction. A copy of the prequalification procedure for products not on the PAL may be obtained from the same office.

The required class and type of erosion mat will be shown on the Plan or will be specified by the Engineer. The Contractor may furnish any prequalified erosion mat product of the class and type shown on the Plans or specified by the Engineer.

A 12–inch (300 mm) by 12–inch (300 mm) sample of a product proposed for erosion mat use may be required by the Engineer to verify that it is prequalified. When a sample is required, provide the manufacturer's literature for the proposed product.

Apply a soil stabilizer over all Class III Type B, Type C, and Type D erosion mats unless an Erosion Control Revegetative Mat (ECRM) is specified by the Engineer as a cover. Select the soil stabilizer or ECRM from the erosion mat PAL. Jute fabric intended for use as erosion mat shall be a woven fabric of a uniform open weave of single jute yarn. The jute yarn consists of loosely twisted construction having an average

twist of not less than one and one–half turns per inch (25 mm). The average size of the warp and weft yarns shall be approximately the same. Furnish the woven fabric in rolled strips. The minimum width of the strips shall be 48 inches (1220 mm), with a tolerance of minus 1 inch (25 mm). The strip shall have 78 warp ends, plus or minus one for each 48 inches (1220 mm) of width. The fabric shall have 4 weft yarns, plus or minus two per linear yard of length. The weight of the fabric measured under average atmospheric conditions is 92 pounds per 100 square yards (50 kg/100 m^2), plus or minus 10 percent. Choose a fabric that is non–toxic to vegetation.

156–2.3 STAPLES. Staples for anchoring erosion mat in place shall be U–shaped, made of No. 11 gage or larger diameter steel wire, or other approved material, have a width of 1 inch (25 mm) to 2 inches (50 mm), and a length of not less than 6 inches (150 mm) for firm soils and not less than 12 inches (300 mm) for loose soils.

156–2.4 BALES. Use straw or hay bales having dimensions shown on the Plans. Provide tightly tied bales that will remain intact during installation and throughout the project.

156–2.5 STAKES. Provide wood or metal stakes according to dimensions shown on the Plans.

156–2.6 SILT FENCE.

a. Geotextile Fabric. The geotextile fabric consists of either woven or non-woven polyester, polypropylene, stabilized nylon, polyethylene or polyvinylidene chloride with the following requirements: All fabric shall have the minimum strength values in the weakest principal direction. Nonwoven fabric may be needle punched, heat bonded, resin bonded, or combination.

		VALUE MINIMUM REQUIREMENTS[1]	
Test	*Method*	*Silty Soils*[2]	*Sandy Soils*[2]
Grab Tensile Strength N	ASTM D 4632	450 minimum	450 minimum
Apparent Opening Size, µm	ASTM D 4751	300 maximum	850-300
Ultra Violet Resistance Strength Retained at 500 Hours, Percent	ASTM D 4355	70 minimum	70 minimum
Permittivity, S-1	ASTM D 4491	0.14 minimum	0.14 minimum

(1) All numerical values represent minimum average roll values (i.e., the average of test results on any roll in a lot should meet or exceed the minimum values in the table).

(2) Soil determinations shall be based on that portion of a total sample passing the 4.75 mm sieve. Samples with no more than 15 percent passing the 75 µm sieve shall be considered as sandy soils. Samples with more than 15 percent passing the 75 µm sieve shall be considered as silty soils. The geotextile fabric shall be covered or wrapped to protect the fabric from ultraviolet radiation and from abrasion due to shipping and hauling.

b. Fence Support System. Provide a fence support system in accordance with Plan requirements.

156-2.7 SILT SCREEN.

a. **Screen Fabric**. The fabric shall comply with the following physical properties:

(1) Thickness - mm..... 0.38
(2) Grab Tensile Strength - N.....530 min.
(3) Equivalent Opening Size, µm .....90 min.
(4) Seams - All seams shall be heat sealed or sewn.
(5) Flotation - 200 mm diameter solid expanded polystyrene log type or approved equal with a buoyancy of approximately 9 kg/300 mm of length. Polystyrene beads or chips shall not be used for flotation.
(6) Main Load Line - 8 mm cable.
(7) Ballast - A 6 mm chain.

CONSTRUCTION REQUIREMENTS

156–3.1 GENERAL. Deliver 25 percent of the Plan quantity of Erosion Mat, Erosion Bales, or Silt Fence to the project site prior to starting any construction operations, unless otherwise directed by the Engineer. Deliver the remaining amount required to fit actual site conditions (determined in consultation with the Engineer) in sufficient time to permit installation as provided for the specific material.

156–3.2 EROSION MAT. Select erosion mat in accordance with Subsection 156–2.2, Erosion Mat. Prior to installation, provide the Engineer with one full set of the manufacturer's literature and recommended installation procedure for each selected product. Install erosion mat in accordance with the procedure recommended by the manufacturer unless otherwise specified in the Contract or directed by the Engineer.

Cover Class III Type B, Type C and Type D erosion mats with a soil stabilizer or ECRM mat as required by Subsection 156-2.2, Erosion Mat. When a soil stabilizer is used, apply at the rate recommended by the manufacturer of the soil stabilizer unless otherwise specified.

Prior to placing the mat, remove and dispose of stones, clods, roots, sticks, excess excavation and other foreign material preventing contact of the mats with the soil.

Reseed seeded areas disturbed during erosion mat placement, in accordance with the original seeding specifications.

Following the placing of the mat, apply water to the area sufficient to moisten the seedbed to a depth of 2 inches (50 mm) and in a manner to preclude washing or erosion.

Maintain the erosion mat and repair areas damaged by erosion, traffic, fires or other causes until acceptance of the Work.

156–3.3 EROSION BALES. Place erosion bales end to end across ditches or at other areas requiring erosion control immediately after shaping of the ditches or slopes is completed. Place bales at right angles to the direction of flow. Embed and securely anchor with stakes as shown on the Plans. Excavate sumps upstream from the dikes as directed by the Engineer. Remove erosion bales after the slopes and ditches have been stabilized and turf developed to the extent that future erosion is unlikely. After turf is established, dispose of bales or use as mulch. Reshape ditches, fill sumps and trenches, dispose of excess eroded material, and topsoil, fertilize and seed area disturbed by removal of bales.

156–3.4 SILT FENCE.

156–3.4.1 INSTALLATION AND REMOVAL. Erect silt fence prior to starting construction operations that might cause sedimentation or siltation at the site.

Whenever possible, construct silt fence in an arc or horseshoe shape with its ends pointing up slope. Construct silt fence to the dimensions and in accordance with the details shown on the Plans. Remove silt fences after the slopes and ditches have been stabilized and turf developed to the extent that future erosion is unlikely. Materials remaining after removal shall become the property of the Contractor and shall be disposed of off the right–of–way.

156–3.4.2 INSPECTION AND MAINTENANCE. Inspect silt fences immediately after each rainfall and at least daily during prolonged rainfall. Immediately correct deficiencies. Make a daily review of the location for silt fences and filter barriers in areas where construction activity changes the earth contour and runoff pattern, to ensure that the silt fences are properly located for effectiveness. Where deficiencies exist, install additional silt fences as directed.

Remove and dispose of sediment deposits when the deposit reaches approximately one half of the volume capacity of the silt fence as determined by the Engineer. Dress sediment deposits remaining in place after the silt fence is no longer required to conform with the existing grade, and topsoil, fertilize and seed the area.

156–3.5 CLEANING SEDIMENT BASINS. Clean sediment basins when sediment has accumulated to the extent that the effectiveness of the sediment basin has been impaired. Dispose of surplus material.

156-3.6 SILT SCREEN. Install silt screen in such a manner as to prevent drift shoreward or downstream. Securely attach the flotation log to the fabric in both the horizontal and vertical direction.

Attach 8 mm cable at the flotation members and extend the entire length of each section of silt screen. Seal a 6 mm cable in the lower hem for ballast.

Join connectors to the main load line and ballast chain to carry all tensile pressure. Join the fabric for its entire height with grommets and lacing rope.

Extend the silt screen from the water surface to a maximum 3 m depth.

Install anchors or stakes on both shore and stream side to maintain stability. Shore anchors shall consist of a post with deadman or approved equal. Stream anchors shall be sufficient size, type and strength to stabilize the barrier beyond the construction area.

Buoy anchors to prevent the barrier from being pulled under water. Use Danforth-type anchors in sandy bottom and heavy kedge type or mushroom anchors on mud bottoms.

Maintain the barrier throughout construction operations.

Upon completion of the Work, remove the barrier in a manner that will prevent siltation of the river.

156–3.7 EROSION CONTROL MOBILIZATIONS. Submit for approval the Erosion Control Implementation Plan (ECIP) required in Section 70, Legal Regulations and Responsibility to Public, for accomplishing temporary and permanent erosion Work. The ECIP shall stage erosion control Work to conform to the number of Erosion Control Mobilizations shown in the Schedule of Prices. No deviation from the approved staging will be allowed without the prior written approval of the Engineer. The Engineer directs Erosion Control Mobilizations. Mobilize with sufficient personnel, equipment, supplies, and incidentals within 72 hours of a written order by the Engineer. If the mobilization fails within the time period, a deduction of $300 per calendar day will be made from money due under the Contract, for each calendar day of delay beyond such time period, except when such time period is extended by the Engineer for delays which are not the fault of and are beyond the control of the Contractor.

Erosion Control Mobilizations shall not include the work and operations necessary for normal maintenance of erosion control items, and shall not include the movement of personnel, equipment and materials to the Work site to accomplish the installation of those erosion control measures deemed necessary by the Engineer to control erosion between the stages contained in the approved Plan of operations, unless otherwise directed in writing by the Engineer.

156–3.8 EMERGENCY EROSION CONTROL MOBILIZATION. Mobilize with sufficient personnel, equipment, materials, and incidentals on the job site within 8 hours of a written order by the Engineer to install temporary erosion control measures on an emergency basis. If Failure to mobilize within the time period will result in a deduction of $300 per calendar day from money due under the Contract, for each calendar day of delay beyond the time period, except when the time period is extended by the Engineer for delays not the fault of and beyond the control of the Contractor.

An emergency is considered to be a sudden occurrence of a serious and urgent nature, which is beyond normal maintenance of erosion control items and mobilizations included in the erosion control implementation plan, and which requires immediate mobilization and movement of necessary personnel, equipment and materials to the emergency site, followed by the immediate installation of temporary erosion control measures.

Unless otherwise directed by the Engineer, replenish stockpiles of materials delivered in compliance with the requirements of Subsection 156-3.1,General, and subsequently used to provide emergency erosion control to the totals existing in the stockpiles of such materials prior to the emergency.

NOTE TO SPECIFIER:
The intent of this section is to incorporate erosion control measures developed by WDOT Highway. This should allow the project to comply with the WDOT–DNR agreement.

156–3.9 SCHEDULE. Prior to the start of construction, submit schedules for accomplishment of temporary and permanent erosion control Work for clearing and grubbing, grading, construction, paving, and structures at watercourses in accordance with Section 70, Legal Regulations and Responsibility to Public. Also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of excess excavated materials. Do not start Work until the erosion control schedules and methods of operation for the applicable construction have been accepted by the Engineer.

156–3.10 AUTHORITY OF DEPARTMENT. The Department has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, to limit the surface area of erodible earth material exposed by excavation, borrow and fill operations, and to direct the Contractor to provide immediate permanent or temporary pollution control measures to minimize contamination of adjacent streams, other watercourses, lakes, ponds, or other areas of water impoundment.

156–3.11 CONSTRUCTION DETAILS. 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, 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. Use temporary erosion and pollution control measures for the following:

a. That are needed to correct conditions that develop during construction that were not foreseen during the design stage,

b. That are needed prior to installation of permanent control features,

c. That are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

Where erosion is likely, schedule and perform clearing and grubbing operations so that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise, temporary erosion control measures may be required between successive construction stages.

The Engineer may 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 in accordance with the accepted schedule. Should seasonal limitations make such coordination unrealistic, implement temporary erosion control measures to the extent feasible and justified.

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 are ordered by the Engineer, perform the Work at Contractor's own expense.

The Engineer may increase or decrease the area of erodible earth material to be exposed at one time as determined by analysis of project conditions.

Maintain Contractor installed erosion control features during the construction period.

Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into or near rivers, streams, and impoundments or into tributary natural or manmade channels.

METHOD OF MEASUREMENT

156–4.1 Temporary erosion and pollution control Work required which is not attributed to the Contractor's negligence, carelessness, or failure to install permanent controls shall be performed as scheduled or ordered by the Engineer. Completed and accepted Work will be measured as follows:

a. Temporary seeding will be measured by the pound. The quantity to be measured for payment will be the actual number of pounds of seed furnished and sown in accordance with the Contract, within the limits of such Work designated in the Contract Documents or as ordered by the Engineer.

b. Erosion Mat, Delivered, will be measured by the square yard, and the quantity measured for payment will be the number of square yards of acceptable erosion mat delivered to the Work and measured for payment under Subsection 156-4.1(c).

c. Erosion Mat, Installed, will be measured by area in square yards, and the quantity measured for payment will be the number of square yards of surface area upon which the erosion mat has been placed and accepted in accordance with the Contract. No allowance will be made for portions of the mat required to be entrenched in the soil for any end or junction slot or for required overlaps.

d. Erosion Bales, Delivered, will be measured by the unit and the quantity to be paid for will be the number of acceptable units delivered to the Work and measured for payment under Subsection 156-4.1(e).

e. Erosion Bales, Installed, completed and accepted, will be measured in place as units. Required topsoiling, fertilizing or seeding will be measured under the applicable item.

f. Silt Fence, Silty Soil, Delivered, or Silt Fence, Sandy Soil, Delivered, will be measured by the linear foot of acceptable fence delivered to the Work and measured for payment under Subsection 156-4.1(g).

g. Silt Fence, Silty Soil, Installed, or Silt Fence, Sandy Soil, Installed, completed and accepted, will be measured in place by the linear foot. Measurement will be along the base of the fence, center to center of end post, for each section of fence.

h. Silt Fence Maintenance is measured by the linear foot completed and accepted. Measurement will be along the base of the fence, end to end of the section maintained, for each time a section of fence is cleaned and repaired.

i. Silt Screen, completed and accepted, will be measured by the foot in place.

j. Cleaning Sediment Basins will be measured by the cubic yard in the vehicle.

k. Erosion Control Mobilizations, performed at the written direction of the Engineer in conformance with the foregoing applicable requirements, shall be measured as units and the quantity measured for payment will be the number of such mobilizations acceptably performed.

l. Emergency Erosion Control Mobilizations, performed at the written direction of the Engineer, shall be measured per each for mobilizations acceptably performed.

NOTE TO SPECIFIER:
The Standard Specifications were prepared assuming that borrow areas and waste areas for airport projects will be located on site and temporary and permanent erosion control for these areas will be shown on the Plans and paid for under Standard Pay Items. If this is not the case, Special Provisions should be added to the Specifications.

156–4.2 Erosion Control Work performed for protection of construction areas outside the construction limits, such as haul roads, equipment and material storage sites, and temporary plant sites, will not be measured and paid for directly but will be considered as a subsidiary obligation of the Contractor with costs included in the Contract prices bid for the Pay Item to which they apply.

156-4.3 BORROW SITES AND MATERIAL DISPOSAL SITES. Pay Items for Mulching; Erosion Mat, Delivered; Erosion Mat, Installed; Erosion Bales, Delivered; Erosion Bales, Installed; Silt Fence, Silty Soil, Delivered; Silt Fence, Sandy Soil, Delivered; Silt Fence, Silty Soil, Installed; Silt Fence, Sandy Soil, Installed; Silt Fence Maintenance; Fertilizer, Type A; Fertilizer, Type B; Seeding (Mixture); and Temporary Seeding, acceptably furnished and placed on borrow sites and material disposal sites in accordance with requirements of the erosion control implementation plan and at the request of the Engineer, will be measured as provided for the separate items.

Only those Pay Items specifically named in the previous paragraph will be measured for payment.

BASIS OF PAYMENT

156–5.1 TEMPORARY SEEDING. The quantity, measured as provided above, will be paid at the Contract unit price per pound for Temporary Seeding, which price will be full compensation for furnishing material, labor, tools, equipment, and incidentals required to complete the Work in accordance with the Contract.

156–5.2 EROSION MAT, DELIVERED. The quantity, measured as provided above, will be paid for at the Contract unit price per square yard for Erosion Mat, Delivered (Class and Type), which price will be full compensation for furnishing and delivering erosion mat materials for the Work, including staples; for protection and storage on the project; and for furnishing all labor, tools, equipment and incidentals necessary to complete the Work in accordance with the Contract.

156–5.3 EROSION MAT, INSTALLED. The quantity, measured as provided above, will be paid for at the Contract unit price per square yard for Erosion Mat Installed (Class and Type), which price will be full compensation for placing and anchoring the mat, including staples; for required preparation of the seeded areas; for installing end and junction slots; for repairing and reseeding damaged areas; for applying soil stabilizer; for furnishing and applying water; for disposal of all surplus and waste materials; and for furnishing all labor, tools, equipment and incidentals necessary to complete the Work in accordance with the Contract.

ECRM mat placed over Class III, Type B, Type C, or Type D mats will be measured and paid for under the separate ECRM mat Pay Items.

156–5.4 EROSION BALES, DELIVERED. The quantity, measured as provided above, will be paid for at the Contract unit price each for Erosion Bales, Delivered, which price will be full compensation for furnishing and delivering acceptable erosion bales for the Work, including stakes; for protection and storage on the project; and for furnishing all labor, tools, equipment and incidentals necessary to complete the Work in accordance with the Contract.

156–5.5 EROSION BALES, INSTALLED. The quantity, measured as provided above, will be paid for at the Contract unit price each for Erosion Bales, Installed, which price will be full compensation for placing all materials, including stakes; for anchoring the bales; for all excavation, including trenches and sumps; for removal and disposition of the bales and all waste or surplus materials, including eroded

materials; for shaping and restoring ditches; and for furnishing all labor, tools, equipment and incidentals necessary to complete the Work in accordance with the Contract.

Required topsoiling, fertilizing or seeding will be paid for under the applicable Pay Item.

156–5.6 SILT FENCE, DELIVERED. The quantity, measured as provided above, will be paid for at the Contract unit price per linear foot for Silt Fence, Silty Soil, Delivered, or for Silt Fence, Sandy Soil, Delivered, which price will be full compensation for furnishing and delivering acceptable silt fence for the Work, including all miscellaneous materials; for protection and storage on the project; and for furnishing all labor, tools, equipment and incidentals necessary to complete the Work in accordance with the Contract.

156–5.7 SILT FENCE, INSTALLED. The quantity, measured as provided above will be paid for at the Contract unit price per linear foot, for Silt Fence, Silty Soil, Installed, or for Silt Fence, Sandy Soil, Installed, which price will be payment in full for erecting fence, including all excavation, placing of posts, backfilling, attaching woven wire and geotextile fabric; for removing the fence at completion of the project; and for furnishing all labor, tools, equipment and incidentals necessary to complete the Work in accordance with the Contract.

156–5.8 SILT FENCE MAINTAINED. The quantity, measured as provided above, will be paid for at the Contract unit price per linear foot for Silt Fence Maintained, which price will be payment in full for required cleaning and repairing; for removing or spreading the accumulated sediment to form a surface suitable for seeding; for the replacement of silt fence and all damages caused by overloading of sediment material or ponding of water adjacent to the silt fence; and for furnishing all labor, tools, equipment and incidentals necessary to complete the Work in accordance with the Contract.

156-5.9 SILT SCREEN. The quantity, measured as provided above, will be paid for at the contract unit price per foot for Silt Screen, which price will be full compensation for furnishing, assembling, erecting, maintaining, and removing the silt screen barrier and for all labor, tools, equipment, and incidentals necessary to complete this item of Work.

156–5.10 CLEANING SEDIMENT BASINS. Cleaning Sediment Basins, measured as provided above, will be paid for at the Contract unit price per cubic yard, which price will be full compensation for all excavation; for disposal of surplus material; and for furnishing all labor, tools, equipment and incidentals necessary to complete the Work.

156–5.11 EROSION CONTROL MOBILIZATION. The quantity, measured as provided above, will be paid at the Contract unit price each for Erosion Control Mobilization, which price will be full compensation for the staged movement of personnel, and materials, except as otherwise provided; and for all labor, tools, equipment and incidentals necessary to complete the Work.

Erosion control items provided for in the Contract, and acceptably furnished and placed under the item of Mobilizations, Erosion Control, will be paid for separately at the Contract unit price for the item or items.

156–5.12 EMERGENCY EROSION CONTROL MOBILIZATIONS. Emergency Erosion Control Mobilizations, measured as provided above, will be paid at the Contract unit price each, which price will be full compensation for movement of personnel, equipment and materials, except as otherwise provided; and for all labor, tools, equipment and incidentals necessary to complete the movement.

Temporary erosion control measures provided for in the Contract, and acceptably furnished and placed under the Pay Item of Emergency Erosion Control Mobilizations, will be paid for separately.

156-5.13 BORROW SITES AND MATERIAL DISPOSAL SITES. Pay Items for Mulching: Erosion Mat, Delivered; Erosion Mat, Installed; Erosion Bales, Delivered; Erosion Bales, Installed; Silt Fence, Silty Soil, Delivered; Silt Fence, Sandy Soil, Delivered; Silt Fence, Silty Soil, Installed; Silt Fence, Sandy Soil, Installed; Silt Fence Maintenance; Fertilizer, Type A; Fertilizer, Type B; Seeding (Mixture); and Seeding, Temporary, acceptably furnished and placed on borrow sites and material disposal sites in accordance with requirements of the erosion control implementation plan and at the request of the Engineer, measured as provided above, will be paid for at the Contract unit price for the separate Pay Items.

Only those Pay Items specifically named will be paid for.

156-5.14 EROSION RESTORATION. Restore areas washed out or damaged, due to erosion occurring after acceptance of the permanent erosion control measures included in the Contract Documents. Restoration consists of salvaged topsoil, seeding, mulching, and erosion control measures constructed in accordance with the Specifications and applicable details, at locations determined by the Engineer.

The Engineer will stake areas to be restored prior to beginning Work. Work required to complete the Salvaged Topsoil Pay Item shall include replacing topsoil lost to erosion, discing the affected area, placing and spreading the material, and preparing the area for seeding or sodding.

Measurement for Payment for Salvaged Topsoil, Seeding, Mulching, Sodding, and the erosion control items specified in this Section will be in accordance with the provisions of the Specifications. The minimum contiguous area to be restored and measured for payment at each discrete location where erosion has occurred, through no fault of the Contractor, is 50 square yards.

Payment for the Work is made based upon the unit prices contained in the Schedule of Prices for Salvaged Topsoil, Seeding, Mulching, Sodding, and Erosion Control Pay Items. If a Pay Item is not contained in the Schedule of Prices the Work it will be considered Extra Work and the cost determined in accordance with the General Covenants and Requirements. Mobilization for each separate occurrence where remobilization for erosion control is necessary is based upon the price bid for Erosion Control Mobilization (one occurrence) or 15 percent of the total cost of the Work for restoration of the eroded area, whichever is less.

156–5.15 Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P15601	Temporary Seeding, per pound
Pay Item P15602	Erosion Mat, Delivered, Class I, Type A, per square yard
Pay Item P15603	Erosion Mat, Installed, Class I, Type A, per square yard
Pay Item P15604	Erosion Mat, Delivered, Class I, Type B, per square yard
Pay Item P15605	Erosion Mat, Installed, Class I, Type B, per square yard
Pay Item P15610	Erosion Mat, Delivered, Class II, Type A, per square yard
Pay Item P15611	Erosion Mat, Installed, Class II, Type A, per square yard
Pay Item P15612	Erosion Mat, Delivered, Class II, Type B, per square yard
Pay Item P15613	Erosion Mat, Installed, Class II, Type B, per square yard
Pay Item P15614	Erosion Mat, Delivered, Class II, Type C, per square yard
Pay Item P15615	Erosion Mat, Installed, Class II, Type C, per square yard
Pay Item P15620	Erosion Mat, Delivered, Class III, Type A, per square yard
Pay Item P15621	Erosion Mat, Installed, Class III, Type A, per square yard
Pay Item P15622	Erosion Mat, Delivered, Class III, Type B, per square yard
Pay Item P15623	Erosion Mat, Installed, Class III, Type B, per square yard
Pay Item P15624	Erosion Mat, Delivered, Class III, Type C, per square yard
Pay Item P15625	Erosion Mat, Installed, Class III, Type C, per square yard
Pay Item P15626	Erosion Mat, Delivered, Class III, Type D, per square yard
Pay Item P15627	Erosion Mat, Installed, Class III, Type D, per square yard
Pay Item P15630	Erosion Bales, Delivered, per each
Pay Item P15631	Erosion Bales, Installed, per each
Pay Item P15632	Silt Fence, Silty Soil, Delivered, per lineal foot
Pay Item P15633	Silt Fence, Sandy Soil, Delivered, per lineal foot
Pay Item P15634	Silt Fence, Silty Soil, Installed, per lineal foot
Pay Item P15635	Silt Fence, Sandy Soil, Installed, per lineal foot
Pay Item P15636	Silt Fence, Maintained, per lineal foot
Pay Item P15637	Silt Screen, per lineal foot
Pay Item P15638	Cleaning Sediment Basins, per cubic yard
Pay Item P15639	Erosion Control Mobilizations, per each
Pay Item P15640	Emergency Erosion Control Mobilizations, per each

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.

TESTING REQUIREMENTS

ASTM D 4355	Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
ASTM D 4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile

MATERIAL REQUIREMENTS

State of Wisconsin Department of Transportation Product Acceptability List (PAL).

SPECIFICATION P–158. REMOVING MISCELLANEOUS STRUCTURES

DESCRIPTION

158–1.1 DESCRIPTION. This Work consists of removing pavements, surface and base course, curb and gutter, sidewalks, masonry, guardrail, fences, utility poles, buildings, septic tanks, manholes, catch basins and inlets, storm sewer, culverts, wells, and other items that interfere with new construction, or require replacement. This Work also includes disposing of the resulting excess material, backfilling resulting excavations, abandoning appurtenant facilities, and filling or sealing as specified.

Removing Rigid Pavement consists of the removal of Portland cement concrete pavements or bases, including overlays, except that asphaltic surfaces salvaged under other Specifications in the Contract are not considered a part of Removing Rigid Pavement. Removing Rigid Pavement, Butt Joints, consists of the removal of Portland cement concrete pavements to permit construction of butt joints.

Removing Bituminous Pavement consists of the removal of all types of bituminous pavements or surfacings, including removal of bituminous overlays of existing Portland cement concrete pavements designated to remain in place. Removing Bituminous Pavement, Butt Joints, consists of removal of bituminous pavements or surfaces to permit construction of butt joints.

Site Clearance consists of removing building foundations and concrete slabs, backfilling the exposed openings and general site clearance at the locations shown on the Plans.

Abandoning Culvert Pipes consists of plugging both ends of existing culvert pipes to be left in place and abandoned.

NOTE TO SPECIFIER:
Indicate the location of pavements to be removed on the Plans. Removing Rigid or Bituminous Pavement should be measured for payment even if it is within cut or fill areas. Use Removing Bituminous Pavement and other applicable items in lieu of the highways' item of "Obliterate Old Road."

The extent and scope of items to be removed should be shown on the Plans and described in Special Provisions in sufficient detail to allow contractors to prepare bids.

Removing Concrete Sidewalk consists of the removal of concrete sidewalk, crosswalk, and steps.

CONSTRUCTION METHODS

158–2.1 BREAKING DOWN AND REMOVING. Remove, entirely within the limits shown, existing structures, including appurtenant parts and connections indicated to be removed, or interfering with the new construction.

In removing pavement, curb, gutter, sidewalk, crosswalk and similar structures, where portions of the existing structure are to be left in the surface of the finished Work, remove the structure to an existing joint, or saw and chip to a true line with a face perpendicular to the surface of the existing structure. Provide sufficient removal to provide for proper grades and connection in the new Work. Maintain drainage to prevent ponding during all stages of construction.

When constructing butt joints, remove the existing pavement or asphaltic surface to the depth shown on the Plans by grinding, planing, chipping, sawing, or other approved methods. Construct to the requirements of Subsection P-631, Milling Bituminous Pavement, for the removal of asphaltic surface by milling. Removed asphaltic surface become the property of the Contractor.

Removed bituminous pavement becomes the property of the Contractor. Dispose of bituminous pavement at locations determined by the Contractor.

Remove walls, foundations, and similar masonry structures entirely or break down within the area designated to an elevation of at least 2 feet (0.6 m) below the earth subgrade and elsewhere to 2 feet (0.6 m) below the finished slopes or natural ground.

In removing manholes, catch basins and inlets, rebuild and properly reconnect connected live sewers. Maintain satisfactory bypass service during such construction operations. Plug unused sewers with Portland cement concrete.

When a portion of the existing structure is to be retained, take care during construction operations to prevent damage to the retained portion.

Complete operations necessary for the removal of existing structures, which endanger the new construction, prior to the construction of the new work.

Do not use equipment or devices which might damage structures, facilities, or property to be preserved and retained.

In removing septic tanks, completely remove the contents of the tank first. Remove and dispose of the contents in conformance to the requirements of the Wisconsin Department of Natural Resources. Break down and remove the tank to an elevation at least 2- feet (0.6 m) below the proposed earth subgrade, or 2 feet (0.6 m) below the finished slopes or natural ground line, as required due to the location of the tank. Before backfilling, break a hole in the bottom of the remaining portion of the tank to permit drainage. Perform backfilling in accordance with the provisions of this Specification. Where a dry well is a part of the septic tank disposal system, remove it to at least 2 feet (0.6 m) below finished grade and backfill in a manner provided for the septic tank.

Dispose of material and debris resulting from removal of buildings and backfill all resulting openings. Buildings to be removed and all resulting materials shall become the property of the Contractor unless otherwise provided in the Contract.

The Department assumes no responsibility for the condition of any building at any time, and no guarantee is made or implied that any building will remain in the condition the bidder finds it at the time it is examined incident to preparing the proposal.

Procure all permits necessary for removing buildings.

Perform removal of buildings and materials in a safe manner and in compliance with the requirements of the Wisconsin Department of Workforce Development and applicable ordinances of the municipality wherein the building is located, and the Wisconsin Department of Natural Resources, particularly those regulating handling and disposal of asbestos, lead paint, and other hazardous substances. Where hazardous conditions are created incident to construction operations, furnish, erect, and maintain suitable barricades to protect and safeguard the public.

Notify public utility companies serving the building in sufficient time, prior to removal operations, to permit them to disconnect and remove their facilities.

Shut off municipal water service lines at the curb boxes and tightly plug sewer connections, or conform to the municipal ordinances or permits which may specify the manner of sealing a sewer service connection..

Unless otherwise provided on the Plans or in the Contract, include in the removal of a building the removal of that portion of its foundation, including masonry floors, to an elevation at least 2 feet (0.6 m) below the natural ground, the proposed finished earth subgrade or finished slopes, as may be necessary due to the location of the building.

Remove heating units, plumbing fixtures and similar appurtenances to the elevation of the basement floor.

Before backfilling, remove all debris not suitable for backfilling. Holes comprising at least 10 percent of the floor area shall be broken in basement floors to permit drainage.

Clear the entire premises of decomposable and combustible refuse, debris, and materials resulting from the removals and leave the premises in a neat condition upon completion of the Work.

Materials removed from building sites in conjunction with Site Clearance become the property of the Contractor. Materials may be buried on site only when noted on the Plans or in the Special Provisions. Clear the entire premises of all decomposable and combustible refuse, debris, and materials resulting from the removals, and upon completion of the Work leave the premises in a neat condition.

Backfill in accordance with the provisions of Subsection 158-2.4, Backfilling, unless otherwise provided in the Contract.

158–2.2 ABANDONING STRUCTURES. If the Contract calls for abandoning manholes, catch basins, inlets, storm sewer, or culverts, thoroughly clean them and plug the existing pipe connections with brick, concrete block masonry, or with portland cement concrete specified in Specification P–610, Structural Portland Cement Concrete. Remove walls of the structures to the required elevation.

Under the Pay Item for Abandoning Culvert Pipes, plug the ends of the pipe to be abandoned in accordance with requirements previously stated.

Abandoning wells consists of filling and sealing drilled or dug wells, which have been used for supply of water from underground sources, as specified.

Properly seal an abandoned well before performing excavation or other Contract Work that might cause the well to be lost.

Prior to the abandonment of the well, remove all drop pipes, obstructions, or debris which might interfere with or prevent the sealing or filling of the well.

Cut the casing off drilled wells at an elevation at least 2 feet (0.6 m) below the natural ground line, proposed earth subgrade or finished slopes, as necessary due to the well location. Remove and dispose of concrete masonry at the well site above the elevation of cut–off of the casing. Fill the casing to the elevation of cut–off with concrete. Place concrete through a conductor pipe except that where practicable a dump bailer may be used. When concrete is placed under water by a conductor pipe, submerge the bottom end of the conductor pipe in the concrete at all times. Backfill excavations at the well site with suitable soils, or Granular Backfill when specified, to the finished earth grade or natural ground line.

Remove masonry or lining of dug wells to an elevation at least 7 feet (2.1m) below the natural ground line, proposed earth subgrade or finished slopes, as necessary due to the location of the well. Fill the well with concrete, bentonite chips, or with soil consisting of clay, silty clay or other impervious clayey soils. Remove substantial water in the well and place the soil in layers and firmly compact in a manner to thoroughly seal the well and to minimize settlement. Where the well is located within the limits of the proposed excavation or embankment or other proposed load bearing areas, place the soils at or near optimum moisture content, in 8–inch (200 mm) layers and so firmly compacted as to preclude settlement. Dug wells may be filled with concrete or bentonite chips to an elevation 2 feet (0.6 m) below the finished earth grade or natural ground line. Place suitable soils, or Granular Backfill when specified, above the concrete.

Bentonite chips may be used to fill drilled or dug wells within the following limitations:

a. The well shall be in bedrock, sand, or gravel.

b. The well shall be 4 inches (100 mm) or larger in diameter.

c. The well shall be no more than 250 feet (75 m) deep.

d. There shall be no more than 150 feet (45 m) of standing water in the well.

e. If the Contractor elects to use the chips to cap a well partially filled with drilling mud or clay slurry, at least the top 20 feet (6 m) shall be bentonite chips.

The bentonite chip material shall be approved by the Department prior to use. The particles shall be irregularly shaped. Pellets or tablet shaped particles will not be accepted.

Use chips in the 0.25 inch (6 mm) to 0.40 inch (10 mm) range for sealing wells up to 4 inch (100 mm) diameter, and use chips in the 0.40 inch (10 mm) to 0.80 inch (20 mm) range for sealing wells larger than 4 inch (100 mm) diameter. Screen the chips prior to using to remove particles smaller than the smallest standard size in the selected range. Do not exceed the rate of pour into the well of one 50 lb. (22.7 kg) bag in 3 minutes to avoid bridging in the well.

Calculate the number of bags needed to fill the well from the following formula. Use of fewer bags than calculated will indicate the chips have bridged. Before the sealing is accepted, clear the point of bridging or drill out and fill the well again.

$$N = \frac{p\, r^2\, h}{0.0195}$$

Where N - number of 22.7 kg bags required
r = well radius in meters
h = well depth in meters
0.0195 = volume of one 22.7 kg bag in cubic meters

Standing water in the well should rise to the top after filling. If it does not, pour clean water into the well through the chips until water does rise to the top.

Concrete used for filling and sealing wells shall be as specified in Specification P–610, Structural Portland Cement Concrete

Perform well abandonment in accordance with the provisions of Chapters NR111, NR112, and NR114 of the Wisconsin Administrative Code, whichever is applicable. Complete a Well Abandonment Report on forms furnished by the Wisconsin Department of Natural Resources (DNR) for each well abandoned and submit the report to the DNR.

Soils used for filling wells may be taken from the roadway excavation where suitable soils are available and when suitable soils are not so available, furnish the soils from other sources.

158–2.3 DISPOSING OF MATERIALS. Carefully remove materials designated for salvage to avoid damage and place in neat piles outside construction limits within the right–of–way at locations designated by the Engineer. Salvaged material may be used in the new construction only when and as provided in the Special Provisions or in the Specifications.

Dispose of concrete, stone, brick and other material not designated for salvage at locations provided by the Contractor.

158–2.4 BACKFILLING. Backfill trenches, holes and pits resulting from breaking down or removal of items described in this Section. Unless otherwise provided in the Contract, 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.

When indicated on Plans or Specifications, backfill excavations with Granular Backfill, otherwise backfill with select material from adjacent excavation.

Granular Backfill shall meet the requirements of Specification P–154, Subbase Course.

METHOD OF MEASUREMENT

158–3.1 METHOD OF MEASUREMENT. Unless otherwise provided, this Work will be measured in the original position of the structures to be removed, as follows:

Removing Rigid Pavement and Removing Bituminous Pavement will be measured by area in square yards regardless of the depth or number of courses encountered. Removing Pavement and Butt Joints will be measured by area in square yards.

Where removing curb, gutter, or curb and gutter is required in conjunction with removing rigid pavement, removal of these structures will all be classed as removing rigid pavement and will be included and measured by area in square yards of removing rigid pavement.

No deduction will be made from the volume of the various classes of Excavation (P-152) for the volume of pavement removed under the Pay Item of Removing Rigid Pavement or Removing Bituminous Pavement.

Removing curb, gutter, or curb and gutter which is separate from and not removable in conjunction with removing rigid pavement, will be measured by length in linear feet, taken along the flow line of gutter for gutter or curb and gutter, and along face of curb for curb.

Removing sidewalk will be measured by area in square yards. The area of steps will be based on the area of the horizontal projection of the steps.

Removing masonry structures will be measured by volume in cubic yards.

Removing guardrail will be measured by length in linear feet, including end sections or anchorages.

Removing fence will be measured by length in linear feet.

Removing utility poles will be measured per each.

Removing manholes, catch basins and inlets will be measured as units, including all attached parts, connections, and plugs in remaining pipes.

Removing or abandoning storm sewer and culverts will be measured per lineal foot or per lump sum for sewer lines indicated on the Plans.

Removing septic tanks will be measured per each or lump sum, and will include the removal of dry wells, which are a part of the disposal system for septic tanks.

Site Clearance will be measured as a lump sum for each specified site.

Removing wind cones, wind tees, and segmented circles will be measured as complete units per lump sum.

Removing Building will be measured as a lump sum for each specified building removed, and Removing Buildings described by parcel number will be measured as a lump sum including all buildings removed within the specific parcel.

Abandoning manholes, catch basins, inlets, culvert pipes, and wells will be measured as units per each.

Granular Backfill, when included in the Schedule of Prices, and when required for backfilling of openings caused by removal of miscellaneous structures, will be measured by Volume in cubic yards.

BASIS OF PAYMENT

158–4.1 BASIS OF PAYMENT. Payment will be made at the Contract prices for accepted quantities. The Contract unit price or lump sum price for removing or abandoning miscellaneous structures, will be payment in full for breaking down, removing, or sealing; for obtaining required work permits; for hauling and disposal of materials; for backfilling, except as otherwise provided for Granular Backfill; for furnishing required concrete masonry; and for furnishing all labor, tools, equipment and incidentals necessary to complete the Work in accordance with the requirements of the Contract.

Granular Backfill, if included in the Schedule of Prices and required for backfilling openings caused by removal or abandoning of miscellaneous structures, will be paid for at the Contract unit price per cubic yard, which price will be full compensation for such backfill complete in place as herein specified; however, when the Contract does not contain the Pay Item Granular Backfill, but Granular Backfill is specified in the Contract, such backfill material required and used will not be paid for separately but will be considered as subsidiary to and included as a part of other Work under the Contract. When Granular Backfill is not specified, but later found necessary and required, such Granular Backfill will be considered and paid for as Extra Work.

If the Contract does not include Pay Items for removing miscellaneous structures encountered in the Work, then removing such structures will be incidental and the cost included in prices bid for will be measured and paid as Common Excavation or Unclassified Excavation, except that concrete structures exceeding 1 cubic yard in volume and not otherwise specified for removal in the Contract will be paid for as Extra Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P15801	Removing Rigid Pavement, per square yard
Pay Item P15802	Removing Bituminous Pavement, per square yard
Pay Item P15803	Removing Rigid Pavement, Butt Joints, per lineal foot
Pay Item P15804	Removing Bituminous Pavement, Butt Joints
Pay Item P15805	Removing Curb, per linear foot
Pay Item P15806	Removing Gutter, per linear foot
Pay Item P15807	Removing Curb and Gutter, per linear foot
Pay Item P15808	Removing Concrete Sidewalk, per square yard
Pay Item P15809	Removing Masonry, per cubic yard
Pay Item P15810	Removing Guardrail, per linear foot
Pay Item P15815	Removing Fence, per linear foot
Pay Item P15816	Removing Utility Poles, per each
Pay Item P15817	Removing Manholes, per each
Pay Item P15818	Removing Catch Basins, per each
Pay Item P15819	Removing Inlets, per each
Pay Item P15820	Removing Storm Sewer, under 30 inch diameter, per linear foot
Pay Item P15821	Removing Storm Sewer, 30 to 42 inch diameter, per linear foot
Pay Item P15822	Removing Storm Sewer, over 42 inch diameter, per linear foot
Pay Item P15823	Removing Storm Sewer, Line No. ___, per linear foot
Pay Item P15824	Removing Storm Sewer, Line No. ___, per linear foot
Pay Item P15830	Removing Culvert under 30 inch diameter, per linear foot
Pay Item P15831	Removing Culvert 30 to 42 inch diameter, per linear foot
Pay Item P15832	Removing Culvert, over 42 inch diameter, per linear foot
Pay Item P15833 through P15840	Removing Culvert No. ___, per linear foot
Pay Item P15850	Removing Septic Tank, Site No. ___, per lump sum
Pay Item P15851	Removing Septic Tank, Site No. ___, per lump sum
Pay Item P15852	Removing Septic Tanks, per each
Pay Item P15853 through P15860	Removing Building Site, No. ___, per lump sum
Pay Item P15861 through P15865	Removing Buildings, Parcel No. _____, per lump sum
Pay Item P15866 through P15870	Site Clearance, Site No. , per lump sum

Pay Item P15871 through P15873	Removing Wind Cone, per lump sum
Pay Item P15874 through P15878	Removing Wind Tee, per lump sum
Pay Item P15879 through P15881	Removing Segmented Circle, per lump sum
Pay Item P15882 through P15890	Abandon Storm Sewer, Line No. ___, per lump sum
Pay Item P15891	Abandon Culvert, per each
Pay Item P15892	Abandon Manhole, per each
Pay Item P15893	Abandon Catch Basin, per each
Pay Item P15894	Abandon Inlet, per each
Pay Item P15895	Abandon Well, per each
Pay Item P15896	Granular Backfill, per ton

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 will be included in the Pay Items contained in the Schedule of Prices.

NOTE TO SPECIFIER:

Coordinate the Pay Items with the Plans to indicate the location of items to be measured for payment.

SPECIFICATION P–159. SITE FINISHING

DESCRIPTION

159–1.1 DESCRIPTION. Site Finishing, for projects where grading and drainage are a part of the Contract, consists of destruction of noxious weeds, clean out of drainage structures installed under the Contract, clean out of material deposited in existing structures as a result of construction operations, removal and disposal of all litter and debris, and final trimming and dressing required to satisfactorily restore and complete the entire construction site in reasonably close conformity with the required lines, grades, and sections shown on the Plans and Specifications.

Site Finishing on Contracts for construction of base course or surface course where grading and construction have been or will be substantially completed under other Contracts consists of the destruction of noxious weeds, the removing and disposing of litter and debris, and final shaping, finishing, trimming and dressing of shoulders, shoulder slopes and other portions of the site disturbed by the operations of the Contractor, to restore the required lines, grades and sections necessary to complete the above portions of the site, in conformity with the Plans and Specifications. On contracts where seeding operations have been completed under a previous Contract, the Contractor shall be held responsible for all damage caused by Contractor operations to the seeded areas or the vegetative covering. Replace topsoil that may have become lost or contaminated with other materials and reseed or restore areas that have become damaged by operations.

NOTE TO SPECIFIER:
Site Finishing is written similar to Highways' item Finishing Roadway. It is intended for use on most grading projects.

159–2.1 CONSTRUCTION METHODS. Trim, shape, and restore areas within grading limits to the finished cross section by means of grader and other equipment, supplemented by hand work where necessary to produce smooth surfaces and slopes, and uniform cross sections.

Remove loose and waste stones not buried, that would fail to pass a 3–inch ring, from the surface of the ground within all areas of the clearing and grubbing limits.

In turf areas, remove all loose or waste stones from topsoil that would fail to pass a 1–inch (25 mm) sieve.

Do not drag, push, or scrape material across or along the finished pavement or surface course.

Destroy all noxious weeds within construction limits by cutting or other means in a manner and at the proper time to prevent the weed plants from maturing to the bloom or flower stage. The term "noxious weeds" include Canada thistle, leafy spurge, field bindweed and such other weeds as the governing body of the county or municipality wherein the project is located declares to be noxious, in conformity with Section 66.96, Noxious Weeds, of the Wisconsin Statutes.

Prior to acceptance of the Work, where grading or structures are a part of the Contract, clean all soil, silt, or debris, and restore the waterways of all drainage installations and structures affected by the Work. Remove materials that have been deposited or lodged as a result of construction operations in waterways of other drainage installations or structures.

Trim and dress slopes of embankments and excavations to restore them to the established or specified lines and grades. Clear ditches and channels of debris and obstructions. Trim slopes to true line and grade. Remove excess earth, debris, spoil banks or other material adjacent to culverts, bridges, ditches, channels, poles, posts, and trees. Remove stones, roots, or other waste materials exposed on embankment or excavation slopes, which are liable to be loosened and dislodged. Dispose of debris from clearing and grubbing operations and leave the site in a neat, presentable condition. Fill holes and depressions appearing on the surface caused by grubbing operations with suitable material.

159–3.1 METHOD OF MEASUREMENT. Site Finishing will be measured for payment as a single complete unit of Work.

159–4.1 BASIS OF PAYMENT. Payment will be made at the Contract lump sum price for Site Finishing, which will 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.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P15901 Site Finishing, per lump sum

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 will be included in the Pay Items contained in the Schedule of Prices.

SPECIFICATION P–208. AGGREGATE BASE COURSE

DESCRIPTION

208–1.1 This Work consists of a base course composed of hard, durable particles or fragments of crushed coarse aggregate blended with either binder and fine aggregate or filler. Construct it on a prepared underlying course in accordance with these Specifications and in conformance with the dimensions and typical cross section shown on the Plans.

MATERIALS

208–2.1 AGGREGATE. Aggregates consist of both fine and coarse fragments of crushed stone, or crushed gravel mixed or blended with sand, screenings, or other similar approved materials. Crushed stone consists of hard, durable particles or fragments of stone.

The crushed gravel consists of hard, durable stones, rock, and boulders crushed to specified size. Produce aggregate free from excess flat, elongated, soft or disintegrated pieces, dirt, or other objectionable matter. The method used in production of crushed gravel shall be such that the fractured particles occurring in the finished product shall be constant and uniform and shall result in at least 45 percent of material retained on a No. 4 mesh (4.75 mm) sieve having one or more fractured faces. If necessary to meet this requirement or to eliminate an excess of fine, uncrushed particles, screen the gravel before crushing. Stones, rocks, and boulders of inferior quality in the pit shall be wasted.

Crushed coarse aggregate shall not have more than 50 percent wear at 500 revolutions as determined by ASTM C 131. When the fraction of the aggregates retained on the No. 4 mesh (4.75 mm) sieve is subjected to five cycles of the sodium sulfate soundness test (ASTM C 88), the weighted loss shall not exceed 18 percent by weight, unless otherwise provided in the Contract.

Incorporate material passing the No. 4 mesh (4.75 mm) sieve produced in the crushing operation of either stone or gravel in the base material to the extent permitted by the gradation requirements. Oversized stones, rocks and boulders occurring in the pit or quarry material shall be wasted; those of acceptable quality may be crushed and become a part of the base material, provided the blend meets the specified gradations. The aggregate shall be free from vegetation, lumps, or excessive amounts of clay and other objectionable substances.

208–2.2 SAMPLING AND TESTING. Furnish aggregates for preliminary testing prior to the start of production. The Engineer will test for initial aggregate submittals necessary to determine compliance with the Specification requirements at no expense to the Contractor.

Furnish samples of aggregates at the start of production and at intervals during production. The Engineer will designate sampling points and intervals. The samples will be the basis of approval of specific lots of aggregates from the standpoint of the quality requirements of this Specification.

Instead of testing, the Engineer may accept certified State of Wisconsin Department of Transportation test results indicating that the aggregate meets specification requirements.

The Engineer may take samples of aggregates to check gradation periodically during construction. Sampling will be in accordance with ASTM D 75, and testing will be in accordance with ASTM C 136 and C 117.

NOTE TO SPECIFIER:
The intent of this specification is to provide an airport specification for base course with requirements similar to Highways Section 304. The resulting material should be superior to the original P–208 material. Use this specification on pavements with gross weights less than 60,000 pounds. When designing pavement thickness, consider using an equivalency factor to increase the thickness of P–208 required.

208–2.3 GRADATION. The gradation shall meet the requirements of one of the gradations given in Table 1 when tested in accordance with ASTM C 117 and C 136.

TABLE 1. REQUIREMENTS FOR GRADATION OF AGGREGATE

Sieve Size	*Percentage by Weight Passing*					
	Gradation No. 1		*Gradation No. 2*		*Gradation No. 3*	
	Crushed Gravel	*Crushed Stone*	*Crushed Gravel*	*Crushed Stone*	*Crushed Gravel*	*Crushed Stone*
1 1/2 Inch (37.0 mm)	100	100	¾	¾	¾	¾
1 Inch (25.0 mm)	75–100	¾	100	100	100	100
3/4 Inch (19.0 mm)	¾	¾	¾	¾	95–100	95–100
3/8 Inch (9.5 mm)	40–75	30–65	50–85	40–75	50–90	50–90
No. 4 (4.75 mm)	30–60	25–55	35–65	25–60	35–70	35–70
No. 10 (2.00 mm)	20–45	15–40	25–50	15–45	20–55	15–55
No. 40 (0.45 mm)	10–30	¾	10–30	¾	10–35	¾
No. 200 (0.075 mm)	3–10	2–12	3–10	3–12	8–15	5–15

The gradations in the table represent the limits that shall determine suitability of aggregate for use from the sources of supply. The final gradations decided within the limits designated in the table shall 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 sieves, or vice versa.

The amount of the fraction of material passing the No. 200 mesh (0.075 mm) sieve shall not exceed one–half the fraction passing the No. 40 mesh (0.45 mm) sieve.

The portion of the filler and binder, including blended material, passing the No. 40 mesh (0.45 mm) sieve shall have a liquid limit not more than 25 and a plasticity index not more than 6 when tested in accordance with ASTM D 4318.

Selection of gradations shown in the table shall be such that the maximum size aggregate used in any course shall be not more than two–thirds the thickness of the layer of the course being constructed.

208–2.4 FILLER FOR BLENDING If filler, in addition to that naturally present in the base course material, is necessary for satisfactory bonding of the material, for changing the soil constants of the material passing the No. 40 mesh (0.45 mm) sieve, or for correcting the gradation to the limitations of the specified gradation, it should be uniformly blended with the base course material at the crushing plant or at the mixing plant. The material for this shall be obtained from Engineer approved sources and shall be of a gradation necessary to accomplish the specified gradation in the finally processed material.

The additional filler may be composed of sand, but the amount of sand shall not exceed 20 percent by weight of the total combined base aggregate. All the sand shall pass a No. 4 mesh (0.45 mm) sieve and not more than 5 percent by weight shall pass a No. 200 mesh (4.75 mm) sieve.

CONSTRUCTION METHODS

208–3.1 OPERATIONS IN PITS AND QUARRIES. Perform Work involved in clearing and stripping pits and quarries, including handling of unsuitable material. Handle material in a manner to construct a uniform and satisfactory base course. Obtain base course material from approved sources.

208–3.2 PREPARING UNDERLYING COURSE. The underlying course will be checked and accepted by the Engineer before placing and spreading operations are started. Correct ruts or soft, yielding places due to improper drainage conditions, hauling, or other causes, and roll the underlying course to the required density before the base course is placed thereon.

To protect the underlying course and to ensure proper drainage, begin spreading the base 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 MIXING. Uniformly blend the aggregate during crushing operations or mix in a plant. The plant shall blend and mix the materials to meet the specifications and to secure the proper moisture content for compaction.

208–3.4 PLACING. Place aggregate base material on the prepared underlying course and compact in layers of the thickness shown on the Plans. Deposit and spread the material where designated and progress continuously without breaks. Deposit and spread material in lanes in a uniform layer and without segregation of size to a loose depth that, when compacted, the layer shall have the required thickness. Spread base aggregate on a moistened subgrade, in layers of uniform thickness. Dumping from vehicles in piles that require rehandling shall not be permitted. Hauling over the uncompacted base course is not permitted.

Construct base course in layers not less than 3 inches (75 mm) nor more than 6 inches (150 mm) compacted thickness. Aggregate, in–place, shall meet gradation specifications. Do not spread more than 2,000 square yards (1,700 square meters) in advance of the rolling. Do not place material in snow or on a soft, muddy, or frozen course.

When more than one layer is required, the construction procedure described applies similarly to each layer.

Exercise caution during the mixing and spreading process to prevent the incorporation of subgrade, subbase, or shoulder material in the base course mixture.

208–3.5 COMPACTION. Compact aggregate immediately upon completion of the spreading operations. Use a sufficient number, type, and weight of rollers to compact the material to the required density. Compact the aggregate base course in-place to a field target density of at least 100 percent and a lower specification limit (L) of at least 97.0 percent of the maximum density of laboratory specimens prepared from samples of base course material delivered to the job site.

The moisture content of the material during placing operations shall not be below, nor more than 1–1/2 percentage points above, the optimum moisture content as determined by ASTM D 698, unless it can be demonstrated in the field that the maximum density can be achieved at lower moisture contents.

NOTE TO SPECIFIER:
For gross aircraft weights greater than 60,000 pounds, revise the ASTM reference in the preceding paragraph, by Special Provision, to required use of ASTM D 1557.

208–3.6 ACCEPTANCE SAMPLING AND TESTING FOR DENSITY. Aggregate base course will be accepted for density on a lot basis. A lot will consist of one day's production where it is not expected to exceed 2,400 square yards (2,000 square meters) of material per layer. A lot will consist of one–half day's production where a day's production is expected to consist of between 2,400 and 4,800 square yards (2,000 and 4,000 square meters) of material per layer. Over 4,800 square yards (4,000 square meters), each additional 2,400 square yards (2,000 square meters) or a portion thereof will constitute an additional lot.

Each lot shall be divided into 8 equal sublots. One in-place field density test will be made for each sublot. Test locations will be determined by the Engineer on a random basis in accordance with statistical procedures contained in ASTM D 3665.

The percent compaction of each sampling location will be determined by dividing the in-place field density of each sublot by the average laboratory maximum density of the lot. The Engineer will determine in–place field density in accordance with ASTM D 2922, Method B, Direct Transmission. The maximum density will be the maximum density of laboratory specimens prepared from samples of material taken from the site and shall be determined in accordance with ASTM D 698. The nuclear gage will be calibrated in accordance with ASTM D 2922, Annex A1 and be operated by a technician in accordance with the requirements of the manufacturer. The operator of the nuclear gage must show evidence of training and experience in the use of this instrument. The gage will be standardized daily in accordance with ASTM D 2922, paragraph 8. Use of ASTM D 2922 results in a wet unit weight, and when using this method, ASTM D 3017 will be used to determine the moisture content of the material. The moisture gage will be standardized daily in accordance with ASTM D 3017, paragraph 7.

Acceptance of each lot of in–place material for density will be based on the percentage of material within specification limits (PWL), calculated in accordance with the computational procedure, described in Section 110, Method of Estimating Percentage of Material within Specification Limits (PWL)..

If the PWL of the lot equals or exceeds 90 percent, the lot will be considered acceptable. If the PWL is less than 90, rework and recompact the lot. After recompaction, the lot will be resampled and retested in accordance with the procedures above. A new PWL will be computed based on the retest results and the lot reevaluated for acceptance. This procedure will be repeated until the PWL is 90 or greater.

NOTE TO SPECIFIER:
If the Modified Proctor (ASTM D 1557) is required to determine the maximum density, it should be changed by Special Provision.

NOTE TO SPECIFIER:
The Engineer shall specify ASTM D 698 for areas designated for aircraft with gross weights of 60,000 pounds (27 200 kg) or less and ASTM D 1557 for areas designated for aircraft with gross weights greater than 60,000 pounds (27 200 kg). ASTM D 698 is indicated in the WBOA Standard Specifications and will not normally require modification since P–209 will generally be used for pavements designed for loads over 60,000 pounds gross weight. If ASTM D 1557 is desired, it should be specified in the Special Provisions.

208-3.7 VERIFICATION TESTING. The Engineer will verify the maximum laboratory density of material placed in the field for each lot. A minimum of one test will be made for each lot of material at the site. The verification process consists of:

a. Compacting the material and determining the dry density and moisture-density in accordance with ASTM D 1557 for aircraft over 60,000 pounds (27,000 kg) (or ASTM D 698 for aircraft of 60,000 pounds (27,000 kg) or less, if this test is required for initial laboratory density testing), and

b. Comparing the results with the laboratory moisture-density curves, to select the maximum density and moisture content for the material being placed. This verification process is commonly referred to as a "one point Proctor." If the material does not conform to existing moisture-density curves, the Engineer will establish the laboratory maximum density and moisture content for the material in accordance with ASTM D 1557 for aircraft over 60,000 pounds (27,000 kg) (or ASTM D 698 for aircraft of 60,000pounds (27,000 kg) or less, if this test is required for initial laboratory density testing). Additional verification tests will be made, if necessary, to properly classify all materials placed in the lot.

208–3.8 SURFACE TEST. After the course has been completely compacted, the surface will 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, reshaped, recompacted, and otherwise manipulated as the Engineer may direct until the required smoothness and accuracy is obtained. The finished surface shall not vary more than 3/8 inch (9 mm) from a 16–foot (4.8 m) straightedge when applied to the surface parallel width, and at right angles to, the centerline.

208–3.9 THICKNESS. The Engineer will determine the thickness of the base course by depth tests or cores taken at intervals in such a manner that each test will represent no more than 300 square yards (250 square meters). When the base deficiency is more than 1/2 inch (12 mm), correct the areas by scarifying, adding satisfactory base mixture, rolling, sprinkling, reshaping, and finishing in accordance with these specifications. Replace, at Contractor's expense, the base material where borings have been taken for test purposes.

NOTE TO SPECIFIER:
Thickness tests are required on FAA funded projects when aggregate is bid by the cubic yard in-place. When the project is State funded or bid by the ton, the specifier should coordinate with the BOA project manager to determine if thickness tests will be included in the testing program.

208–3.10 PROTECTION. Do not work on the base course when temperatures are freezing nor when the subgrade is wet. Do not construct base course when the aggregates contain frozen materials or when the underlying course is frozen.

Hauling equipment may be routed over completed portions of the base course, provided no damage results and provided that such equipment is routed over the full width of the base course to avoid rutting or uneven compaction. The Engineer may limit hauling over completed or partially completed base course when, such hauling is causing damage. Repair, at Contractor's expense, damage resulting to the base course from routing equipment over the base course

208–3.11 MAINTENANCE. Perform maintenance work on the completed base course to keep the base course in a condition equal to that which existed immediately after the finished surface was tested. Keep the surface clean and free from foreign material. Maintain drainage at all times.

Before preparations begin for the application of a surface treatment or for a surface course, allow the base course to partially dry until the average moisture content of the full depth of base is less than 80 percent of the optimum moisture of the base mixture. The drying shall not continue to the extent that the surface of the base becomes dusty with consequent loss of binder. If during the curing period the surface of the base dries too fast, keep it moist by sprinkling until the prime coat is applied as directed.

METHOD OF MEASUREMENT

208–4.1 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 depth test. On individual depth measurements, thickness more than 1/2 inch (12 mm) in excess of that shown on the Plans will be considered as specified thickness. The quantity of base course, when measured by the ton, will be determined from recorded truck scale weights.

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.

BASIS OF PAYMENT

208–5.1 Payment will be made at 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 of these materials, compacting, and reworking and recompacting if necessary, and for all labor, equipment, tools, and incidentals necessary to complete the Work.

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 for the project 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 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.

NOTE TO SPECIFIER:
Normally, Aggregate Base Course on WBOA projects will be bid by the ton.

Gradation will be indicated within the Pay Item description. If more than one gradation is allowable, add a Special Provision allowing a substitution.

Standard Pay items for work covered by this Specification are as follows:

Pay Item P20801	Aggregate Base Course, Gradation No. 1, per cubic yard
Pay Item P20802	Aggregate Base Course, Gradation No. 1, per ton
Pay Item P20803	Aggregate Base Course, Gradation No. 2, per cubic yard
Pay Item P20804	Aggregate Base Course, Gradation No. 2, per ton
Pay Item P20805	Aggregate Base Course, Gradation No. 3, per cubic yard
Pay Item P20806	Aggregate Base Course, Gradation No. 3, per ton

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 will be included in the Pay Items contained in the Schedule of Prices.

TESTING REQUIREMENTS

ASTM C 29	Standard Test Method for Unit Weight and voids in Aggregate
ASTM D 75	Standard Practice for Sampling Aggregate
ASTM C 88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	Materials Finer than 75um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregate
ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600kN-m/m^3))
ASTM D 1557	Test Method for Laboratory Compaction Characteristics Using Modified Effort (56,000 ft-lbf/ft^3 (2,700kN-m/m^3))
ASTM D 2922	Density of Soil and Soil–Aggregate in-Place by Nuclear Methods
ASTM D 3017	Moisture Content of Soil and Soil–Aggregate in-Place by Nuclear Methods
ASTM D 3665	Random Sampling of Paving Materials
ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils

SPECIFICATION P–209. CRUSHED AGGREGATE BASE COURSE

DESCRIPTION

209–1.1 This Work consists of a base course composed of crushed aggregates constructed on a prepared course in accordance with these Specifications and in conformity to the dimensions and typical cross sections shown on the Plans.

MATERIALS

209–2.1 AGGREGATE. Aggregates consist of clean, sound, durable particles of crushed stone or crushed slag and shall be free from coatings of clay, silt, vegetable matter, and other objectionable materials and shall contain no clay balls. Fine aggregate passing the No. 4 (4.75 mm) sieve shall consist of fines from the operation of crushing the coarse aggregate. If necessary, fine aggregate may be added to produce the correct gradation. Produce the fine aggregate by crushing stone, gravel, or slag that meet the requirements for wear and soundness specified for coarse aggregate.

The crushed slag shall be an air–cooled, blast furnace slag and shall have a unit weight of not less than 70 pounds per cubic foot (1.12 Mg/cubic meter) when tested in accordance with ASTM C 29.

The crushed aggregate portion that is retained on the No. 4 (4.75 mm) sieve shall contain not more than 15 percent, by weight, of flat or elongated pieces as defined in ASTM D 693 and shall have at least 90 percent by weight of particles with at least two fractured faces and 100 percent with at least one fractured face. The area of each face shall be equal to at least 75 percent of the smallest midsectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 to count as two fractured faces.

The percentage of wear shall not be greater than 45 percent when tested in accordance with ASTM C 131. The sodium sulfate soundness loss shall not exceed 12 percent, after 5 cycles, when tested in accordance with ASTM C 88.

The fraction passing the No. 40 (0.42 mm) sieve shall have a liquid limit no greater than 25 and a plasticity index of not more than 4 when tested in accordance with ASTM D 4318. The fine aggregate shall have a minimum sand equivalent value of 35 when tested in accordance with ASTM D 2419.

a. Sampling and Testing. Furnish aggregates for preliminary testing prior to the start of production. All tests for initial aggregate submittals necessary to determine compliance with the specification requirements will be made by the Engineer at no expense to the Contractor.

Furnish samples of aggregates at the start of production and at intervals during production. The Engineer will designate sampling points and intervals. The samples will be the basis of approval of specific lots of aggregates from the standpoint of the quality requirements of this Section.

Instead of testing, the Engineer may accept certified State of Wisconsin Department of Transportation test results indicating that the aggregate meets Specification requirements.

The Engineer will take samples of aggregates to check gradation at least once daily. Sampling will be in accordance with ASTM D 75, and testing will be in accordance with ASTM C 136 and C 117.

b. Gradation Requirements. The gradation (job mix) of the final mixture shall fall within the design range indicated in Table 1, when tested in accordance with ASTM C 117 and C 136. The final gradation shall be continuously well 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 1. REQUIREMENTS FOR GRADATION OF AGGREGATE[1]

Sieve Size	*Design Range Percentage by Weight Passing Sieves*	*Job Mix Tolerances Percent*
2 in (37.0 mm)	100	
1–1/2 (37.0 mm)	95–100	±5
1 in (25.0 mm)	70–95	±8
3/4 in (19.0 mm)	55–85	±8
No. 4 (4.75 mm)	30–60	±8
No. 30 (0.60 mm)	12–30	±5
No. 200 (0.075 mm)	0–8	±3

[1] Where environmental conditions (temperature and availability of free moisture) indicate potential damage due to frost action, the maximum percent of material, by weight, of particles smaller than 0.02 mm shall be 3 percent. It also may be necessary to have a lower percentage of material passing the No. 200 (0.075 mm)sieve to help control the percentage of particles smaller than 0.02 mm.

The job mix tolerances in Table 1 shall be applied to the job mix gradation to establish a job control grading band. The full tolerance will still apply if application of the tolerances' results in a job control grading band outside the design range.

The fraction of the final mixture that passes the No. 200 (0.075 mm) sieve shall not exceed 60 percent of the fraction passing the No. 30 (0.60 mm) sieve.

CONSTRUCTION METHODS

209–3.1 PREPARING UNDERLYING COURSE. The underlying course will be checked and accepted by the Engineer before placing and spreading operations are started. Correct soft or yielding places caused by improper drainage conditions, hauling, or other causes at the Contractor's expense before the base course is placed thereon. Do not place material on frozen subgrade.

209–3.2 MIXING. Uniformly blend the aggregate during crushing operations or mix in a plant. The plant shall blend and mix the materials to meet the Specifications and to secure the proper moisture content for compaction.

209–3.3 PLACING. Place the crushed aggregate base material on the moistened subgrade in layers of uniform thickness with a mechanical spreader.

The maximum depth of a compacted layer shall be 6 inches (150 mm). If the total depth of the compacted material is more than 6 inches (150 mm), construct it in two or more layers. In multi–layer construction, place the base course in approximately equal–depth layers.

Clean the previously constructed layer of loose and foreign material prior to placing the next layer. Keep the surface of the compacted material moist until covered with the next layer.

209–3.4 COMPACTION. Thoroughly compact the crushed aggregate immediately upon completion of the spreading operations. The number, type, and weight of rollers shall be sufficient to compact the material to the required density. Compact the aggregate base course in-place to a field target density of at least 100 percent and a lower specification limit (L) of at least 97.0 percent of the maximum density of laboratory specimens prepared from samples of base course material delivered to the job site.

The moisture content of the material during placing operations shall not be below, nor more than 1–1/2 percentage points above, the optimum moisture content as determined by ASTM D 1557.

NOTE TO SPECIFIER:
For gross aircraft weights less than 60,000 pounds, the preceding ASTM reference may be revised by Special Provision to require the use of ASTM D 698.

209–3.5 ACCEPTANCE SAMPLING AND TESTING FOR DENSITY. Aggregate base course will be accepted for density on a lot basis. A lot will consist of one day's production where it is not expected to exceed approximately 2,400 square yards (2,000 square meters). A lot will consist of one–half day's production where a day's production is expected to consist of between approximately 2,400 and 4,800 square yards

(2,000 and 4,000 square meters). Over approximately 4,800 square yards (4,000 square meters), each additional 2,400 square yards (2,000 square meters) (approximately) or a portion thereof will constitute an additional lot.

Each lot shall be divided into 8 equal sublots One in-place field density test will be made for each sublot. Test locations will be determined by the Engineer on a random basis in accordance with statistical procedures contained in ASTM D 3665.

The percent compaction of each sampling location will be determined by dividing the in-place field density of each sublot by the average laboratory maximum density of the lot. The in–place field density will be determined by the Engineer in accordance with ASTM D 2922, Method B, Direct Transmission. The maximum density will be the maximum density of laboratory specimens prepared from samples of material taken from the site and will be determined in accordance with ASTM D 1557. The nuclear gage will be calibrated in accordance with ASTM D 2922, Annex A1 and will be operated by a technician in accordance with the requirements of the manufacturer. The operator of the nuclear gage must show evidence of training and experience in the use of this instrument. The gage will be standardized daily in accordance with ASTM D 2922, paragraph 8. Use of ASTM D 2922 results in a wet unit weight, and when using this method, ASTM D 3017 will be used to determine the moisture content of the material. The moisture gage will be standardized daily in accordance with ASTM D 3017, paragraph 7.

Acceptance of each lot of in–place material for density will be based on the percentage of material within specification limits (PWL), calculated in accordance with the computational procedure, described in Section 110, Method of Estimating Percentage of Material within Specification Limits (PWL).

If the PWL of the lot equals or exceeds 90 percent, the lot will be considered acceptable. If the PWL is less than 90, rework and recompact the lot.

After recompaction, the lot will be resampled and retested in accordance with the procedures above. A new PWL will be computed based on the retest results and the lot reevaluated for acceptance. Repeat this procedure until the PWL is 90 or greater.

NOTE TO SPECIFIER:
The Engineer shall specify ASTM D 698 for areas designated for aircraft with gross weights of 60,000 pounds (27 200 kg) or less and ASTM D 1557 for areas designated for aircraft with gross weights greater than 60,000 pounds (27 200 kg). The Standard Specifications contain the requirements for over 60,000 pounds gross weight. If the other ASTM specification is appropriate, the specification should be modified in the Special Provisions. Normally use P–208 for aircraft gross weights under 60,000 pounds.

209-3.6 VERIFICATION TESTING. The Engineer will verify the maximum laboratory density of material placed in the field for each lot. A minimum of one test will be made for each lot of material at the site. The verification process consists of:

a. Compacting the material and determining the dry density and moisture-density in accordance with ASTM D 1557 for aircraft over 60,000 pounds (27,000 kg) (or ASTM D 698 for aircraft of 60,000 pounds (27,000 kg) or less if this test is required for initial laboratory density testing); and

b. Comparing the results with the laboratory moisture-density curves, to select the maximum density and moisture content for the material being placed. This verification process is commonly referred to as a "one point Proctor." If the material does not conform to existing moisture-density curves, the Engineer will establish the laboratory maximum density and moisture content of the material in accordance with ASTM D 1557 for aircraft over 60,000 pounds (27,000 kg) (or ASTM D 698 for aircraft of 60,000 pounds (27,000 kg)or less if this test is required to initial laboratory density testing). Additional verification tests will be made, if necessary, to properly classify all materials placed in the lot.

209–3.7 FINISHING. Finish the surface of the aggregate base course by blading or with automated equipment specially designed for this purpose.

In no case will the addition of thin layers of material be added to the top layer of base course to meet grade. If the elevation of the top layer is 1/2 inch (12 mm) or more below grade, scarify the top layer of base to a depth of at least 3 inches (75 mm), new material added, and blend and recompact the layer to bring it to grade. If the finished surface is above Plan grade, cut it back to grade and reroll it.

209–3.8 SURFACE TOLERANCES. The finished surface shall not vary more than 3/8 inch (9 mm) when tested by the Engineer with a 16–foot (4.9 m) straightedge applied parallel with or at right angles to the centerline. Correct deviations in excess of this amount at the Contractor's expense.

209–3.9 THICKNESS CONTROL. The completed thickness of the base course shall be within 1/2 inch (12 mm) of the design thickness. When the quantity of base course is measured by cubic yard, four determinations of thickness will be made for each lot of material placed. The lot size shall be consistent with that specified in Subsection 209-3.5. Each lot shall be divided into 4 equal sublots. One test will be made for each sublot. Sampling locations will be determined by the Engineer on a random basis in accordance with procedures contained in ASTM D 3665. Where the thickness is deficient by more than 1/2 inch (12 mm), correct areas where the thickness is deficient by more than ½ inch (12 mm) at no additional cost by excavating to the required depth and replacing with new material. Additional test holes may be required to identify the limits of deficient areas.

NOTE TO SPECIFIER:
Thickness tests are required on FAA funded projects when aggregate is bid by the cubic yard in place. When the project is State funded or is bid by the ton, the specifier should coordinate with the BOA project manager to determine if thickness tests should be included in the testing program.

209–3.10 MAINTENANCE. Maintain the base course in a condition that will meet all Specification requirements until the Work is accepted. Equipment used in the construction of an adjoining section may be routed over completed portions of the base course, provided no damage results and provided that the equipment is routed over the full width of the base course to avoid rutting or uneven compaction.

METHOD OF MEASUREMENT

209–4.1 The quantity of crushed aggregate base course to be paid for will be determined by measurement of the number of cubic yards or tons of material actually constructed and accepted by the Engineer as complying with the Plans and Specifications.

The quantity of base course, measured by the cubic yard (CY) will be measured in final (compacted) position. Depth measurements for payment will not exceed typical thicknesses shown on Plans.

Base course measured by the ton will be determined from recorded truck scale weights. When base course delivered contains total moisture exceeding the optimal moisture content (determined by lab testing) by greater than ½ percent the quantity measured for payment will be reduced based upon measurements obtained by the Engineer.

BASIS OF PAYMENT

209–5.1 Payment will be made at the Contract unit price per cubic yard or ton for crushed aggregate base course. This price will be full compensation for furnishing all materials, for preparing and placing these materials for reworking and recompacting if necessary, and for all labor, equipment tools, and incidentals necessary to complete the Work.

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 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.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P20901	Crushed Aggregate Base Course, per ton
Pay Item P20902	Crushed Aggregate Base Course, per cubic yard

Measurement and Payment will only be made for Pay Items included in the Schedule of Prices. Include the cost of all Work required by the Contract Documents in the Pay Items contained in the Schedule of Prices.

TESTING REQUIREMENTS

ASTM C 29	Unit Weight of Aggregate
ASTM C 88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	Materials Finer than 75um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregate
ASTM D 75	Sampling Aggregate

ASTM D 693	Crushed Stone, Crushed Slag, and Crushed Gravel for Dry– or Water–Bound Macadam Base Courses and Bituminous Macadam Base and Surface Courses of Pavements
ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
ASTM D 1557	Test Method for Laboratory Compaction Characteristics Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))
ASTM D 2419	Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2922	Density of Soil and Soil–Aggregate in-Place by Nuclear Methods
ASTM D 3017	Moisture Content of Soil and Soil–Aggregate in-Place by Nuclear Methods
ASTM D 3665	Random Sampling of Paving Materials
ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils

SPECIFICATION P–306. ECONOCRETE SUBBASE COURSE

DESCRIPTION

306–1.1 This Work consists of constructing a subbase course composed of aggregate and cement uniformly blended together and mixed with water, spread, shaped, and compacted in accordance with these Specifications and in conformity to the lines, grades, dimensions, and typical cross sections shown on the Plans.

MATERIALS

306–2.1 AGGREGATE. Provide aggregates in accordance with ASTM C 33. Aggregate shall be stone or gravel, crushed or uncrushed. Fine aggregate may be that naturally contained in the aggregate material or may be sand. Aggregate shall consist of hard, durable particles, free from excess flat, elongated, soft pieces, dirt, or other objectionable matter. Aggregate may also be a slag suitable for concrete.

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.

NOTE TO SPECIFIER:
The Engineer may specify crushed portland cement concrete pavement if the existing pavement or material on hand is to be recycled.

The aggregate shall conform to the gradation shown in Table 1 when tested in accordance with ASTM C 136. Provide gradation No. 1 unless otherwise specified in the Special Provisions.

TABLE 1. AGGREGATE – ECONOCRETE SUBBASE COURSE
Percentage by Weight Passing Sieves

Sieve Size/Gradation (square opening)	*Gradation No. 1 1"(25.0 mm) Maximum*	*Gradation No. 1A 1–1/2"(37.5 mm) Maximum*	*Gradation No. 2 2" (50.0 mm) Maximum*
2 in (50.0 mm)			100
1–1/2 in (37.5 mm)		100	
1 in (25.0 mm)	100	70–95	55–85
3/4 in (19.0 mm)	70–100	55–85	50–80
No. 4 (4.75 mm)	35–65	30–60	30–60
No. 40 (0.450 mm)	14–30	10–30	10–30
No. 200 (0.075 mm)	0–15	0–15	0–15

NOTE TO SPECIFIER:
Where locally available aggregate cannot economically be blended to meet the grading requirements, or if recycled pavement is used, the gradations may be modified by the design Engineer to fit the characteristics of the available aggregates provided strength requirements are met.

If gradation 1A or 2 is desired, add the requirement in a Special Provision.

306–2.2 CEMENT. Cement shall conform to the requirements of ASTM C 150, Type 1.

306–2.3 WATER. Water used in mixing or curing shall be as clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product as possible. Water shall meet the requirements of AASHTO T 26. Water known to be of potable quality may be used without testing.

306–2.4 COVER MATERIAL FOR CURING. Curing materials shall conform to one of the following specifications:

a. Liquid membrane–forming compounds for curing econocrete shall conform to the requirements of ASTM C 309, Type 2, Class A or B.

b. Asphalt emulsion for curing econocrete shall conform to the requirements of ASTM D 977, Type SS–1h.

306–2.5 ADMIXTURES. The Engineer will approve materials added to the econocrete mix. 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. Pozzolanic Admixtures. Pozzolanic admixtures shall be fly ash or raw or calcined natural pozzolans meeting the requirements of ASTM C 618.

b. Air–Entraining Admixtures. Air entraining admixtures shall meet the requirements of ASTM C 260.

c. Water Reducing Admixtures. Water reducing admixtures shall meet the requirements of ASTM C 494, Type A, water–reducing or Type D, water–reducing and retarding. Add water–reducing admixtures 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.

NOTE TO SPECIFIER:
Since the cement content is low in econocrete (which could cause poor workability for normal aggregates), the workability may be increased by extra fines in the aggregate; higher than normal amounts of entrained air; addition of pozzolanic admixtures or workability agents; or a combination of these.

CONSTRUCTION METHODS

306–3.1 PROPORTIONING. Prior to the start of paving operations and after approval of all material to be used, submit a mix design and test data showing the proportions of materials used and the actual compressive strength obtained from the econocrete. Compressive strength shall be not less than 500 psi (3447 kPa) at 7 days and 750 psi (5171 kPa) at 28 days, or more than 1,200 psi (8274 kPa) at 28 days, using test specimens prepared in accordance with ASTM C 192 and tested in accordance with ASTM C 39. The minimum cementitious material (cement plus fly ash) shall be 200 pounds per cubic yard (119 kg per cubic meter). When fly ash is used as a partial replacement for cement, the minimum cement content may be met by considering Portland cement plus fly ash as the total cementitious material. The replacement rate shall be determined from laboratory trial mixes, but shall not exceed 20 percent by weight of the total cementitious material.

NOTE TO SPECIFIER:
The Engineer may wish to specify aAn upper limit of 1200 psi (8268 kPa) is specified since a comprehensive strength greater than 1200 psi (8268 kPa) may induce cracking in the overlying pavement.

When adding air–entraining admixture ensure uniform distribution of the agent throughout the batch. The percentage of air entrainment shall not be less than 6 percent or more than 10 percent. Test air content in accordance with ASTM C 231 for gravel and stone coarse aggregate and ASTM C 173 for slag and other highly porous coarse aggregate. Provide a mix with a slump of 2 inches (50 mm) at the time of placing the econocrete. Testing shall be in accordance with ASTM C 143. The freeze–thaw weight loss shall not exceed 14 percent when tested in accordance with ASTM D 560.

306–3.2 EQUIPMENT. The Engineer will approve equipment and tools necessary for handling materials and performing all parts of the Work as to design, capacity, and mechanical condition. Have the equipment at the job site before the start of construction operations for examination and approval.

a. Batch Plant and Equipment. The batch plant and equipment shall conform to the requirements of ASTM C 94.

b. Mixers.

(1) **General**. Econocrete may be mixed at a central plant, or wholly or in part in truck mixers. Each 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.

(2) **Central Plant Mixer**. Central plant mixers shall conform to the requirements of ASTM C 94. Examine the mixers for changes in condition due to accumulation of hard concrete or mortar or wear of blades. Replace the pickup and throwover

blades when they have worn down 3/4 inch (19 mm) or more. Have a copy of the manufacturer's design on hand showing dimensions and arrangement of blades in reference to original height and depth.

(3) **Truck mixers and truck agitators**. Truck mixers used for mixing and hauling econocrete and truck agitators used for hauling central–mixed econocrete shall conform to the requirements of ASTM C 94.

(4) **Nonagitator trucks**. Nonagitating hauling equipment shall conform to the requirements of ASTM C 94.

c. Finishing Equipment.

(1) **Finishing Machine**. The finishing machine shall be equipped with one or more oscillating–type transverse screeds.

(2) **Vibrators**. For side–form construction, vibrators may be either the surface pan type for pavements less than 8 inches (200 mm) thick or the internal type with either immersed tube or multiple spuds for the full width of the slab. They may be attached to the spreader or the finishing machine, or they may be mounted on a separate carriage. Do not allow the vibrators to come in contact with the joint, subgrade, or side forms. The frequency of the surface vibrators shall not be less than 3,500 vibrations per minute, and the frequency of the internal type shall not be less than 7,000 vibrations per minute for spud vibrators. When spud–type internal vibrators are used adjacent to the side forms, they shall have a frequency of not less than 3,500 vibrations per minute.

For slip–form construction, the paver shall vibrate the econocrete for the full width and depth of the strip of pavement being placed. Accomplish vibration by internal vibrators with a frequency range variable between 7,000 and 12,000 vibrations per minute. The amplitude of vibration shall be between 0.025 and 0.06 inches (0.6 mm and 1.5 mm).

Provide, as necessary, the number, spacing, frequency, and eccentric weights to achieve an acceptable density and finishing quality. Adequate power to operate all vibrators at the weight and frequency required for a satisfactory finish shall be available on the paver. The internal vibrators may be supplemented by vibrating screeds operating on the surface of the econocrete. The frequency of surface vibrators shall not be less than 3,500 vibrations per minute. Furnish a tachometer or other suitable device for measuring the frequency of the vibrators. The vibrators and tamping elements shall be automatically controlled so that they can be stopped as forward motion ceases. Override switches shall be of the spring–loaded, momentary–contact type.

d. Concrete Saw. When sawing joints is specified or is necessary in accordance with 306–3.10, provide sawing equipment with adequate power to complete the sawing to the required dimensions and at the required rate. Provide at least one standby saw in good working order. Maintain an ample supply of saw blades at the site of the Work at all times during sawing operations. Provide adequate artificial lighting facilities for night sawing. Have all of this equipment on the job both before and at all times during econocrete placement.

e. Forms. Straight side forms shall be made of steel having a thickness of not less than 7/32 inch (6 mm) and shall be furnished in sections not less than 10 feet (3 m) in length. Forms shall have a depth equal to the prescribed edge thickness of the econocrete without horizontal joint and a base width equal to the depth of the forms. Use flexible or curved forms of proper radius for curves of 100–feet (30 m) radius or less. Flexible or curved forms shall be of a design acceptable to the Engineer. Provide forms with 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. Flange braces shall extend outward on the base not less than two–thirds the height of the form. Remove from the Work forms with battered top surfaces and bent, twisted, or broken forms. Do not use repaired forms, except as approved by the Engineer. The top face of the form shall not vary from a true plane more than 1/8 inch (3 mm) in 10 feet (3 m), and the upstanding leg shall not vary more than 1/4 inch (6 mm). The forms shall contain provisions for locking the ends of abutting sections together tightly for secure setting.

f. Slip–form Pavers. Ensure the paver is fully energized, self–propelled, and designed for the specific purpose of placing, consolidating, and finishing the econocrete pavement, true to grade, tolerances, and cross section. Ensure it is of sufficient weight and power to construct the maximum specified paving lane width as shown in the Plans, at adequate forward speed, without transverse, longitudinal, or vertical instability or without displacement. Equip the paver with electronic or hydraulic horizontal and vertical control devices.

306–3.3 FORM SETTING. Set forms sufficiently in advance of the econocrete placement to ensure continuous paving operation. After the forms have been set to correct grade, thoroughly tamp the grade, either mechanically or by hand, at both the inside and outside edges of the base of the forms. Stake into place forms with not less than 3 pins for each 10–foot (3 m) section. Place a pin at each side of every joint.

Tightly lock form sections and ensure they are free from play or movement in any direction. The forms shall not deviate from true line by more than 1/4 inch (6 mm) at any joint. Set forms so that they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Clean and oil forms prior to the placing of econocrete.

Check the alignment and grade elevations of the forms and make corrections immediately before placing the econocrete. When forms have been disturbed or grades have become unstable, reset and recheck the form.

306–3.4 CONDITIONING OF UNDERLYING COURSE, SLIP–FORM CONSTRUCTION. Widen the compacted subgrade on which the pavement will be placed approximately 3 feet (0.90 m) to extend beyond the paving machine track to support the paver without any noticeable displacement. After the subgrade has been placed and compacted to the required density, trim the areas that will support the paving machine and the area to be paved to the proper elevation and profile by means of a properly designed machine. Control automatically the grade of the subgrade on which the econocrete pavement is to be placed by steel guide wires erected and maintained by the Contractor. If the density of the subgrade is disturbed by the trimming operations, re-compact before the econocrete is placed. Delay the grading operations as long as possible to immediately precede paving insofar as practicable, particularly if the subgrade is subjected to haul traffic. If traffic is allowed to use the prepared grade, check and correct the grade immediately before the placement of econocrete. Moisten the prepared grade well , without saturating, immediately ahead of econocrete placement to prevent rapid loss of moisture from the econocrete. In cold weather, protect the underlying course so that it will be entirely free of frost when econocrete is placed.

306–3.5 CONDITIONING OF UNDERLYING COURSE, SIDE–FORM CONSTRUCTION. Moisten the prepared grade well , without saturating, immediately ahead of econocrete placement to prevent rapid loss of moisture from the econocrete. Fill ruts or depressions in the subgrade, caused by hauling or usage of other equipment, as they develop with suitable material and thoroughly compact by rolling. A multi–pin template weighting not less than 1,000 pounds (450 kg) per 20 feet (6 m) or other approved templates shall be provided and operated on the forms immediately in advance of the placing of the econocrete. Propel the template by hand and do not attach it to a tractor or other power unit. Provide adjustable templates so that they may be set and maintained at the correct contour of the underlying course. Adjust and operate the templates to provide an accurate retest of the grade before placing the econocrete. Remove all excess material. Low areas may be filled and compacted to a condition similar to that of the surrounding grade, or filled with econocrete integral with the pavement. In cold weather, protect the underlying course so that it will be entirely free from frost when the econocrete is placed. The use of chemicals to eliminate frost in the underlying material will not be permitted. Maintain the template in accurate adjustment and check it daily. The Work described under the foregoing paragraphs does not constitute a regular subgrading operation, but rather a final accurate check of the underlying course.

306–3.6 HANDLING, MEASURING, AND BATCHING MATERIAL. The batch plant site, layout, equipment, and provisions for transporting material shall assure a continuous supply of material to the Work. Build stockpiles in layers of not more than 3 feet (0.90 m) in thickness. Each layer shall be completely in place before beginning the next layer and shall not be allowed to "cone" down over the next lower layer. Do not stockpile aggregates from different sources and of different grading together. The Engineer will not accept improperly placed stockpiles.

Handle aggregates from stockpiles or other sources to the batching to secure the specified grading of the material. Do not use aggregates that have become segregated or mixed with earth or foreign material. Stockpile or bin all aggregates for draining that are produced or handled by hydraulic methods, and washed aggregates, for at least 12 hours before being batched. Rail shipments requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage. Weigh the fine aggregate and coarse aggregate in separate hoppers in the respective amounts set in the job mix except where a unit aggregate such as crusher run or pit run are used, in which case a single stockpile will be satisfactory Measure cement by weight. Use separate scales and hopper, with a device to positively indicate the complete discharge of the batch of cement into the batch box or container, for weighing the cement.

When required by the Contract or when permitted, equip batching plants to proportion aggregates and bulk cement, by weight, automatically using interlocked proportioning devices of an approved type. Use a suitable method of handling the cement from weighing hopper to transporting container or into the batch itself for transportation to the mixer (for example, chute, boot, or other approved device) to prevent loss of cement. Arrange the device to provide positive assurance of the actual presence in each batch of the entire cement content specified.

When cement is placed in contact with the aggregates, batches may be rejected unless mixed within 1–1/2 hours of the contact. Conduct batching so that the results in the weights of each material required will be within a tolerance of 1 percent for cement and 2 percent for aggregates.

Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within plus or minus 1 percent of required amounts. Unless the water is to be weighed, the water–measuring equipment shall include an auxiliary tank from which the measuring tank shall be filled.

When required, the Engineer will approve methods and equipment for adding air–entraining agents or other admixtures to the batch. Measure all admixtures into the mixer with an accuracy of plus or minus 3 percent.

306–3.7 MIXING ECONOCRETE. The econocrete 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. Measure mixing time from the time all materials, except water, are emptied into the drum. Mix and deliver ready–mixed econocrete in accordance with the requirements of ASTM C 94, except the minimum required revolutions of the mixing speed for transit mixed econocrete may be reduced to not less than that recommended by the mixer manufacturer. Indicate the number of

revolutions recommended by the mixer manufacturer on the manufacturer's serial plate attached to the mixer. Furnish test data acceptable to the Engineer verifying that the make and model of the mixer will produce uniform econocrete conforming to the provisions of ASTM C 94 at the reduced number of revolutions shown on the serial plate.

When mixed at the work site or in a central mix plant, the mixing time shall not be less than 50 seconds nor more than 90 seconds. Mixing time ends when the discharge chute opens. Transfer time in multiple drum mixers is included in mixing time. Remove the contents of an individual mixer drum before a succeeding batch is emptied therein.

Operate the mixer at the drum speed as shown on the manufacturer's nameplate on the approved mixer. Discard, at the Contractor's expense, econocrete that is mixed less than the specified time. The volume of econocrete mixed per batch shall not exceed the mixer's nominal capacity in cubic feet (cubic meters), as shown on the manufacturer's standard rating plate on the mixer. An overload up to 10 percent above the mixer's nominal capacity may be permitted provided test data for segregation and uniform consistency are satisfactory, and provided no spillage of econocrete takes place. Charge the batch into the drum so that a portion of the mixing water enters in advance of the cement and aggregates. Provide a uniform flow of water. Have all water in the drum by the end of the first 15 seconds of the mixing period. Keep the throat of the drum free of accumulations that may restrict the free flow of materials into the drum.

Transport mixed econocrete from the central mixing plant in truck mixers, truck agitators, or nonagitating trucks. Do not exceed 45 minutes for the time elapsing from the time water is added to the mix until the econocrete is deposited in place at the Work site when the econocrete is hauled in nonagitating trucks, and do not exceed 90 minutes when the econocrete is hauled in truck mixers or truck agitators. Retempering econocrete by adding water or by other means will not be permitted, except when econocrete is delivered in transit mixers. 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, if permitted by the Engineer. All these operations must be performed within 45 minutes after the initial mixing operations, and the water–cement ratio must not be exceeded. Admixtures for increasing the workability or for accelerating the set will be permitted only when approved by the Engineer. At the option of the Contractor or when specified by the Engineer, a water–reducing admixture may be used.

306–3.8 LIMITATIONS OF MIXING. Do not mix, place, or finish econocrete when the natural light is insufficient, unless an adequate and approved artificial lighting system is operated.

Unless authorized in writing by the Engineer, discontinue mixing and econocreting operations when a descending air temperature in the shade and away from artificial heat reaches 40°F (4°C). Do not resume mixing and econocrete operations until an ascending air temperature in the shade and away from artificial heat reaches 35°F (2°C).

When econocreting is authorized during cold weather, the aggregates may be heated by either steam or dry heat prior to being placed in the mixer. Heat the mass uniformly and arrange it to preclude the possible occurrence of overheated areas that might be detrimental to the materials. Unless otherwise authorized, the temperature of the mixed econocrete shall not be less than 50°F (10°C) at the time of placement in the forms.

If the air temperature is 35°F (2°C) or less at the time of placing econocrete, the Engineer may require the water and/or the aggregates to be heated to not less than 70°F (20°C) nor more than 150°F (66°C). Do not place econocrete on frozen subgrade or use frozen aggregates in the econocrete.

During the periods of warm weather when the maximum daily air temperature exceeds 85°F (30°C), the following precautions should be taken:

a. Sprinkle the forms and/or the underlying material with water immediately before placing the econocrete.

b. Place the econocrete at the coolest temperature practicable, and in no case should the temperature of the econocrete when placed exceed 100°F (38°C).

c. Cool the aggregates and/or mixing water as necessary to maintain the econocrete temperature at or not more than the specified maximum.

306–3.9 PLACING ECONOCRETE.

a. Side–Form Method. Deposit the econocrete on the moistened grade to require as little rehandling as possible. Truck mixers, truck agitators, or nonagitating hauling equipment equipped with means for discharge of econocrete without segregation of the materials, shall unload the econocrete on the grade to prevent segregation of the materials. Place the econocrete continuously between transverse joints without the use of intermediate bulkheads. Do necessary hand spreading with shovels (not rakes). Do not allow workers to walk in the freshly mixed econocrete with boots or shoes coated with earth or foreign substances.

b. Slip–Form Method. Place the econocrete with an approved crawler–mounted, slip–form paver designed to spread, consolidate, and shape the freshly placed econocrete in one complete pass of the machine so that a minimum of hand finishing will be necessary to provide a pavement in conformance with requirements of the Plans and Specifications. Provide adjustable side forms and finishing screeds to the extent required to produce the specified pavement edge and surface tolerance. The side forms shall be of dimensions, shape, and strength to support

the econocrete laterally for a sufficient length of time so that no appreciable edge slumping will occur. Accomplish final finishing while the econocrete is still in the plastic state.

306–3.10 JOINTS. Construct transverse joints in econocrete subbases if compressive strengths exceed the following limitations:

28 day compressive strength of mix design, per project ..... 1,200 psi
Average 28 day compressive strengths as determined in 306–4.1, per lot ..... 1,200 psi
Average 7 day compressive strength as determined in 306–4.1, per lot ..... 800 psi

If one of the above events occurs, construct transverse joints every 50 feet (15 m). Saw joints in the hardened econocrete or formed in the plastic mixture to a depth of at least one-sixth the thickness of the econocrete base. Offset all joints in the econocrete base at least 6 inches (150 mm) from joints in the surface course.

NOTE TO SPECIFIER:
Joints are not considered necessary to econocrete subbases due to the normally lower strengths and moduli of elasticity of these subbases relative to these parameters in the overlying Portland cement concrete pavement. When a relatively high strength econocrete subbase is placed (compressive strength greater than 1200 psi), joints should be constructed, unless a good bond breaker, such as a wax-based curing compound, is used between the econocrete and the overlying pavement.

306–3.11 FINAL STRIKE–OFF, CONSOLIDATION, AND FINISHING.

a. Sequence. The sequence of operations is strike–off, consolidation, and finishing.

b. Strike–off, Consolidation, and Finishing. Place the econocrete with a slip–form paver capable of striking–off, consolidating, and finishing in one pass of the equipment. Using form–paving methods is optional.

c. Surface Testing and Corrections. After the econocrete base has been struck off and consolidated and while the econocrete is still plastic, test it for trueness with a 16–foot (4.8 m) straightedge. Show no variations in the surface of more than 3/8 inch (9 mm) from a 16–foot (4.8 m) straightedge laid in any location parallel with or at right angles to the longitudinal axis of the centerline. Remove surplus material and refinish the surface by hand. Immediately fill depressions with freshly mixed econocrete, struck off, consolidated, and refinished.

306–3.12 CURING. Immediately after the finishing operations have been complete and marring of the econocrete will not occur, cure the entire surface of the newly placed econocrete 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 econocreting operations. Do not leave the econocrete exposed for more than 1/2 hour during the curing period. The following are alternate approved methods for curing econocrete pavements.

a. Impervious Membrane Method. Spray the entire surface of the pavement uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the econocrete has taken place. Do not apply the curing compound during rainfall. Apply curing compound by mechanical sprayers under pressure at the rate of 1 gallon (4 liters) to not more than 200 square feet (18 square meters). Use fully atomizing spraying equipment equipped with a tank agitator. At the time of use, thoroughly mix the compound with pigment uniformly dispersed throughout the vehicle. During application, stir the compound continuously by effective mechanical means. Hand spraying of odd widths or shapes and concrete surfaces exposed by the removal of forms will be permitted. Do not apply curing compound to the inside faces of joints to be sealed, but use approved means to ensure proper curing for 72 hours. Use a curing compound where the film will harden within 30 minutes after application. Should the film become damaged from any cause within the required curing period, repair the damaged portions immediately with additional compound. Upon removal of side forms, protect the sides of the exposed slabs immediately to provide a curing treatment equal to that provided for the surface.

b. Asphalt Emulsion. Uniformly spray the entire surface of the pavement with asphalt emulsion before the set of the econocrete has taken place. Apply the asphalt emulsion by distributing equipment at the rate of approximately 0.2 gallons (0.95 liter) per square yard (square meter). Should the film become damaged from any cause within the required curing period, repair the damaged portions immediately with additional asphalt emulsion.

c. Curing in Cold Weather. When the average daily temperature is below 40°F (4°C), curing consists of covering the newly laid pavement with not less than 12 inches (300 mm) of loose, dry hay or straw, or equivalent protective curing authorized by the Engineer, which shall be retained in place for 10 days. Secure the hay or straw to avoid being blown away.

When econocrete is being placed and the air temperature may be expected to drop below 35°F (2°C), provide a sufficient supply of straw, hay, grass, or other suitable blanketing material such as burlap or polyethylene along the Work. Whenever the temperature is expected to reach the freezing point during the day or night, spread the material so provided over the pavement to a sufficient depth to prevent freezing of the econocrete.

Maintain this protection for at least 10 days. The Contractor shall be responsible for the quality and strength of the econocrete placed during cold weather, and econocrete injured by frost action shall be removed and replaced at the Contractor's expense.

306–3.13 PROTECTION OF ECONOCRETE. Protect the pavement against traffic caused by the Contractor's employees and agents. This includes watchmen to direct traffic and erection and maintenance of warning signs, lights, pavement bridges, or crossovers, etc. The Plans or Special Provisions will indicate the location and type of device or facility required to protect the Work and provide adequately for traffic. Repair damage to the subbase course occurring prior to final acceptance or replace the pavement at the Contractor's expense. Have available at all times materials for the protection of the edges and surfaces of the unhardened econocrete to protect against the effects of rain. The protective materials consist of rolled polyethylene sheeting at least 4 mils (0.1 mm) thick of sufficient length and width to cover the plastic econocrete 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 econocrete surface. When rain appears imminent, stop all paving operations and have all available personnel begin covering the surface of the unhardened econocrete with the protective covering.

Do not permit traffic on the econocrete until a minimum compressive strength of 500 psi has been developed as determined from test specimens.

MATERIAL ACCEPTANCE

306–4.1 ACCEPTANCE SAMPLING AND TESTING. The Engineer will perform all acceptance sampling and testing, except for coring for thickness determination, necessary to determine conformance with the requirements specified in this Section. Econocrete will be accepted for strength and thickness on a lot basis.

Testing organizations performing these tests will meet the requirements of ASTM C 1077. Bear the cost of providing curing facilities for the strength specimens, per paragraph 306–4.1a(4), and coring and filling operations, per paragraph 306–4.1b(2).

a. Compressive Strength.

(1) Lot Size. A strength lot will consist of:

One day's production not to exceed approximately 2,000 cubic yards

A half day's production where a day's production is expected to consist of between approximately 2,000 cubic yards and approximately 4,000 cubic yards

Similar subdivisions for a day's production of over 4,000 cubic yards

If a single day's production is expected to be less than approximately 1,000 cubic yards but more than approximately 500 cubic yards, it will become two (2) sublots and added to the next lot, i.e., n=6.

If a single day's production is expected to be less than approximately 500 cubic yards, it will become one sublot for the next lot, i.e., n=5.

(2) Sampling. Each lot will be divided into four equal sublots. One specimen will be made by the Engineer for each sublot from the plastic econocrete delivered to the job site to determine strength. The Engineer will determine sampling locations in accordance with random sampling procedures contained in ASTM D 3665. The econocrete will be sampled in accordance with ASTM C 172.

The Engineer will convert the above cubic yard lot sizes into equivalent square yard areas in the increments shown above.

Test ages of the specimens will be 7 days and 28 days. One set of specimens (one 7–day cylinder and three 28–day cylinders) will be made for every sublot placed. Each set of specimens will be molded from the same batch of econocrete and will consist of one cylinder to provide a 7–day compressive strength test and two cylinders to provide a 28–day compressive test (the extra cylinder will be a back–up in the event of an obvious defective cylinder).

When it appears that the 7-day test specimens will fail to conform to the requirements for strength, the Engineer will have the right to order changes in the econocrete sufficient to modify the strength to meet these requirements. When a satisfactory relationship between 7–day and 28–day strengths has been established and approved, the 7–day test results may be used as an indication of the 28–day strengths However, the 7–day test results will not replace the results of the 28–day tests if the 28–day results fall below the requirements.

(3) Testing. Specimens will be made in accordance with ASTM C 31 and the compressive strength of each specimen will be determined in accordance with ASTM C 39.

(4) Curing. Provide adequate facilities for the initial curing of test specimens. During the 48 hours after molding, the temperature immediately adjacent to the specimens must be maintained in the range of 60° to 80°F (16° to 27°C), and loss of moisture from the specimens must be prevented. The specimens may be stored in tightly constructed wooden boxes, damp sand pits, under wet burlap in favorable weather, in heavyweight closed plastic bags, or by other suitable methods provided the temperature and moisture loss requirements are met.

(5) Partial Lots. When operational conditions cause a strength lot to be terminated before the specified four tests have been made for the lot, the following procedure will be used to adjust the lot size and the number of tests for the lot:

Three sublets will constitute a lot. One or two sublots, will be incorporated into the next lot (or the previous lot if at the end of production) and the total number of sublots shall be used in the acceptance criteria calculation, i.e., n=5 or n=6.

b. Pavement Thickness.

(1) Lot Size. A thickness lot will consist of 4,000 square yards (3,350 square meters).

(2) Sampling. Take one core for each thickness lot. The Engineer will determine sampling locations in accordance with random sampling procedures contained in ASTM D 3665.

When measurement taken in accordance Section 306–4.1(b)3 shows the core is deficient more than 0.5 inch (12 mm) from the plan thickness, take two additional cores at random and use in determining the average thickness for that lot.

Cut cores neatly with a core drill. Furnish all tools, labor, and materials for cutting samples and filling the cored hole. Fill core holes with a non–shrink grout approved by the Engineer within one day after sampling.

(3) Testing. The Engineer will determine the thickness of the cores by the average caliper measurement in accordance with ASTM C 174.

306–4.2 ACCEPTANCE CRITERIA.

a. General. Acceptance will be based on the following characteristics of the completed pavement:

(1) Compressive strength
(2) Thickness
(3) Smoothness

Compressive strength will be evaluated for acceptance in accordance with paragraph 306–4.2b. The Engineer will evaluate thickness for acceptance in accordance with paragraph 306–4.2c. The Engineer will evaluate smoothness in accordance with paragraph 306–4.2d.

The Engineer may at any time, not withstanding previous plant acceptance, reject and require the Contractor to dispose of any batch of econocrete 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.

b. Compressive Strength. Acceptance of each lot of in–place econocrete for compressive strength will be based on the percentage of material within specification limits (PWL). The PWL plan considers the variability (standard deviation) of the material and the testing

procedures, as well as the average (mean) value of the test results. If a material with high variability is produced, then a higher average strength must be maintained in order to achieve a PWL of 80 percent or more.

The percentage of material within limits will be determined in accordance with procedures specified in Section 110, Method of Estimating Percentage of Material within Specification Limits (PWL) of the General Requirement and Covenants.

The lower specification limit (L) for compressive strength will be the 28-day design strength given in paragraph 306–3.1, Proportioning. If the PWL of the lot equals or exceeds 80 percent for compressive strength, the pay factor for the lot will be 1.0, as determined in accordance with paragraph 306–7.1a. If the PWL is less than 80 percent, the pay factor for the lot will be less than 1.0, as determined in accordance with paragraph 306–7.1a.

c. Pavement Thickness. Acceptance of each lot of in–place econocrete will be based on the following:

If the measurement of the core from a lot is not deficient more than 0.5 inch (12 mm) from the Plan thickness, the pay factor will be 1.0. When three cores were taken in accordance with 306–4.1(b)2, and the average of the three cores is not deficient more than 0.5 inch (12 mm) from Plan thickness, the pay factor will be 1.0. If the average of three cores is deficient more than 0.5 inch (12 mm) from the Plan thickness, the entire lot will be removed and replaced at the Contractor's expense or be permitted to remain in–place at an adjusted payment in accordance with 306–7.1b.

d. Pavement Smoothness. Surface testing and corrections to the plastic econocrete will be in accordance with 306–3.11(c). As soon as the econocrete has hardened sufficiently, the Engineer will test the econocrete surface with a 16–foot (5 m) straightedge or other specified device. Surface smoothness deviations shall not exceed 3/8 inch (10 mm) from a 16–foot (5 m) straightedge placed in any direction.

Areas in a slab showing high spots of more than 3/8 inch (10 mm) but not exceeding 3/4 inch (19 mm) in 16 feet (5 m) will be marked. Grind down high spots with an approved grinding machine to an elevation that will fall within the tolerance of 3/8 inch (10 mm) or less. Where the departure from correct cross section exceeds 3/4 inch (19 mm), remove the pavement and replace it at the expense of the Contractor when so directed by the Engineer.

CONTRACTOR QUALITY CONTROL

306–5.1 QUALITY CONTROL PROGRAM. Develop a Quality Control Program in accordance with Section 100, Method of Estimating Percentage of Material within Specification Limits, of the General Provisions. The program shall address all elements that effect the quality of the pavement including, but not limited to:

a. Mix Design

b. Aggregate Gradation

c. Quality of Materials

d. Stockpile Management

e. Proportioning

f. Mixing and Transportation

g. Placing and Consolidation

h. Compressive Strength

k. Finishing and Curing

l. Surface Smoothness

m. Thickness

NOTE TO SPECIFIER:
When the design requires paving an area less than 600 square yards (500 square meters), the Engineer may request modification to this requirement by Special Provisions.

306–5.2 QUALITY CONTROL TESTING. 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. Include in the testing program, but not necessarily limited to, tests for aggregate gradation, aggregate moisture content, slump, and air content.

Develop a Quality Control Testing Plan as part of the Quality Control Program.

a. Aggregate.

(1) Gradation. Make a sieve analysis at least twice daily in accordance with ASTM C 136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

(2) Moisture Content. If an electric moisture meter is used, make at least two direct measurements of moisture content per week to check the calibration. If direct measurements are made instead of using an electric meter, make two tests per day. Make tests in accordance with ASTM C 70 or ASTM C 566.

b. Slump. Perform four slump tests for each lot of material produced in accordance with the lot size defined in Section 306–4.1. Make one test for each sublot. Perform slump tests in accordance with ASTM C 143 from material randomly sampled from material discharged from trucks at the paving site. Take material samples in accordance with ASTM C 172.

c. Air Content. Perform four air content tests, for each lot of material produced in accordance with the lot size defined in Section 306–4.1. Make one test for each sublot. Perform air content tests in accordance with ASTM C 231 for gravel and stone coarse aggregate and ASTM C 173 for slag or other porous coarse aggregate, from material randomly sampled from trucks at the plant site. Take material samples in accordance with ASTM C 172.

306–5.3 CONTROL CHARTS. Maintain linear control charts for aggregate gradation, slump, and air content.

Post control charts in a location satisfactory to the Engineer and keep it 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 test results. Use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the projected data during production indicates a potential problem and satisfactory corrective action is not being taken, the Engineer may halt production or acceptance of the material.

a. Aggregate Gradation. Record the running average of the last five gradation tests for each control sieve on linear control charts. Superimpose specification limits contained in Tables 1 on the Control Chart for job control.

b. Slump and Air Content. Maintain linear control charts both for individual measurements and range (i.e. difference between highest and lowest measurements) for slump and air content in accordance with the following Action and Suspension Limits.

TABLE 1. CONTROL CHART LIMITS
Based on Sample Size n=4

Control Parameter	*Individual Measurements*		*(n=4)*
	Action Limit	*Suspension Limit*	*Range Suspension Limit*
Slump	±1 inch (25 mm)	±1.5 inch (38 mm)	±2.0 inch (51 mm)
Air	±1.2%	±1.8%	±2.8%

The individual measurement control charts shall use the mix design target values as indicators of central tendency.

306–5.4 CORRECTIVE ACTION. Indicate on the Quality Control Plan that appropriate action shall be taken when the process is believed to be out of control. Detail in the Quality Control Plan what action will be taken to bring the process into control and detail 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.

a. Aggregate Gradation. When two consecutive averages of five tests are outside of the Tables 1 specification limits, take immediate steps, including a halt to production, to correct the grading.

b. Aggregate Moisture Content. Whenever the moisture content of the fine or coarse aggregate changes by more than 0.5 percent, adjust the scale settings for the aggregate batcher(s) and water batcher.

c. Slump. Halt production and make appropriate adjustments whenever:

(1) One point falls outside the Suspension Limit line for individual measurements or range; or

(2) Two points in a row fall outside the Action Limit line for individual measurements.

d. Air Content. Halt production and adjust the amount of air–entraining admixture whenever:

(1) One point falls outside the Suspension Limit line for individual measurements or range; or

(2) Two points in a row fall outside the Action Limit line for individual measurements.

Whenever a point falls outside the Action Limits line, calibrate the air–entraining admixture dispenser to ensure that it is operating correctly and with good reproducibility.

METHOD OF MEASUREMENT

306–6.1 Econocrete Subbase Course will be measured for payment by the number of square yards in–place, completed and accepted.

The Econocrete Subbase Contractor Quality Control Program will be measured for payment by the square yards of econocrete subbase course placed, completed and accepted.

BASIS OF PAYMENT

306–7.1 GENERAL. Payment for an accepted lot of Econocrete Subbase Course will be made at the Contract unit price per square yard adjusted in accordance with paragraphs 306–7.1a,b. Payment will be full compensation for all labor, materials, tools equipment, and incidentals required to complete the Work as specified herein and on the drawings.

The Quality Control Program, Econocrete Subbase Course will be measured for payment by the square yard of econocrete placed, completed and accepted.

a. Basis of Adjusted Payment for Compressive Strength (PF_S). A pay factor for compressive strength will be determined in accordance with the following schedule when the percent within specification limits (PWL) equals or exceeds 60 percent.

Percent within limits (PWL)	Pay Factor for Compressive Strength (PF_S)
80–100	$0.76 + 0.003\ PWL$
60–79	$0.00017\ PWL^2 - 0.0105\ PWL + 0.75$

When the PWL is below 60 percent, the lot will be removed and replaced. However, the Engineer may decide to accept the deficient lot. In that case, if the Engineer and Contractor agree in writing that the lot shall not be removed, it will be paid for at 50 percent of the Contract unit price.

b. Basis of Adjusted Payment for Thickness (PF_T). A pay factor for thickness will be determined in accordance with the following:

If the pay factor in accordance with 306–4.2c is 1.0, full payment will be made.

If the pay factor is less than 1.0, and the Engineer and Contractor agree in writing that the lot shall not be removed, the deficient lot may be paid for at 75 percent of the Contract unit price.

306–7.2 PAYMENT FOR QUALITY CONTROL PROGRAM. Payment for the Quality Control Program, Econocrete Subbase Course will be made at the Contract unit price per square yard for Quality Control Program, Econocrete Subbase Course.

Payment will be made under:

Pay Item P30601	Econocrete Subbase Course, per square yard
Pay Item P30602	Econocrete Subbase Contractor Quality Management Program, per square yard

Measurement and Payment will only be made for Items included in the Schedule of Prices. The cost of all Work required by the Contract Documents will be included in the Pay Items contained in the Schedule of Prices.

TESTING REQUIREMENTS

ASTM C 31	Making and Curing Concrete Test Specimens in the Field
ASTM C 39	Compressive Strength of Cylindrical Concrete Specimens
ASTM C 70	Surface Moisture in Fine Aggregate
ASTM C 136	Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143	Test for Slump of Portland Cement Concrete
ASTM C 172	Sampling Freshly Mixed Concrete
ASTM C 173	Test for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 174	Measuring Length of Drilled Concrete Cores
ASTM C 192	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	Test for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 560	Freezing and Thawing Test of Compacted Soil Cement
ASTM C 566	Total Moisture Contents of Aggregates by Drying
ASTM C 1077	Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM D 75	Standard Practice for Sampling Aggregates
ASTM D 3665	Random Sampling of Construction Materials
AASHTO T 26	Quality of Water to be Used in Concrete

MATERIAL REQUIREMENTS

ASTM C 33	Specification for Concrete Aggregates
ASTM C 94	Specification for Ready–Mixed Concrete
ASTM C 150	Specification for Portland Cement
ASTM C 260	Specification for Air–Entraining Admixtures for Concrete
ASTM C 309	Specification for Liquid Membrane–Forming Compounds
ASTM C 494	Specification for Chemical Admixtures for Concrete
ASTM C 618	Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 977	Specifications for Emulsified Asphalt
ASTM C 989	Specification for Ground Granulated Blast–Furnace Slag for Use in Concrete and Mortars

SPECIFICATION P–401. PLANT MIX BITUMINOUS PAVEMENTS

DESCRIPTION

401–1.1 This Work consists of a surface, base, or leveling course composed of mineral aggregate and bituminous material mixed in a central mixing plant and placed on a prepared course in accordance with these Specifications and shall conform to the lines, grades, thickness, and typical cross sections shown on the Plans. Construct each course to the depth, typical section, or elevation required by the Plans and have it rolled, finished, and approved before the placement of the next course.

NOTE TO SPECIFIER:
This specification is intended to be used for pavements subject to aircraft loadings. State highway department specifications may be used for access roads, perimeter roads, and other pavements not subject to aircraft loading.

See note in paragraph 401–3.2 regarding pavements designed for aircraft gross weights of 12,500 pounds (5,662 kg) or less.

MATERIALS

401-2.2 AGGREGATE. Aggregates shall consist of crushed stone or crushed gravel with or without sand or other inert finely divided mineral aggregate. The portion of materials retained on the No. 8 sieve is coarse aggregate. The portion passing the No. 8 (2.36 mm) sieve and retained on the No. 200 (0.075 mm) sieve is fine aggregate, and the portion passing the No. 200 (0.075 mm) sieve is mineral filler.

a. Coarse Aggregate. Coarse aggregate consists of sound, tough, durable particles, free bituminous material and is free from organic matter and other deleterious substances. The percentage of wear shall not be greater than 40 percent when tested in accordance with ASTM C 131. The sodium sulfate soundness loss shall not exceed 10 percent, or the magnesium sulfate soundness loss shall not exceed 13 percent, after five cycles, when tested in accordance with ASTM C 88.

NOTE TO SPECIFIER:
The FAA recommendations for percentage of wear, sodium sulfate loss, and magnesium sulfate soundness loss have been included in the Standard Specification. Aggregates with a higher percentage loss or wear may be specified in the Special Provisions, provided a satisfactory service record under similar conditions of service and exposure has shall have been demonstrated.

Specifier should check the paverment design and indicate the aircraft gross weight on the Plans or in the Special Provisions.

Aggregate for pavements designed for aircraft gross weights of 60,000 pounds (27,000kg) or more, shall contain at least 70 percent by weight of individual pieces having two or more fractured faces and 85 percent by weight having at least one fractured face. Aggregate for pavements designed for aircraft gross weights less than 60,000 pounds (27,000kg), shall contain at least 50 percent by weight of individual pieces having at least two fractured faces and 65 percent by weight having at least one fractured face. If the aircraft gross weight for pavement design is not specified on the Plans or in the Special Provisions, the requirements for aircraft gross weights of 60,000 pounds (27,200 kg) or more shall apply for pavement constructed under this Specification. The area of each face shall be equal to at least 75 percent of the smallest midsection 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. Fractured faces shall be obtained by crushing.

The aggregate shall not contain more than 8 percent, by weight, of flat or elongated pieces, when tested in accordance with ASTM D 4791. A flat or elongated piece is one having a ratio, between the maximum and minimum dimensions of a circumscribing rectangular prism, exceeding five to one.

NOTE TO SPECIFIER:
The Engineer shall specify the design aircraft gross weight on the Plans or in the Special Provisions. The following FAA requirements were incorporated into the Standard Specification.

For pavements designed for aircraft gross weights of 60,000 pounds (27,200 kg) or more the Engineer shall specify 70 percent for two fractured faces and 85 percent for one fractured face. For pavements designed for aircraft gross weights less than 60,000 pounds (27,200 kg), the Engineer shall specify 50 percent for two fractured faces and 65 percent for one fractured face.

b. Fine Aggregate. Fine aggregate shall consist of clean, sound, 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 and shall contain no clay balls. The fine aggregate, including any blended material for the find aggregate, shall have a plasticity index of not more than 6 and a liquid limit of not more than 25 when tested in accordance with ASTM D 4318.

Natural (non-manufactured) sand may be used to obtain the gradation of the aggregate blend or to improve the workability of the mix. The amount of sand to be added will be adjusted to produce mixtures conforming to requirements of this specification. The fine aggregate shall not contain more than 20 percent natural sand by weight of total aggregates.

The aggregate shall have sand equivalent values of 35 or greater when tested in accordance with ASTM D 2419.

NOTE TO SPECIFIER:
The addition of natural sand to a mix containing all crushed coarse and fine aggregates will normally increase its workability and compactability. However, the addition of excessive amounts of natural sand tends to decrease the stability of the mixture. The requirement for a maximum of 20 percent natural sand may be included for locations where low stabilities are a chronic problem. This requirement was included in the Standard Specification.

c. Sampling. ASTM D 75 shall be used in sampling coarse and fine aggregate, and ASTM C 183 shall be used in sampling mineral filler.

401–2.2 MINERAL FILLER. If filler, in addition to that naturally present in the aggregate, is necessary, it shall meet the requirements of ASTM D 242.

401–2.3 BITUMINOUS MATERIAL. Provide bituminous material either conforming to ASTM D 946, penetration grade 85–100, or conforming to ASTM D 3381, viscosity grade AC–10, , unless otherwise specified on the Plans or in the Special Provisions.

NOTE TO SPECIFIER:
The Engineer shall prepare a Special Provision for the grade and ASTM specification of bituminous material, if different specifications are required from those given, based on geographical location and climatic conditions. The Engineer shall specify both the penetration grade and the viscosity grade of the asphalt material. (Example Special Provision. The Asphalt Material for Plant Mix Bituminous Pavements shall conform to ASTM D 946, penetration grade _____, or conform to ASTM D 3381, viscosity grade _____.) Table VI–1, Selecting Asphalt Grade, contained in the Asphalt Institute's Manual Series–1 (MS–1) provides guidance on the selection of asphalt type. For cold climates, Table 2 of ASTM D 3381 may be specified to minimize the susceptibility for thermal cracking. Other specifications to minimize cracking, such as the addition of Penetration Index, Pen–Vis number, or performance based asphalts (PBA) can also be specified with approval of the Federal Aviation Administration. Grades of some materials are listed below:

Furnish vendor's certified test reports for each lot of bitumen shipped to the project. The vendor's certified test report for the bituminous material can be used for acceptance or tested independently by the Engineer.

401–2.4 PRELIMINARY MATERIAL ACCEPTANCE. Prior to delivery of materials to the job site, submit certified test reports to the Engineer for the following materials:

a. Coarse Aggregate.

(1.) Percent of wear.
(2.) Soundness.

b. Fine Aggregate.

(1.) Liquid limit.
(2.) Plastic index.

c. Mineral Filler.

d. Bituminous Material.

The certification(s) must show the appropriate ASTM test(s) for each material, the test results, and a statement that the material meets the Specification requirement.

The Engineer may request samples for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable Specifications.

COMPOSITION

401–3.1 COMPOSITION OF MIXTURE. The bituminous plant mix shall be composed of a mixture of well–graded aggregate, filler if required, and bituminous material. 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. Do not produce bituminous mixture for payment until a job mix formula has been approved by the Engineer. Design the bituminous mixture using procedures contained in Chapter 5, Marshall Method of Mix Design, of the Asphalt Institute's Manual Series No. 2 (MS–2), Mix Design Methods for Asphalt Concrete, and meet the requirements of Tables 1 and 2.

The design criteria in Table 1 are target values necessary to meet the acceptance requirements contained in Paragraph 401–5.2b. The criteria is based on a production process which has a material variability with the following standard deviations:

Stability (lbs.) = 270
Flow 0.01 inch(0.25 mm) = 1.5
Air Voids (%) = 0.65

If material variability exceeds the standard deviations indicated, the job mix formula and subsequent production targets should be based on a stability greater than shown in Table 1, and the flow and air voids should be targeted close to the mid–range of the criteria in order to meet the acceptance requirements.

If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867, is less than 75, reject the aggregates or the treat asphalt with an approved anti–stripping agent. Have a sufficient amount of anti–stripping agent added to the asphalt to produce a TSR of not less than 75. If an antistrip agent is required, provide it at no additional cost.

Submit the job mix formula to the Engineer at least 10 days prior to the start of paving operations and include as a minimum:

a. Percent passing each sieve size.

b. Percent of asphalt cement.

c. Asphalt viscosity or penetration grade.

d. Number of blows of hammer compaction per side of molded specimen.

e. Mixing temperature.

f. Compaction temperature.

g. Temperature of mix when discharged from the mixer.

h. Temperature–viscosity relationship of the asphalt cement.

i. Plot of the combined gradation on the Federal Highway Administration (FHWA) 45 power gradation curve.

j. Graphical plots of stability, flow, air voids, voids in the mineral aggregate, and unit weight versus asphalt content.

k. Percent natural sand.

l. Percent fractured faces.

m. Percent elongated particles.

n. Tensile Strength Ratio (TSR).

o. Antistrip agent (if required).

Submit samples to the Engineer, upon request, for job mix formula verification testing.

The job mix formula for each mixture is effective until modified in writing by the Engineer. Should a change in sources of materials be made, a new job mix formula must be approved by the Engineer before the new material is used.

NOTE TO SPECIFIER:
The Engineer may change the number of days the JMF shall be submitted prior to beginning paving by Special Provision.

The Marshall Design Criteria recommended by FAA are included in Table 1. The 75 blow Marshall design is specified; if the 50 blow design is desired, it should be specified in a Special Provision.

TABLE 1. MARSHALL DESIGN CRITERIA

Test Property	*Pavements Designed for Aircraft Gross Weights of 60,000 lbs (27,000 kg). or More or Tire Pressures of 100 psi (690 Pa) or More*	*Pavements Designed for Aircraft Gross Weight Less than 60,000 lbs (27,000 kg). or Tire Pressure Less Than 100 psi (690 Pa)*
Number of blows	75	50
Stability, lbs (N)	2150 (9560)	1350 (6000)
Flow, 0.01 in. (0.25 mm)	10–14	10–18
Air voids (percent)	2.8–4.2	2.8–4.2
Percent Voids in mineral aggregate	See Table 2	See Table 2

Utilize the 75 blow Marshall Mix Design for pavements designed for aircraft gross weights of 60,000 lbs. (27,000 kg) or more or tire pressures of 100 psi (690 Pa) or more unless otherwise specified in the Contract Documents.

TABLE 2. MINIMUM PERCENT VOIDS IN MINERAL AGGREGATE

Gradation No.	*Maximum Particle Size* *in.*	*mm.*	*Minimum Voids in Mineral Aggregate, percent* *Percent*
1	1–1/4	(30.0)	11
2	1	(25.0)	12
3	3/4	(19.0)	13
4	1/2	(12.5)	14

The mineral aggregate shall be of such size that the percentage composition by weight, as determined by laboratory screens, will conform to the gradation or gradations specified in Table 3 when tested in accordance with ASTM C 136 and C 117.

The gradations in Table 3 represent the limits that determine the suitability of aggregate for use from the sources of supply. The aggregate, as selected (and used in the JMF), shall have a gradation within the limits designated in Table 3 and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice versa, but shall be well graded from coarse to fine.

Deviations from the final approved mix design for bitumen content and gradation of aggregates shall be within the action limits for individual measurements as specified in Paragraph 401–6.5a. The limits still will apply if they fall outside the master grading band in Table 3.

The maximum size aggregate used cannot be more than one–half of the thickness of the course being constructed.

TABLE 3. AGGREGATE – BITUMINOUS PAVEMENTS

Percentage by Weight Passing Sieves					
Sieve Size		*Gradation Number*			
in.	mm.	No. 1 (1–1/4" max.)	No. 2 (1" max.)	No. 3 (3/4" max.)	No. 4 (1/2" max.)
1–1/4	30.0 mm	100	—	—	—
1	24.0 mm	86–98	100	—	—
3/4	19.0 mm	68–93	76–98	100	—
1/2	12.5 mm	57–81	66–86	79–99	100
3/8	9.5 mm	49–69	57–77	68–88	79–99
No. 4	4.75 mm	34–54	40–60	48–68	58–78
No. 8	2.36 mm	22–42	26–46	33–53	39–59
No. 16	1.18 mm	13–33	17–37	20–40	26–46
No. 30	0.600 mm	8–24	11–27	14–30	19–35
No. 50	0.300 mm	6–18	7–19	9–21	12–24
No. 100	0.150 mm	4–12	6–16	6–16	7–17
No. 200	0.075 mm	3–6	3–6	3–6	3–6
Asphalt Percent		4.5–7.0	4.5–7.0	5.0–7.5	5.5–8.0

The aggregate gradations shown are based on aggregates of uniform specific gravity. Correct the percentages passing the various sieves when aggregates of varying specific gravities are used, as indicated in the Asphalt Institute Manual Series No. 2 (MS–2), Chapter 3. Use Gradation No. 2 or No. 3 unless otherwise specified in the Contract Documents.

NOTE TO SPECIFIER:
The aggregate gradation may be changed by Special Provision.

Where locally–available aggregates cannot be economically blended to meet the grading requirements of the gradations shown, the gradations may be modified to fit the characteristics of such local aggregates with approval of the FAA. The modified gradation must produce a paving mixture that satisfies the mix design requirements.

For pavements designed to accommodate aircraft gross weights of 12,500 pounds (5,662 kg) or less, state highway department specifications for high–quality, hot–mix bituminous pavements that have a satisfactory performance record under equivalent loadings and exposure may be used.

401–3.3 RECYCLED ASPHALT CONCRETE. Recycled asphalt concrete shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, asphalt cement, and recycling agent, if necessary. RAP may be used for all courses.

The RAP shall be of a consistent gradation and asphalt content and may be obtained from the job site or an existing source.

All new aggregates used in the recycled mix shall meet the requirements of Paragraph 401–2.1, Aggregate. New bituminous material shall meet the requirements of Paragraph 401–2.3, Bituminous Material. Recycling agents shall meet the requirements of ASTM D 4552.

Design the recycled asphalt concrete mix using procedures contained in the Asphalt Institute's Manual Series Number 20 (MS–20), Asphalt Hot–Mix Recycling, in conjunction with MS–2. Meet the requirements of Paragraph 401–3.2, Job Mix Formula. In addition to the requirements of Paragraph 401–3.2, indicate the percent of reclaimed asphalt pavement, the percent and viscosity grade of new asphalt, the percent and grade of hot–mix recycling agent (if used), and the properties (including viscosity and penetration) of the asphalt blend.

Submit documentation to the Engineer, indicating that the mixing equipment proposed for use is adequate to mix the percentage of RAP shown in the job mix formula and meets all local and national environmental regulations.

NOTE TO SPECIFIER:
Delete this paragraph if recycled asphalt pavement is not to be allowed and include a sentence that RAP will not be permitted to be used in the Special Provisions or on the Plans.

Recycling agents should be used when the desired viscosity of the asphalt blend cannot be obtained using only a soft asphalt.

401–3.4 TEST SECTION. Prior to full production, prepare and place a quantity of bituminous mixture according to the job mix formula. Prepare enough mixture to construct a test section 300 feet (90 m) long and 20 to 30 feet (6 to 9 m) wide placed in two lanes, with a longitudinal cold joint, and to the same depth specified for the construction of the course that it represents. The underlying grade or pavement structure upon which the test section is to be constructed must be the same as the course to be constructed. Use the same type and weight equipment in construction of the test section on the remainder of the course represented by the test section.

Random samples will be taken at the plant and tested for stability, flow, and air voids in accordance with Paragraph 401–5.1a(2). Test for aggregate gradation and asphalt content in accordance with Paragraphs 401–6.3a and 3b, and evaluate in accordance with Paragraphs 401–6.5a and 5b. Take three randomly selected cores from the finished pavement mat, and three from the longitudinal joint. These will be tested in accordance with Paragraph 401–5.1b(4). Random sampling will be in accordance with procedures contained in ASTM D 3665.

Mat density and air voids will be evaluated in accordance with Paragraph 401–5.2f(1). Stability and flow will be evaluated in accordance with Paragraph 401–5.2f(2). Joint density will be evaluated in accordance with Paragraph 401–5.2f(3).

Voids in the mineral aggregate (VMA), for each plant sample, will be computed in accordance with procedures contained in Chapter 5, Marshall Method of Mix Design, of the Asphalt Institute's Manual Series No. 2 (MS–2), Mix Design Methods for Asphalt Concrete.

The test section will be considered acceptable if:

a. Stability, flow, mat density, air voids, and joint density are 90 percent or more within limits,

b. Gradation and asphalt content are within the action limits specified in Paragraphs 401–6.5a and 6.5b, and

c. The VMA is within the limits of Table 2.

If the initial test section should prove to be unacceptable, make the necessary adjustments to the job mix formula, plant operation, placing procedures, and/or rolling procedures. Place a second test section. If the second test section also does not meet Specification requirements, remove both sections at the Contractor's expense. Construct and evaluate additional test sections, as required, for conformance to the Specifications. Remove additional sections that are not acceptable at the Contractor's expense. Do not begin full production until an acceptable section has been constructed and accepted by the Engineer. The initial test section, whether acceptable or unacceptable, and any subsequent section that meets Specification requirements will be paid for in accordance with Paragraph 401–8.1 and 401–8.2.

Perform job mix control testing at the start of Plant production and in conjunction with the calibration of the plant for the job mix formula. Recognize that the aggregates produced by the Pant may not satisfy the gradation requirements or produce a mix that exactly meets the job mix formula. In those instances, it will be necessary to reevaluate and redesign the mix using plant–produced aggregates. Prepare specimens and determine the optimum bitumen content in the same manner as for the original design tests.

NOTE TO SPECIFIER:
The Standard Specification includes the FAA recommendation for a minimum test section of 300 feet (90 m) long and 20 feet to 30 (6 m to 9) wide. The test section affords the Contractor and the Engineer an opportunity to determine the quality of the mixture in place, as well as performance of the plant and laydown equipment.

Until the plant is producing the desired mix consistency, frequent testing may be necessary.

401–3.5 TESTING LABORATORY. The laboratory used to develop the job mix formula shall meet the requirements of ASTM D 3666. Submit a certification signed by the manager of the laboratory stating that it meets these requirements to the Engineer prior to the start of construction. The certification shall contain as a minimum:

a. Qualifications of personnel: laboratory manager, supervising technician, and testing technicians.

b. A listing of equipment to be used in developing the job mix.

c. A copy of the laboratory's quality control system.

d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

CONSTRUCTION METHODS

401–4.1 WEATHER LIMITATIONS. Do not place the bituminous mixture on a wet surface or when the surface temperature of the underlying course is less than specified in Table 4. The temperature requirements may be waived by the Engineer, if requested; however, meet all other requirements including compaction.

TABLE 4. BASE TEMPERATURE LIMITATIONS

Mat Thickness	*Base Temperature (Minimum)*	
	Deg. F	*Deg. C*
3 in. (75 mm) or greater	40	4
Greater than 1 in. (25 mm) but less than 3 in. (75 mm)	45	7
1 in. (25 mm) or less	50	10

401–4.2 BITUMINOUS MIXING PLANT Plants used for the preparation of bituminous mixtures shall conform to the requirements of ASTM D 995 with the following changes:

a. Requirements for All Plants.

(1.) Truck Scales. The bituminous mixture shall be weighed on approved scales furnished by the Contractor, or on public scales at the Contractor's expense. The scales will be inspected and sealed as often as the Engineer deems necessary to assure their accuracy. Scales shall conform to the requirements of the General Requirements and Covenants, Section 90–01, Measurement of Quantities.

(2.) Testing Facilities. Provide laboratory facilities at the plant or on the job site for the use of the Engineer's acceptance testing and the Contractor's quality control testing, in accordance with Paragraph 401–6.2, Testing Laboratory.

(3.) Inspection of Plant. 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 proportions; and checking the temperatures maintained in the preparation of the mixtures.

(4.) Storage Bins and Surge Bins. Paragraph 3.9 of ASTM D 995 is deleted. Instead, the following applies. Use of surge bins or storage bins for temporary storage of hot bituminous mixtures will be permitted as follows:

(a.) The bituminous mixture may be stored in surge bins for a period of time not to exceed 3 hours,

(b.) The bituminous mixture may be stored in insulated storage bins for a period of time not to exceed 24 hours.

Mix drawn from the bins must meet the same requirements as mix loaded directly into trucks.

If the Engineer determines that there is an excessive amount of heat loss, segregation, or oxidation of the mixture due to temporary storage, no overnight storage will be allowed.

401–4.3 HAULING EQUIPMENT. Use trucks for hauling bituminous mixtures with tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, lightly coat the truck beds with a minimum amount of paraffin oil, lime solution, or other approved material. Provide each truck with 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, insulate truck beds and securely fasten covers.

401–4.4 BITUMINOUS PAVERS. Provide self-propelled bituminous pavers, with an activated screed, heated if necessary, and capable of spreading and finishing courses of bituminous plant mix material 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 paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed must effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

Equip the paver with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor–directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent.

The controls must be capable of working in conjunction with any of the following attachments:

a. Ski–type device of not less than 30 feet (9.14 m) in length.

b. Taut stringline (wire) set to grade.

c. Short ski or shoe

d. Laser control.

NOTE TO SPECIFIER:
The FAA recommendation to require automatic grade controls for pavements serving aircraft over 60,000 pounds (27 200 kg) or more gross weight and on all runways was included in the standard specification. In some instances it may be advisable to specify the type of attachment required to guide the automatic control.

401–4.5 ROLLERS. Rollers of the vibratory, steel wheel, or pneumatic–tired type may be used as long as they are in good condition, capable of operating at slow speeds to avoid displacement of the bituminous mixture. Provide a sufficient number, type, and weight of rollers to compact the mixture to the required density while the mixture is still in a workable condition.

Do not use equipment that causes excessive crushing of the aggregate.

401–4.6 PREPARATION OF BITUMINOUS MATERIAL. Heat the bituminous material in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature. The temperature of the bituminous material 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 (160°C).

401–4.7 PREPARATION OF MINERAL AGGREGATE. Heat and dry the aggregate for the mixture prior to introduction into the mixer. The maximum temperature and rate of heating shall be such that no damage occurs to the aggregates. Do not exceed a temperature of 350°F (175°C) for the aggregate and mineral filler when the asphalt is added. Take particular care 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.

401–4.8 PREPARATION OF BITUMINOUS MIXTURE. Weigh or meter the aggregates and the bituminous material and introduce it into the mixer in the amount specified by the job mix formula.

Mix the combined materials until the aggregate obtains a uniform coating of bitumen and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture. Establish the wet mixing time for all plants, based on the procedure for determining the percentage of coated particles described in ASTM D 2489, 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, determine the minimum mixing time by dividing the weight of its contents at operating level by the weight of the mixture delivered per second by the mixer. Do not exceed a 0.5 percent moisture content of all bituminous mix upon discharge.

NOTE TO SPECIFIER:
For batch plants, wet mixing time begins with the introduction of bituminous material into the mixer and ends with the opening of the mixer discharge gate. Distribution of aggregate and bituminous material as they enter the pugmill, speed of mixer shafts, and arrangement and pitch of paddles are factors governing efficiency of mixing. Prolonged exposure to air and heat in the pugmill harden the asphalt film on the aggregate. Mixing time, therefore, should be the shortest time required to obtain uniform distribution of aggregate sizes and thorough coating of aggregate particles with bituminous material.

401–4.9 PREPARATION OF THE UNDERLYING SURFACE. Clean all dust and debris from the underlying course immediately before placing the bituminous mixture. If required by the Contract Specifications, apply a prime coat or tack coat in accordance with Specification P–602 or P–603.

NOTE TO SPECIFIER:
Specifications for prime and tack coat are included in the Standard Specifications. If prime or tack coats are desired on a project, the appropriate Pay Items should be included in the Schedule of Prices. Refer to Items P–602 and P–603 for comments on appropriate usage of these Items.

401–4.10 TRANSPORTING, SPREADING, AND FINISHING. Transport the bituminous mixture from the mixing plant to the site in vehicles conforming to the requirements of Paragraph 401–4.3, Hauling Equipment. Schedule deliveries so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Provide adequate artificial lighting during night placements. Do not permit hauling over freshly placed material until the material has been compacted, as specified, and allowed to cool to ambient atmospheric temperature.

NOTE TO SPECIFIER:
The FAA will allow use of a material transfer vehicle. A material transfer vehicle allows the paver to be operated almost continuously without stopping between truckloads of mix, if a continuous supply of mix is available from the asphalt plant.

Place and compact the mix at a temperature suitable for obtaining density, surface smoothness, and other specified requirements but not less than 250°F (107°C).

Upon arrival, spread the mixture to the full width by an approved bituminous paver. Strike it off in a uniform layer of a depth that, when the work is completed, it will have the required thickness and conform to the grade and contour indicated. Regulate the speed of the paver to eliminate pulling and tearing of the bituminous mat. Unless otherwise directed, begin placement of the mixture along the centerline of a crowned section or on the high side of areas with a one–way slope. Place the mixture in consecutive adjacent strips having a minimum width of 12.5 feet except where edge lanes require less width to complete the area. The longitudinal joint on new pavement in one course must offset the longitudinal joint in the course immediately below by at least 1 foot (300 mm); however, the joint in the top course shall be at the centerline of the pavement. Offset transverse joints in one course by at least 10 feet (3 m) from transverse joints in the previous layer.

Offset transverse joints in adjacent lanes a minimum of 10 feet (3 m).

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread, raked, and luted by hand tools.

NOTE TO SPECIFIER:
The Engineer should specify the widest paving lane practicable in an effort to hold the number of longitudinal joints to a minimum. The Standard Specification required a minimum 12.5 foot paving lane. This could be changed by Special Provision if runway width and other conditions make it desirable.

401–4.11 COMPACTION OF MIXTURE. After placing, thoroughly and uniformly compact the mixture by rolling. Compact the surface as soon as possible when the mixture 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 is at the discretion of the Contractor.

Drive the roller slowly at all times, to avoid displacement of the hot mixture and to be effective in compaction. Immediately correct displacement occurring as a result of reversing the direction of the roller, or from other causes.

Furnish sufficient rollers to handle the output of the Plant. Continue rolling until the surface texture is uniform, true to grade and cross section, and the required field density is obtained.

To prevent adhesion of the mixture to the roller, keep the wheels properly moistened (and scrapers used), but do not use excessive water.

In areas not accessible to the roller, thoroughly compact the mixture with hot hand tampers.

Remove and replace mixture that becomes loose and broken, mixed with dirt, contains check–cracking, or is otherwise defective with fresh hot mixture and compact it immediately to conform to the surrounding area. Do this Work at the Contractor's expense. Skin patching is not allowed.

401–4.12 JOINTS. Form joints to ensure a continuous bond between the courses and to obtain required density. Make the joints with the same texture as other sections of the course and meet the requirements for smoothness and grade.

Do not allow the roller to pass over the unprotected end of the freshly laid mixture except when necessary to form a transverse joint. When necessary to form a transverse joint, make it by means of placing a bulkhead or by tapering the course. Cut back the tapered edge to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. In both methods give all contact surfaces a tack coat of bituminous material before placing any fresh mixture against the joint.

Cut back longitudinal joints that are irregular, damaged, or defective to expose a clean, sound surface for the full depth of the course. Tack all contact surfaces a with coat of bituminous material prior to placing any fresh mixture against the joint.

Tack coat for joints is considered incidental and the cost included in the price for Bituminous Surface Course.

MATERIAL ACCEPTANCE

401–5.1 ACCEPTANCE SAMPLING AND TESTING. 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 coring as required in this Specification shall be completed by Contractor). Testing organizations performing these tests shall meet the requirements of ASTM D 3666.

a. Plant–Produced Material. Plant–produced material will be tested for stability, flow, and air voids on a lot basis. Sampling will be from material deposited into trucks at the plant or from trucks at the job site. A lot will consist of:

One day's production not to exceed 2,000 tons (1,814,000 kg) or

A half day's production where a day's production is expected to consist of between 2,000 and 4,000 tons (1,814,000 and 3,628,000 kg), or

Similar subdivisions for tonnages over 4,000 tons (3,628,000 kg).

Where more than one plant is simultaneously producing material for the job, the lot sizes shall apply separately for each plant.

(1.) Sampling. Each lot will consist of four equal sublots Sufficient material for preparation of test specimens will be sampled by the Engineer on a random basis, in accordance with the procedures contained in ASTM D 3665. One set of laboratory compacted specimens will be prepared for each sublot in accordance with ASTM D 1559, Paragraph 4.5, at the number of blows required by Paragraph 401–3.2, Table 1. Each set of laboratory compacted specimens will consist of three test portions prepared from the same sample increment.

The sample of bituminous mixture may be put in a covered metal tin and placed in an oven for not more than 30 minutes to maintain the heat. The compaction of the specimens should be as specified in the job mix formula.

(2.) Testing. Sample specimens will be tested for stability and flow in accordance with ASTM D 1559, Paragraph 5. Air voids will be determined by the Engineer in accordance with ASTM D 3203.

Prior to testing, the Engineer will measure the bulk specific gravity of each test specimen in accordance with ASTM D 2726 or D 1188, whichever applies, for use in computing air voids and pavement density.

For air voids determination, the theoretical maximum specific gravity of the mixture will be measured twice for each lot in accordance with ASTM D 2041, Type C or D container. Samples will be taken on a random basis in accordance with ASTM D 3665. The value used in the voids computation for each sublot will be the average of the two maximum specific gravity measurements for the lot.

The stability, flow, and air voids for each sublot will be computed by averaging the results of the three test specimens representing that sublot.

(3) Acceptance. The Engineer will determine acceptance of plant produced material for stability, flow, and air voids in accordance with the requirements of Paragraph 401–5.2b.

b. Field Place Material. Material placed in the field will be tested for mat and joint density on a lot basis.

(1.) Mat Density. The lot size will be the same as that indicated in Paragraph 401–5.1a and will be divided into 4 equal sublots. Take one core of finished, compacted materials from each sublot. The Engineer will determine core locations on a random basis in accordance with procedures contained in ASTM D 3665. Do not take cores closer than one foot from a transverse or longitudinal joint.

(2.) Joint Density. The lot size will be the total length of longitudinal joints constructed by a lot of material as defined in Paragraph 401–5.1a. The lot will be divided into 4 equal sublots.

Take one core of finished, compacted materials from each sublot. The Engineer will determine core locations on a random basis in accordance with procedures contained in ASTM D 3665.

(3.) Sampling. Cut samples neatly with a core drill. Use a core drill bit with a cutting edge of hardened steel or other suitable material with diamond chips embedded in the metal cutting edge. The minimum diameter of the sample shall be 3 inches. Discard samples that are clearly defective, as a result of sampling, and take another sample. Furnish all tools, labor, and materials for cutting samples and filling the cored pavement. Fill cored holes in a manner acceptable to the Engineer and within one day after sampling.

(4.) Testing. The bulk specific gravity of each cored sample will be measured by the Engineer in accordance with ASTM D 2726 or D 1188, whichever is applicable. The percent compaction (density) of each sample will be determined by

dividing the bulk specific gravity of each sublot sample by the average bulk specific gravity of all laboratory prepared specimens for the lot, as determined in Paragraph 401–5.1a(2).

(5.) Acceptance. The Engineer will determine acceptance of field placed material for mat density in accordance with the requirements of Paragraph 401–5.2c. Acceptance for joint density will be determined in accordance with the requirements of Paragraph 401–5.2d.

c. Partial Lots – Plant–Produced Material. When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot, the following procedure will be used to adjust the lot size and the number of tests for the lot.

The last batch produced where production is unexpectedly halted will be sampled and its properties will be considered as representative of the particular sublot from which it was taken. Where three sublots are produced, they shall constitute a lot. Where one or two sublots are produced, they shall be incorporated into the next lot and the total number of sublots shall be used in the acceptance plan calculation, i.e., n = 5 or n = 6, for example.

d. Partial Lots – Field Placed Material. The lot size for field placed material will correspond to that of the plant material, except that in no case shall less than three (3) cored samples be obtained, i.e., n=3.

401–5.2 ACCEPTANCE CRITERIA.

a. General. Acceptance will be based on the following characteristics of the bituminous mixture and completed pavement as well as the implementation of the Contractor's Quality Control Plan and test results:

(1.) Stability
(2.) Flow
(3.) Air voids
(4.) Mat density
(5.) Joint density
(6.) Thickness
(7.) Smoothness
(8.) Grade

Stability, flow, and air voids will be evaluated for acceptance in accordance with Paragraph 401–5.2b. Mat density will be evaluated for acceptance in accordance with Paragraph 401–5.2c. Joint density will be evaluated for acceptance in accordance with Paragraph 401–5.2d.

Acceptance for mat density and air voids will be based on the criteria contained in Paragraph 401–5.2f(1). Acceptance for stability and flow will be based on the criteria contained in Paragraph 401–5.2f(2). Acceptance for joint density will be based on the criteria contained in Paragraph 401–5f(3). The Engineer will evaluate thickness for compliance in accordance with Paragraph 401–5.2f(4). Acceptance for smoothness will be based on the criteria contained in Paragraph 401–5.2f(5). Acceptance for grade will be based on the criteria contained in Paragraph 401–5.2f(6).

The Engineer may at any time, notwithstanding previous plant acceptance, reject and require the Contractor to dispose of any batch of bituminous mixture which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, or improper mix temperature. Such rejection may be based on only visual inspection or temperature measurements. 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 the material was erroneously rejected, payment will be made for the material at the Contract unit price.

b. Stability, Flow, Air Voids. Acceptance of each lot of plant produced material for stability, flow, and air voids will be based on the percentage of material within specification limits (PWL). The PWL plan considers the variability (standard deviation) of the material and the testing procedures, as well as the average (mean) value of the test results. If a material with high variability is produced, the production target must be adjusted as outlined in Paragraph 401–3.2 to achieve a PWL of 90 or more.

c. Mat Density. Acceptance of each lot of in–place pavement for mat density will be based on the percentage of material within specification limits (PWL). If a material with high variability is produced, then a higher target density must be maintained in order to achieve a PWL of 90 or more.

d. Joint Density. Acceptance of each lot of in–place pavement for joint density will be based on the percentage of material within specification limits (PWL). If a material with high variability is produced, then a higher target density must be maintained in order to achieve a PWL of 90 or more.

e. Percentage of Material Within Specification Limits (PWL). The percentage of material within specification limits (PWL) will be determined in accordance with procedures specified in Section 110 of the General Provisions. The specification tolerance limits (L) and (U) are contained in Table 5.

f. Acceptance Criteria.

(1.) Mat Density and Air Voids. If the PWL of the lot equals or exceeds 90 percent, the lot will be acceptable. If the PWL is less than 90 percent, payment will be made in accordance with Paragraph 401–8.1a.

(2.) Stability and Flow. If the PWL of the lot equals or exceeds 90 percent, the lot will be acceptable. If the PWL is less than 90 percent, determine the reason and take corrective action. If the PWL is below 80 percent, stop production and make adjustments to the mix.

(3.) Joint Density. If the PWL of the lot equals or exceeds 90 percent, the lot will be acceptable. If the PWL is less than 90 percent, evaluate the method of compacting joints. If the PWL is below 80 percent, stop production until the reason for poor compaction can be determined and corrected.

(4.) Thickness. Thickness will be evaluated for compliance by the Engineer to the requirements shown on the Plans. Measurements of thickness will be made by the Engineer using the cores extracted for each sublot for density measurement.

(5.) Smoothness. The finished surfaces of the pavement cannot vary more than 1/4 inch for the surface course or 3/8 inch for base course. Each lot will be evaluated with a 12–foot (3.6 m) straightedge. The lot size shall be 2,000 square yards (1,650 square meters). Measurements will be made perpendicular and parallel to the centerline at distances not to exceed 50 feet (15.2 m). When more than 15 percent of all measurements within a lot exceed the specified tolerance, remove the deficient area and replace with new material. Remove sufficient material to allow at least one inch of asphalt concrete to be placed. Skin patching is not permitted. High points may be ground off.

NOTE TO SPECIFIER:
The FAA recommendation to require a smoothness specification of 3/8 inch (9.5 mm) for base course and 1/4 inch (6.2 mm) for surface course was included in the standard specification.

A recommended lot size of 2,000 square yards (1,650 square meters) was also included.

(6.) Grade. Do not vary the finished surface of the pavement from the gradeline elevations and cross sections shown on the Plans by more than 1/2 inch (12.70 mm). The finished grade of each lot will be determined by running levels at intervals of 50 feet (15.2 m) or less longitudinally and transversely to determine the elevation of the completed pavement. The lot size will be 2,000 square yards (1,650 square meters). When more than 15 percent of all the measurements within a lot are outside the specified tolerance, remove the deficient area and replace with new material. Remove sufficient material to allow at least one inch of asphalt concrete to be placed. Skin patching for correcting low areas is not be permitted. High points may be ground off.

NOTE TO SPECIFIER:
A minimum lot size of 2,000 square yards (1,650 square meters) is recommended by FAA and was included in the Standard Specification. The size may be changed by Special Provision.

TABLE 5. ACCEPTANCE LIMITS STABILITY, FLOW, AIR VOIDS, DENSITY

Test Property	*Pavements Designed for Aircraft Gross Weights of 60,000 lbs.(27,000 kg) or More or Tire Pressure Greater Than 100 psi (690 Pa)*		*Pavements Designed for Aircraft Gross Weight Less than 60,000 lbs.(27,000 kg) or Tire Pressure Less Than 100 psi (690 Pa)*	
Number of Blows	75		50	
	Specification Tolerance		Specification Tolerance	
	L	U	L	U
Stability, min. pounds (N)	1800 (8000)	—	1000 (4450)	—
Flow, 0.01–inch (0.25 mm)	8	16	8	20
Air voids total mix (percent)	2.0	5.0	2.0	5.0
Density (percent)	96.3	—	96.3	—
Joint density (percent)	93.3	—	93.3	—

401–5.3 RESAMPLING PAVEMENT.

a. General. Resampling of a lot of pavement for mat density will be allowed if the Contractor requests, 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 Paragraphs 401–5.1b and 401–5.2c. Only one resampling per lot will be permitted.

(1.) 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.

(2.) The cost for resampling and retesting is the responsibility of the Contractor.

b. Payment for Resampled Lots. The redefined PWL for a resampled lot will be used to calculate the payment for that lot in accordance with Table 8.

c. Outliers. If the tests within a lot include a very large or a very small value which appears to be outside the normal limits of variation, check for an outlier in accordance with ASTM E 178, at a significance level of 5 percent, to determine if this value should be discarded when computing the PWL.

401–5.4 LEVELING COURSE. A pavement course used for trueing and leveling shall meet the requirements of Paragraph 401–3.2 and 5.2b, but shall not be subject to the density requirements of Paragraph 401–5.2c and d. Compact the leveling course with the same effort used to achieve density of the test section. The trueing and leveling course shall not exceed a nominal thickness of 1–1/2 inches (38 mm). Areas of pavement requiring a leveling course are shown on Plans.

NOTE TO SPECIFIER:
Areas of the pavement requiring a leveling course shall be shown on the Plans.

CONTRACTOR QUALITY CONTROL

401–6.1 GENERAL. Develop a Quality Control Program in accordance with Section 100 of the General Provisions. The program shall address all elements which affect the quality of the pavement including, but not limited to:

a. Mix Design

b. Aggregate Grading

c. Quality of Materials

d. Stockpile Management

e. Proportioning

f. Mixing and Transportation

g. Placing and Finishing

h. Joints

i. Compaction

j. Surface smoothness

401–6.2 TESTING LABORATORY. Provide a fully equipped asphalt laboratory located at the Plant or job site. Use it for quality control testing and provide adequate equipment for the performance of the tests required by these Specifications. Provide the Engineer a separate field laboratory under Specification P–632 for acceptance testing.

NOTE TO SPECIFIER:
Include a Pay Item for a field laboratory under Specification P–632 for use by Engineer for acceptance testing. Specification P–632 is similar to the Wisconsin DOT Highways Specification for field offices and laboratories.

Keep laboratory facilities clean and maintain all equipment in proper working condition. Permit unrestricted access to the Engineer to inspect the Contractor's laboratory facility and witness quality control activities. The Engineer will advise the Contractor in writing of noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, immediately suspend the incorporation of the materials into the Work and do not resume until the deficiencies are satisfactorily corrected.

401–6.3 QUALITY CONTROL TESTING. Perform all quality control tests necessary to control the production and construction processes applicable to these Specifications and as set forth in the Quality Control Program. The testing program shall include, but is not necessarily limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, field compaction, and surface smoothness. Develop a Quality Control Testing Plan as part of the Quality Control Program.

a. Asphalt Content. Perform a minimum of two extraction tests per lot in accordance with ASTM D 2172 for determination of asphalt content. Determine the weight of ash portion of the extraction test, as described in ASTM D 2172, as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. Use the last weight of ash value obtained in the calculation of the asphalt content for the mixture.

The use of the nuclear method for determining asphalt content in accordance with ASTM D 4125 is permitted, provided that it is calibrated for the specific mix being used.

b. Gradation. Determine aggregate gradations a minimum of twice per lot from mechanical analysis of extracted aggregate in accordance with AASHTO T 30 and ASTM C 136 (dry sieve). When asphalt content is determined by the nuclear method, determine aggregate gradation from hot bin samples on batch plants, or from the cold feed on drum mix or continuous mix plants, and test it in accordance with ASTM C 136 (dry sieve) using actual batch weights to determine the combined aggregate gradation of the mixture.

c. Moisture Content of Aggregate. Determine the moisture content of aggregate used for production a minimum of once per lot in accordance with ASTM C 566.

d. Moisture Content of Mixture. Determine the moisture content of the mixture once per lot in accordance with ASTM D 1461.

e. Temperatures. Check temperatures at least four times per lot, at necessary locations to determine the temperatures of the dryer, the bitumen in the storage tank, the mixture at the plant, and the mixture at the job site.

f. In–Place Density Monitoring. Conduct 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 D 2950.

g. Additional Testing. Additional testing that the Contractor deems necessary to control the process is optional.

h. Monitoring. The Engineer reserves the right to monitor the above testing.

401.6.4 SAMPLING. When directed by the Engineer, sample and test material which appears inconsistent with similar material being sampled, unless the material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

401–6.5 CONTROL CHARTS. Maintain linear control charts both for individual measurements and range (i.e., difference between highest and lowest measurements) for aggregate gradation and asphalt content.

Post control charts in a location satisfactory to the Engineer and keep it current. As a minimum, identify in the control charts the project number, the Contract Pay Item number, the test number, each test parameter, the Action and Suspension Limits applicable to each test parameter, and the Contractor's test results. Use the control charts as part of a process control system for identifying potential problems. The Engineer may suspend production or acceptance of the material, if satisfactory corrective action is not taken.

a. Individual Measurements. Establish control charts for individual measurements to maintain process control within tolerance for aggregate gradation and asphalt content. Use the job mix formula target values on the control charts as indicators of central tendency for the following test parameters with associated Action and Suspension Limits:

TABLE 6. CONTROL CHART LIMITS FOR INDIVIDUAL MEASUREMENTS

Gradation		*1 & 2 (1 Inch and Greater Aggregate Size)*		*3 (3/4 Inch Maximum Aggregate Size)*		*4 (1/2 Inch Maximum Aggregate Size)*	
Sieve Size		*Action Limit*	*Suspension Limit*	*Action Limit*	*Suspension Limit*	*Action Limit*	*Suspension Limit*
in.	*mm.*						
1 and greater	25 and greater	0%	0%	—	—	—	—
¾	19.0	±6%	11%	0%	0%	—	—
½	12.5	±6%	±9%	±6%	±9%	0%	0%
3/8	9.5	±6%	±9%	±6%	±9%	±6%	±9%
No. 4	4.75	±6%	±9%	±6%	±9%	±6%	±9%
No. 16	1.18	±5%	±7.5%	±5%	±7.5%	±5%	±7.5%
No. 50	0.30	±13%	±4.5%	±13%	±4.5%	±13%	±4.5%
No. 200	0.075	±2%	±3%	±2%	±3%	±2%	±3%
Asphalt Content		±0.45%	±0.70%	±0.45%	±0.70%	±0.45%	±0.70%

b. Range. Establish control charges for range to control process variability for the test parameters and Suspension Limits listed below. Establish the range to control process variability for the test parameters and Suspension Limits listed below. Compute the range 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, adjust the Suspension Limits by multiplying the Suspension Limit by 1.18 for n = 3 and by 1.27 for n = 4.

TABLE 7. CONTROL CHART LIMITS BASED ON RANGE
(Based on n = 2)

Sieve		*Suspension Limit, Percent*
in.	*mm.*	
1/2 inch	12.5	11
3/8 inch	9.5	11
No. 4	4.75	11
No. 16	1.18	9
No. 50	0.30	6
No. 200	0.075	3.5
Asphalt Content		0.8

c. Corrective Action. Indicate the appropriate action to be taken in the Quality Control Plan when the process is believed to be out of tolerance. Provide a set of rules in the Plan 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:

(1.) One point falls outside the Suspension Limit line for individual measurements or range; or

(2.) Two points in a row fall outside the Action Limit line for individual measurements.

NOTE TO SPECIFIER:
The aggregate control chart parameters and Suspension and Action Limits contained in the above paragraphs are originally based on 3/4 inch (19.0 mm) maximum size aggregate gradation. For 1–inch (25.0 mm) or 1–1/4 inch (31.2 mm) maximum size aggregate, the Individual Measurements Chart requirements were amended as follows:

Sieve	**Action Limit**	**Suspension Limit**
1 or 1–1/4 inch	**0%**	**0%**
3/4 inch sieve	**±6%**	**11%**

For 1/2–inch (12.5 mm) maximum size aggregate, the 3/4–inch (19.0 mm) and 1–inch (25.0 mm) sieves were deleted from the Individual Measurements Chart and the 1/2–inch (12.5 mm) sieve Action and Suspension Limits were changed to 0%. For the 1/2–inch (12.5 mm) gradation, the 1/2–inch sieve were deleted from the Range Chart.

METHOD OF MEASUREMENT

401–7.1 Plant mix bituminous concrete pavement will be measured by the number of tons of Bituminous Surface Course, Bituminous Leveling Course, or Bituminous Base Course and the number of tons of Bituminous Material used in the accepted Work.

a. Recorded batch weights or truck scale weights will be used to determine the basis for the tonnage of Bituminous Surface Course, Bituminous Leveling Course, or Bituminous Base Course.

b. Measurement of Bituminous Material by the ton will be based on the net weights of material shipments, except when batch weights are recorded or the job operations require the delivery of bituminous mixtures to be intermittent or in such minor quantities that the measurement of the bituminous materials based on net weights would be impractical. In the latter case, the measurement may be based on the theoretical percentage of bituminous material in the mixture or on the weight of bituminous material contained in each batch.

When batch weights are recorded, the measurement may be based on the batch weight of bituminous material.

Deductions will be made for quantities which are wasted or are not actually incorporated in the Work in accordance with the Contract.

c. Measurement for Bituminous Pavement Contractor Quality Control Program will be measured by the ton of Bituminous Surface Course, Bituminous Leveling Course, or Bituminous Base Course constructed. The weight of bituminous material will not be deducted from the weight of Bituminous Surface Course, Bituminous Leveling Course, or Bituminous Base Course measured for payment.

BASIS OF PAYMENT

401–8.1 PAYMENT. Payment for an accepted lot of bituminous concrete pavement will be made at the Contract unit price per ton for Bituminous Surface Course, Bituminous Leveling Course, or Bituminous Base Course and Bituminous Material adjusted according to Paragraph 401–8.1a. The price will be compensation for furnishing all materials, for all preparation, mixing, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the Work.

a. Basis of Adjusted Payment. Each lot will be accepted at the full Contract Price when the percent within limits (PWL) for mat density and air voids equals or exceeds 90 percent. Each lot not meeting the 90 percent PWL requirements will be accepted at an adjusted Contract unit price in accordance with Table 6. Payment will be calculated for both mat density and air voids, and payment will be based on the lower of the two values. **The price adjustment will apply to the price for the bituminous course, but not the price for bituminous material.**

TABLE 8. PRICE ADJUSTMENT SCHEDULE

Percentage of Material Within the Specification Limit (PWL)	*Percent of Contract Unit Price to be Paid*
90–100	100
80–90	0.5 PWL + 55.00
65–80	2.0 PWL – 65.0
Below 65	*

* The lot shall be removed and replaced. However, the Engineer may decide to accept the deficient lot. In that case, if the Engineer and Contractor agree in writing that the lot shall not be removed, it will be paid for at 50 percent of the Contract Price.

401–8.2 BITUMINOUS MATERIAL. The number of tons of bituminous materials, measured as provided, will be paid for at the Contract unit price per ton for the Pay Item Bituminous Material. The price will be full compensation for furnishing, heating, unloading, transporting and placing in the mixer; and for all labor, tools, equipment, and incidentals necessary to complete the Work.

401–8.3 CONTRACTOR QUALITY CONTROL PROGRAM. Payment for Bituminous Pavement Contractor Quality Control Program will be made at the Contract unit price per ton and will be full compensation for providing services to conduct the quality control program, including testing services, inspection, supervision, control charts, adjustment to production, and all incidental items.

401–8.4 Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P40101	Bituminous Surface Course, per ton.
Pay Item P40102	Bituminous Leveling Course, per ton.
Pay Item P40103	Bituminous Base Course, per ton.
Pay Item P40104	Bituminous Material, per ton.
Pay Item P40105	Bituminous Pavement Contractor Quality Control Program, per ton.

Measurement and Payment will only be made for Pay Items contained in the Schedule of Prices. The cost of all Work required by the Contract Documents will be included in the Pay Items contained in the Schedule of Prices.

TESTING REQUIREMENTS

ASTM C 29	Unit Weight of Aggregate
ASTM C 88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	Test Method for Materials Finer than 75–mm (No.200) Sieve in Mineral Aggregates by Washing
ASTM C 131	Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C 183	Sampling Hydraulic Cement
ASTM C 566	Total Moisture Content of Aggregate by Drying
ASTM D 75	Sampling Aggregates
ASTM D 995	Requirements for Mixing Plants for Hot–Mixed Hot–Laid Bituminous Paving Mixtures
ASTM D 1118	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin–Coated Specimens
ASTM D 1461	Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D 1559	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2041	Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2172	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2419	Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2489	Degree of Particle Coating of Bituminous–Aggregate Mixtures
ASTM D 2726	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface–Dry Specimens
ASTM D 3203	Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
ASTM D 2950	Density of Bituminous Concrete in Place by Nuclear Method
ASTM D 3665	Random Sampling of Paving Materials
ASTM D 3666	Inspection and Testing Agencies for Bituminous Paving Materials
ASTM D 4125	Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4791	Flat or Elongated Particles in Coarse Aggregate
ASTM D 4867	Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM E 178	Practice for Dealing With Outlying Observations
AASHTO T 30	Mechanical Analysis of Extracted Aggregate
The Asphalt Institute's Manual No. 2 (MS–2)	Mix Design Methods for Asphalt Concrete
The Asphalt Institute's Manual No. 20 (MS–20)	Hot–Mix Recycling

MATERIAL REQUIREMENTS

ASTM D 242	Mineral Filler for Bituminous Paving Mixtures
ASTM D 946	Asphalt Cement for Use in Pavement Construction
ASTM D 3381	Viscosity–Graded Asphalt Cement for Use in Pavement Construction
ASTM D 4552	Classifying Hot–Mix Recycling Agents

SPECIFICATION P-501. PORTLAND CEMENT CONCRETE PAVEMENT

DESCRIPTION

501–1.1 This Work consists of pavement composed of Portland cement concrete, constructed on a prepared underlying surface in accordance with these Specifications and shall conform to the lines, grades, thickness, and typical cross sections shown on the Plans. Reinforcement is required when shown on the Plans.

MATERIALS

501–2.1 AGGREGATES.

a. Reactivity. Aggregate shall be free of substances that are deleteriously reactive with the alkalis in the cement in an amount sufficient to cause excessive expansion of the concrete. Acceptable aggregate shall be based on satisfactory evidence furnished by the Contractor that the aggregate is free from these materials. Include as part of the evidence service records of concrete of comparable properties under similar conditions of exposure and/or certified records of tests by a testing laboratory that meets the requirements of ASTM C 1077. Test aggregate in accordance with ASTM C 295. If reactive materials are identified, test the aggregate in accordance with ASTM C 289. If the results are positive, test the aggregate in accordance with ASTM C 227.

NOTE TO SPECIFIER:
Aggregates from operational pits and quarries can be relied upon only if there is evidence that the nature of the aggregate has not changed as the quarry is exhausted.

The tests for reactivity in the Standard Specifications were based on the following recommendations. Normally the tests are performed in specific order. The petrographic analysis (ASTM C 295) is conducted first. If reactive minerals are identified, a quick chemical test (ASTM C 289) is conducted. If the results are positive, a mortar–bar expansion test (ASTM C 227) is conducted.

While not wholly conclusive, petrographic examination (ASTM C 295) and chemical test (ASTM C 289), provide valuable indicators. However, ASTM C 289 test results may not be correct for aggregates containing carbonates of calcium, magnesium or ferrous iron, such as calcite, dolomite, magnesite or siderite; or silicates of magnesium such as serpentine. The mortar bar method (ASTM C 227) while preferable and more reliable, requires at least 6 months and preferably one year to yield results. It should be used for new sources of aggregate.

See ASTM C 33, Appendix X1, Methods for Evaluating Potential Reactivity of An Aggregate for additional information.

Proposed test method ASTM P 214, Accelerated Detection of Potentially Deleterious Expansion of Mortar Bars Due to Alkali–Silica Reaction, may be substituted for ASTM C 227 at the option of the Engineer, including test parameters.

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b. Fine Aggregate. Fine aggregate shall conform to the requirements of ASTM C 33. Gradation shall meet the requirements of Table 1 when tested in accordance with ASTM C 136, except as may otherwise be qualified under Section 5 of ASTM C 33. Fine aggregate shall comprise 30 to 45 percent of total aggregate (fine aggregate plus coarse aggregate).

TABLE 1. GRADATION FOR FINE AGGREGATE
ASTM C 33

Sieve Designation (square openings)		*Percentage by Weight Passing Sieves*
in.	*mm.*	
3/8 in.	9.5 mm	100
No. 4	4.75 mm	95–100
No. 8	2.36 mm	80–100
No. 16	1.18 mm	50–85
No. 30	600 micro–m	25–60
No. 50	300 micro–m	10–30
No. 100	150 micro–m	2–10

c. Coarse Aggregate. Coarse aggregate shall conform to the requirements of ASTM C 33. Gradation, within the separated size groups, shall meet the requirements of Table 2 when tested in accordance with ASTM C 136. When the nominal maximum size of the aggregate is greater than one inch, furnish the aggregates in two size groups.

Aggregates delivered to the mixer shall consist of crushed stone, crushed or uncrushed gravel, air–cooled blast furnace slag, crushed recycled concrete pavement, or a combination thereof. The aggregate shall be composed of clean, hard, uncoated particles and shall meet the requirements for deleterious substances contained in ASTM C 33, Class 4S. Remove dust and other coating from the aggregates by washing. The aggregate in different size groups shall not contain more than 8 percent by weight of flat or elongated pieces when tested in accordance with ASTM D 4791. A flat or elongated particle is one having a ratio between the maximum and the minimum dimensions of a circumscribing rectangular prism exceeding 5 to 1.

Prior to approval of mixture design, submit written certification that the aggregate does not have a history of D–Cracking and that the aggregate is approved by the Division of Transportation, Infrastructure Development specifically addressing susceptibility to D–Cracking. If the aggregate is not approved by the Division of Transportation, Infrastructure Development, the aggregates may be approved provided the aggregate is tested in accordance with ASTM C 666 and receives a durability factor of 95 percent or greater.

NOTE TO SPECIFIER:
Class was specified in accordance with Table 3 of ASTM C 33. ASTM C 666, Resistance of Concrete to Rapid Freezing and Thawing, was added to the list of testing requirements.

The percentage of wear shall be no more than 40 percent when tested in accordance with ASTM C 131 or ASTM C 535.

NOTE TO SPECIFIER:
The percentage of wear was specified per FAA to not exceed 40 percent. In certain cases where aggregate of this quality cannot be obtained economically, aggregate with a higher percentage of wear may be specified in a Special Provision if a satisfactory service record of at least 5 years' duration under similar conditions of service and exposure has been demonstrated.

The FAA recommended gradations were inserted into Table 2 of the Standard Specifications. Where locally available aggregates cannot be economically blended to meet the grading requirements, the gradations may be modified by the Engineer to fit the characteristics of locally available aggregates by Special Provision upon approval of WBOA and ADO.

The concrete mix design shall be based upon use of Coarse Aggregate (C.A.) Mix unless otherwise specified in the Plans or Special Provisions. In C.A. Mix A and B, aggregate sizes No. 3 and No. 4 shall comprise 35 to 65 percent of the total amount of coarse aggregate.

TABLE 2. GRADATION FOR COARSE AGGREGATE

Sieve Designations (square openings)		*Percentage by Weight Passing Sieves*				
		C.A. Mix A From 2" to No. 4 (50.0 mm–4.75 mm)		*C.A. Mix B From 1–1/2" to No. 4 (38.0 mm–4.75 mm)*		*C.A. Mix C From 1" to No. 4 (25.0 mm–4.75 mm)*
in.	*mm*	*No. 3* (2" – 1")*	*No. 57* (1" – No. 4)*	*No. 4* (1–1/2"–3/4")*	*No. 67* (3/4"–No.4)*	*No. 57* (1"–No.4)*
2–1/2	63	100	—	—	—	—
2	50.0	90–100	—	100	—	—
1–1/2	38.0	35–70	100	90–100	—	100
1	25.0	0–15	95–100	20–55	100	95–100
3/4	19.0	—	—	0–15	90–100	—
1/2	12.5	0–5	25–60	—	—	25–60
3/8	9.5	—	—	0–5	20–55	—
No. 4	4.75	—	0–10	—	0–10	0–10
No. 8	2.36	—	0–5	—	0–5	0–5

* ASTM C 33 Table 2 Size Number

501–2.2 CEMENT. Cement shall conform to the requirements of ASTM C 150 Type I, Type II, or Type III.

NOTE TO SPECIFIER:
The FAA allows the following: ASTM C 150 – Type I, II, III, or IV. ASTM C 595 – Type IP, IS, S, I. Type I, Type II, or Type III cement was used in the Standard Specifications other types may be specified in the Special Provisions.

ASTM C 150 covers Portland cements. ASTM C 595 covers blended hydraulic cements as follows: IP – Portland–Pozzolan Cement, IS – Portland Blast–Furnace Slag Cements, S – Slag Cement, I – Pozzolan Modified–Portland Cement.

The chemical requirements for all cement types specified should meet suitable criteria for deleterious activity in accordance with ASTM C 33 or based on historical data. Low alkali cements (less than 0.6% total equivalent alkalinity) should be specified when any doubt exists.

Do not use cement that is partially set or contains lumps of caked cement. Do not use cement salvaged from discarded or used bags.

501–2.3 CEMENTITIOUS MATERIALS.

a. Fly Ash. Fly ash shall meet the requirements of ASTM C 618, Class C or F with the exception of loss of ignition, where the maximum shall be less than 6 percent for Class F. When reactive cements or aggregates are used in the concrete, supplementary optional chemical and physical properties of Tables 1A and 2A contained in ASTM C 618 shall apply.

b. Blast Furnace Slag. Ground blast furnace slag shall meet the requirements of ASTM C 989, Grade 100 or 120.

NOTE TO SPECIFIER:
Fly ash may be accepted from sources that are prequalified by other agencies such as the Division of Transportation, Infrastructure Development, Department of Transportation Division of Highways, provided it meets the loss of ignition requirement of this specification and is accompanied by a certification and test data.

501–2.4 PREMOLDED JOINT FILLER. Premolded joint filler for expansion joints shall conform to the requirements of ASTM D 1751 or ASTM D 1752, Type II or III, and shall be punched to admit the dowels where called for on the Plans. Unless otherwise specified by the Engineer, furnish the filler for each joint in a single piece for the full depth and width required for the joint. When the use of more than one piece is required for a joint, fasten the abutting ends securely and hold accurately to shape by stapling or other positive fastening means satisfactory to the Engineer.

NOTE TO SPECIFIER:
Joint filler must be compatible with joint sealants.

501–2.5 JOINT SEALER. The joint sealer for the joints in the concrete pavement shall meet the requirements of Specification P–605 and shall be of the type(s) specified in the Plans.

501–2.6 STEEL REINFORCEMENT. Reinforcing, when shown on the Plans, shall consist of welded steel wire fabric conforming to the requirements of ASTM A 185 or ASTM A 497. Provide either type unless a specific type is indicated on the Plans.

NOTE TO SPECIFIER:
The FAA allows the following:

Welded Steel Wire Fabric	**ASTM A 185**
Welded Deformed Steel Fabric	**ASTM A 497**
Bar Mats	**ASTM A 184 or A 704**

Welded wire fabric shall be furnished in flat sheets only.

Welded steel wire fabric was specified in the Standard Specifications; changes can be made by Special Provision.

501–2.7 DOWEL AND TIE BARS. Tie bars shall be deformed steel bars and conform to the requirements of ASTM A 615, ASTM A 616, or ASTM A 617, except that rail steel bars, Grade 50 or 60, shall not be used for tie bars that are to be bent or restraightened during construction. Tie bars designated as Grade 40 in ASTM A 615 can be used for construction requiring bent bars.

Dowel bars shall be plain steel bars conforming to ASTM A 615, ASTM A 616 or ASTM A 617 and shall be free from burring or other deformation restricting slippage in the concrete. High strength dowel bars shall conform to ASTM A 714, Class 2, Type S, Grade I, II or III, Bare Finish. Before delivery to the construction site paint each dowel bar on all surfaces with one coat of paint meeting Federal Specification TT–P–664. If plastic or epoxy–coated steel dowels are used no paint coating is required, except when specified for a particular situation on the Contract Plans. Coated dowels shall conform to the requirements of AASHTO M 254.

NOTE TO SPECIFIER:
The designer should consider which dowel sizes and coating are commonly available locally in order to reduce delivery times and prices. 1- 1/4" and 1-1/2" dowels, 18 inches in length, are currently common sizes for highway projects. Epoxy coating is the standard on highway projects. It costs about 7 cents more per lineal foot of dowel than painting; however, it is more durable.

The sleeves for dowel bars used in expansion joints shall be metal or other type of an approved design to cover 2 to 3 inches (50 mm to 75 mm) of the dowel, with a closed end and with a suitable stop to hold the end of the bar at least 1 inch (25 mm) from the closed end of the sleeve. Sleeves shall be designed so that they will not collapse during construction.

501–2.8 WATER. Water used in mixing or curing shall be clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product. Water will be tested in accordance with the requirements of AASHTO T 26. Water known to be of potable quality may be used without testing.

501–2.9 COVER MATERIAL FOR CURING. 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 C 309, Type 2, Class B.

b. White polyethylene film for curing concrete shall conform to the requirements of ASTM C 171.

c. White burlap–polyethylene sheeting for curing concrete shall conform to the requirements of ASTM C 171.

d. Waterproof paper for curing concrete shall conform to the requirements of ASTM C 171.

501–2.10 ADMIXTURES. The Engineer will approve the use of material added to the concrete mix. Submit certificates indicating that the material to be furnished meets all of the requirements indicated below. 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 material being furnished or proposed for use on the Work to determine whether the admixture is uniform in quality with that approved.

a. Air–Entraining Admixtures. Air–entraining admixtures shall meet the requirements of ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions. The air–entrainment agent and chemical admixtures shall be compatible.

b. Chemical Admixtures. Water–reducing, set retarding, and set–accelerating admixtures shall meet the requirements of ASTM C 494, including the flexural strength test.

501–2.11 EPOXY–RESIN. Epoxy–resin used to anchor dowels and tie bars in pavements shall conform to the requirements of ASTM C 881, Type I, Grade 3, Class C. Class A or B shall be used when the surface temperature of the hardened concrete is below 60°F (16°C).

501–2.12 MATERIAL ACCEPTANCE. Prior to use of materials, submit certified test reports to the Engineer for those materials proposed for use during construction. The certification shall show the appropriate ASTM test(s) for each material, the test results, and a statement that the material passed or failed.

The Engineer may request samples for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

MIX DESIGN

501–3.1 PROPORTIONS. Design concrete to achieve a 28-day flexural strength so that not more than 20 percent of the concrete produced will fall below a flexural strength of 650 psi (4480 kPa). Design the mix using the procedures contained in Chapter 7 of the Portland Cement Association's Manual, "Design and Control of Concrete Mixtures."

NOTE TO SPECIFIER:
The design flexural strength was specified as 650 psi (4480 kPa) in the Standard Specifications. The minimum flexural strength allowable for airport pavements is 600 psi (4136 kPa). The design strength can be modified by Special Provision upon approval by WBOA.

Higher flexural strength can be specified when local materials make this economically feasible. However, it must be recognized that due to variations in materials, operations, and testing the average strength of concrete furnished by a supplier must be substantially above the specified strength to insure a good statistical chance of meeting the acceptance criteria throughout the duration of the job.

For pavements designed to accommodate aircraft gross weights of 30,000 pounds (13 600 kg) or less, this section may be modified to indicate that concrete shall be designed to achieve a 28 day compressive strength such that not more than 20 percent of the concrete produced will fall below the design compressive strength of 4,400 psi (30 300 kPa).

If the specified strength is required earlier than 28 days, the Engineer shall designate the time period.

To ensure that not more than 20 percent of the concrete actually produced will fall below the specified strength, the mix design average strength must be considerably higher than the specified strength. The amount of overdesign necessary to meet specification requirements depends on the producer's standard deviation of flexural test results and the accuracy which that value can be estimated from historic data for the same or similar materials. The minimum cementitious material (cement plus fly ash) shall be 500 pounds per cubic yard (297 kg per cubic meter). The ratio of water to cementitious material, including free surface moisture on the aggregates but not including moisture absorbed by the aggregates shall not be more than 0.50 by weight.

NOTE TO SPECIFIER:
A minimum cement content of 500 pounds (227 kg) was specified in the Standard Specifications. A higher minimum may be necessary to meet the specified strength when other cementitious

materials are substituted or to meet durability requirements for severe freeze/thaw, deicer, or sulfate exposure.

A maximum water/cementitious ratio of 0.50 was specified in the Standard Specifications. A lower water/cementitious material ratio may be necessary for severe freeze/thaw, deicer, or sulfate exposure.

Prior to the start of paving operations and after approval of all material to be used in the concrete, submit a mix design showing the proportions and flexural strength obtained from the concrete at 7 and 28 days. Include with the mix design copies of test reports, including test dates, and a complete list of materials including type, brand, source, and amount of cement, fly ash, ground slag, coarse aggregate, fine aggregate, water, and admixtures. Show the fineness modulus of the fine aggregate and the air content. Submit the mix design to the Engineer at least 15 days prior to the start of operations. Do not begin production until the mix design is approved in writing by the Engineer.

Should a change in sources be made, or admixtures added or deleted from the mix, submit a new mix design must be submitted to the Engineer for approval.

NOTE TO SPECIFIER:
A minimum of 10 days was included in the Standard Specification. A longer time may be required by Special Provision. The Engineer may specify that previously approved mix designs older than 90 days shall not be used.

Flexural strength test specimens shall be prepared in accordance with ASTM C 31 and tested in accordance with ASTM C 78. The mix determined shall be workable concrete having a slump for side–form concrete between 1 and 2 inches (25 mm and 50 mm) as determined by ASTM C 143. For vibrated slip–form concrete, the slump shall be between 1/2 inch (13 mm) and 1 1/2 inches (38 mm).

NOTE TO SPECIFIER:
If the basis of the design strength in paragraph 501–3.1 is changed by Special Provision to compressive strength, the specimens should be tested in accordance with ASTM C 39. Substitute "compressive strength" for "flexural strength" in appropriate sections of the Specification.

501–3.2 CEMENTITIOUS MATERIALS.

a. Fly Ash. Fly ash may be used in the mix design. When fly ash is used as a partial replacement for cement, the minimum cement content may be met by considering Portland cement plus fly ash as the total cementitious material. The replacement rate shall be determined from laboratory trial mixes, but shall not exceed 20 percent by weight of the total cementitious material.

b. Ground Slag. Ground blast–furnace slag may be used in a mix design containing Type I or Type II cement. The slag, or slag plus fly ash if both are used, may constitute between 25 to 55 percent of the total cementitious material by weight. If the concrete is to be used for slipforming operations and the air temperature is expected to be lower than 55°F (13°C) the percent slag shall not exceed 30 percent by weight.

NOTE TO SPECIFIER:
The percentage of fly ash allowed in the mix was specified as 20% of total cementitious material in the Standard Specifications.
Due to variations in fly ash, cement, strength requirements, etc. the replacement rate specified can be changed by Special Provision based on local materials, but should be between 10–20 percent.

Concrete containing fly ash will ultimately develop a flexural strength greater than concrete without fly ash. However, the rate of development and the ultimate strength of the concrete depends on the characteristics of the fly ash, the cement used, the proportions of fly ash and cement, and the curing environment.

EPA guidelines published in 40 CFR Part 249, which implement provisions of the Resource Conservation and Recovery Act of 1976, require that contract specifications allow for the use of fly ash, unless its use can be determined to be inappropriate for technical reasons documented by the Owner or the design Engineer.

501–3.3 ADMIXTURES.

a. Air–Entraining. Add air–entraining admixture so that it will insure uniform distribution of the agent throughout the batch. Base the air content of freshly mixed air–entrained concrete on trial mixes with the materials to be used in the work adjusted to produce concrete of

the required plasticity and workability. The percentage of air in the mix is 6 percent. Determine air content by testing in accordance with ASTM C 231 for gravel and stone coarse aggregate and ASTM C 173 for slag and other highly porous coarse aggregate.

b. Chemical. Add water–reducing, set–controlling, and other approved admixtures to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements. Conduct tests on trial mixes, with the materials to be used in the Work, in accordance with ASTM C 494.

NOTE TO SPECIFIER:
Six percent air was specified in the Standard Specification. Changes can be made by Special Provisions based upon the following FAA recommendations. For warm climate areas where freezing and thawing is not a factor, non–air–entrained concrete may be used.

RECOMMENDED AIR CONTENT (PERCENT
Maximum Size Aggregate

Mild exposure – When desired for other than durability, such as to improve workability. Used where pavement will not be exposed to freezing or to deicing agents.

Moderate exposure – Service in a climate where freezing is expected but where the concrete will not be continually exposed to moisture or free water for long periods prior to freezing and will not be exposed to deicing agents or other aggressive chemicals.

Severe exposure – Concrete which is exposed to deicing chemicals or other aggressive agents or where the concrete may become highly saturated by continual contact with moisture or free water prior to freezing.

501–3.4 TESTING LABORATORY. The laboratory used to develop the mix design shall meet the requirements of ASTM C 1077. Submit a certification that it meets these requirements to the Engineer prior to the start of mix design and it should contain as a minimum:

a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.

b. A statement that the equipment used in developing the mix design is in calibration.

c. A statement that each test specified in developing the mix design is offered in the scope of the laboratory's services.

d. A copy of the laboratory's quality control system.

CONSTRUCTION METHODS

501–4.1 EQUIPMENT. Furnish all equipment and tools necessary for handling materials and performing all parts of the Work.

a. Batch Plant and Equipment. The batch plant and equipment shall conform to the requirements of ASTM C 94.

b. Mixers and Transportation Equipment.

(1) General. Concrete may be mixed at a central plant, or wholly or in part in truck mixers. Each 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.

NOTE TO SPECIFIER:
The Engineer may specify by Special Provision the use of a central plant mixer if deemed necessary for a particular project.

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(2) Central Plant Mixer. Central plant mixers shall conform to the requirements of ASTM C 94.

Examine the mixer daily for changes in condition due to accumulation of hard concrete or mortar or wear of blades. Replace the pickup and throwover blades when they have worn down 3/4 inch (19 mm) 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.

(3) Truck Mixers and Truck Agitators. Truck mixers used for mixing and hauling concrete and truck agitators used for hauling central–mixed concrete shall conform to the requirements of ASTM C 94.

(4) Nonagitator Trucks. Nonagitating hauling equipment shall conform to the requirements of ASTM C 94.

c. Finishing Equipment. The finishing equipment shall be of sufficient weight and power for proper finishing of the concrete. The finishing machine shall be designed and operated to strike off, screed, and consolidate the concrete so that laitance on the surface is less than 1/8–inch (3 mm) thick.

d. Vibrators. Vibrators shall be either internal type with immersed tube or multiple spuds, or surface type vibrating pan or screed. For pavements 8 inches (200 mm) or more thick, internal vibrators shall be used. They may be attached to the spreader or the finishing machine, or they may be mounted on a separate carriage. Use an operating frequency for internal vibrators between 8,000 and 12,000 vibrations per minute. Average amplitude for internal vibrators shall be 0.025–0.05 inches (0.6 – 1.3 mm). For pavements less than 8 inches (200 mm) thick, vibrating surface pans or screeds will be allowed. Operating frequencies for surface vibrators shall be between 3,000 and 6,000 vibrations per minute.

Set the number, spacing, and frequency to provide a dense and homogeneous pavement. Provide adequate power to operate all vibrators on the paver. The vibrators shall be automatically controlled so that they shall be stopped as forward motion ceases.

Hand held vibrators may be used in irregular areas.

e. Concrete Saws. Provide sawing equipment adequate in number of units and power to complete the sawing to the required dimensions. 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.

f. Side Forms. Straight side forms shall be made of steel and shall be furnished in sections not less than 10 feet (3 m) 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–foot (30 m) radius or less. Provide forms 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. Do not use forms with battered top surfaces and bent, twisted or broken forms. Do not use built–up forms , except as approved by the Engineer. The top face of the form shall not vary from a true plane more than 1/8 inch (3 mm) in 10 feet (3 m), and the upstanding leg shall not vary more than 1/4 inch (6 mm). 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 the Engineer.

g. Pavers. Use a paver that will be fully energized, self–propelled, and designed for the specific purpose of placing, consolidating, and finishing the concrete pavement, true to grade, tolerances, and cross section. It must be of sufficient weight and power to construct the maximum specified concrete paving lane width as shown in the Plans, at adequate forward speed, without transverse, longitudinal or vertical instability or without displacement. Equip the paver with electronic or hydraulic horizontal and vertical control devices.

501–4.2 FORM SETTING. Set forms sufficiently in advance of the concrete placement to insure continuous paving operation. After the forms have been set to correct grade, thoroughly tamp the underlying surface, either mechanically or by hand, at both the inside and outside edges of the base of the forms. Stake forms into place sufficiently to maintain the form in position for the method of placement.

Tightly lock form sections to be free from play or movement in any direction. The forms cannot deviate from true line by more than 1/8 inch (3 mm) at any joint. Set forms so that they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Clean and oil forms prior to the placing of concrete.

Check the alignment and grade elevations of the forms and make corrections immediately before placing the concrete.

501–4.3 CONDITIONING OF UNDERLYING SURFACE, SLIP–FORM CONSTRUCTION. Widen the compacted underlying surface on which the pavement will be placed approximately 3 feet (1 m) to extend beyond the paving machine track to support the paver without any noticeable displacement. After the underlying surface has been placed and compacted to the required density, trim or grade the areas which will support the paving machine and the area to be paved to the Plan grade elevation and profile by means of a properly designed machine. Control the grade of the underlying surface by a positive grade control system using lasers, stringlines, or guide wires. If the density of the underlying surface is disturbed by the trimming operations, correct it by additional compaction and retest it at the option of the Engineer before the concrete is placed, except when stabilized subbases are being constructed. If damage occurs on a stabilized subbase, correct it full depth. If traffic is allowed to use the prepared grade, check and correct the grade immediately before the placement of concrete. Moisten the prepared

grade with water, without saturating, immediately ahead of concrete placement to prevent rapid loss of moisture from concrete. Protect the underlying surface so that it will be entirely free of frost when concrete is placed.

NOTE TO SPECIFIER:
Stabilized subbase is required to accommodate aircraft with gross weights in excess of 100,000 pounds (45,300 kg) per Advisory Circular 150/5320–6.

The typical sections on the Plans should show subgrade extending a minimum of 3 feet (1 m) beyond the concrete.

501–4.4 CONDITIONING OF UNDERLYING SURFACE, SIDE–FORM AND FILL–IN LANE CONSTRUCTION. Moisten the prepared underlying surface with water, without saturating, immediately ahead of concrete placement to prevent rapid loss of moisture from the concrete. Correct and retest damage caused by hauling or usage of other equipment at the option of the Engineer. If damage occurs to a stabilized subbase, correct it full depth. Provide and operate a template on the forms immediately in advance of the placing of all concrete. Propel the template by hand only and do not attach to a tractor or other power unit. Adjust templates so that they may be set and maintained at the correct contour of the underlying surface. Adjust and operate the templates to provide an accurate retest of the grade before placing the concrete thereon. Remove and waste all excess fill and compact low areas to a condition similar to that of the surrounding grade. Protect the underlying surface so that it will be entirely free from frost when the concrete is placed. The use of chemicals to eliminate frost in the underlying surface is not permitted.

Maintain the template in accurate adjustment, at all times and check it daily.

501–4.5 HANDLING, MEASURING, AND BATCHING MATERIAL. The batch plant site, layout, equipment, and provisions for transporting material shall assure a continuous supply of material to the Work. Construct stockpiles in a manner that prevents segregation and intermixing of deleterious materials.

Do not use aggregates that have become segregated or mixed with earth or foreign material. Stockpile or bin for draining all aggregates produced or handled by hydraulic methods, and washed aggregates, at least 12 hours before being batched. Rail shipments requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage.

Equip batching plants to proportion aggregates and bulk cement, by weight, automatically using interlocked proportioning devices of an approved type. When bulk cement is used, use a suitable method of handling the cement from weighing hopper to transporting container or into the batch itself for transportation to the mixer, such as a chute, boot, or other approved device, to prevent loss of cement. Arrange the device to provide positive assurance that the cement content specified is present in each batch.

501–4.6 MIXING CONCRETE. 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. Measure mixing time from the time all materials, except water, are emptied into the drum. Mix and deliver all concrete to the site in accordance with the requirements of ASTM C 94. Transport mixed concrete from the central mixing plant in truck mixers, truck agitators, or nonagitating trucks. The elapsed time from the addition of cementitious material to the mix until the concrete is deposited in place at the Work site shall not exceed 30 minutes when the concrete is hauled in nonagitating trucks, and shall not exceed 90 minutes when the concrete is hauled in truck mixers or truck agitators. Retempering concrete by adding water or by other means will not be permitted, except when concrete is delivered in transit mixers. 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 mix design is not exceeded.

501–4.7 LIMITATIONS ON MIXING AND PLACING. Do not mix, place, or finish concrete when the natural light is insufficient, unless an adequate and approved artificial lighting system is operated.

a. Cold Weather. Unless authorized in writing by the Engineer, discontinue mixing and concreting operations when a descending air temperature in the shade and away from artificial heat reaches 40°F (4°C), and do not resume the operations until an ascending air temperature in the shade and away from artificial heat reaches 35°F (2°C).

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 (10°C) at the time of placement. Do not place concrete on frozen material and do not use frozen aggregates in the concrete.

When concreting is authorized during cold weather, water and/or the aggregates may be heated to not more than 150°F (66°C). Heat the mass uniformly and arrange the heating apparatus to preclude the possible occurrence of overheated areas that might be detrimental to the materials.

NOTE TO SPECIFIER:
Information regarding cold weather concreting practices may be found in ACI 306R, Cold Weather Concreting.

b. Hot Weather. During periods of hot weather when the maximum daily air temperature exceeds 85°F (30°C), take the following precautions:

(1) Sprinkle the forms and/or the underlying surface with water immediately before placing the concrete. Place the concrete at the coolest temperature practicable, and never allow the temperature of the concrete when placed to exceed 95°F (35°C). Cool the aggregates and/or mixing water as necessary to maintain the concrete temperature at or not more than the specified maximum.

(2) Keep the finished surfaces of the newly laid pavement damp by applying a water–fog or mist with approved spraying equipment until the pavement is covered by the curing medium. If necessary, provide wind screens to protect the concrete from an evaporation rate in excess of 0.2 psf (.97 kg/m^2) per hour as determined in accordance with Figure 2.1.5 in ACI 305R, Hot Weather Concreting, which takes into consideration relative humidity, wind velocity, and air temperature.

(3) When conditions exist that problems with plastic cracking can be expected, and particularly if plastic cracking begins to occur, immediately take additional measures as necessary to protect the concrete surface. These measures shall consist of wind screens, more effective fog sprays, and similar measures starting immediately behind the paver. If these measures are not effective in preventing plastic cracking, stop paving operations immediately.

501–4.8 PLACING CONCRETE. Side (fixed) form or slip–form paving is optional. During concrete conveyance, the free vertical drop of the concrete from one point to another or to the underlying surface shall not exceed 3 feet (1 m).

Hauling equipment or other mechanical equipment can be permitted on adjoining previously constructed pavement when the concrete strength reaches a flexural strength of 550 psi (3,790 kPa) or a compressive strength of 3,500 psi (24,130 kPa), based on the average of four field cured specimens per 2,000 cubic yards (1,530 m^3) of concrete placed. Subgrade and subbase planers, concrete pavers, and concrete finishing equipment may be permitted to ride upon the edges of previously constructed pavement when the concrete has attained a minimum flexural strength of 400 psi (2,760 kPa) or a compressive strength of 2,000 psi (13,790 kPa), based on the average of four field cured specimens per 2,000 cubic yards (1,530 m^3) of concrete placed.

NOTE TO SPECIFIER:
The Engineer may specify either side form or slip–form method of paving or allow the Contractor the option as indicated in the Standard Specification.

Select either of the following paving methods:

a. Side–form Method. For the side–form method, deposit the concrete on the moistened grade to require as little rehandling as possible. Unless truck mixers, truck agitators, or nonagitating hauling equipment are equipped with means for discharge of concrete without segregation of the materials, place and spread the concrete using an approved mechanical spreading device that prevents segregation of the materials. Continuously place the concrete between transverse joints without the use of intermediate bulkheads. Do necessary hand spreading with shovels. Do not use rakes for spreading. Do not allow workers to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substances.

Deposit concrete as near to expansion and contraction joints as possible without disturbing them, but do not dump the concrete from the discharge bucket or hopper onto a joint assembly unless the hopper is centered above the joint assembly.

Thoroughly consolidate concrete against and along the faces of all forms and previously placed concrete and along the full length and on both sides of all joint assemblies by means of vibrators inserted in the concrete. Vibrators cannot come in contact with a joint assembly, the grade, or a side form. Never operate the vibrator longer than 20 seconds in any one location, never allow the vibrators be used to move the concrete.

b. Slip–form Method. For this method, place the concrete with an approved crawler–mounted, slip–form paver designed to spread, consolidate, and shape the freshly placed concrete in one complete pass of the machine so that a minimum of hand finishing will be necessary to provide a dense and homogeneous pavement in conformance with requirements of the Plans and Specifications. Place the concrete directly on top of the joint assemblies to prevent them from moving when the paver moves over them. Side forms and finishing screeds shall be adjustable to the extent required to produce the specified pavement edge and surface tolerance. The side forms shall be of dimensions, shape, and strength to support the concrete laterally for a sufficient length of time so that no edge slumping exceeds the requirements of Paragraph 501–5.2e(5). Accomplish final finishing while the concrete is still in the plastic state.

In the event that slumping or sloughing occurs behind the paver or if there are any other structural or surface defects which, in the opinion of the Engineer, cannot be corrected within permissible tolerances, immediately stop paving operations until proper adjustment of the equipment or

procedures have been made. In the event that satisfactory procedures and pavement are not achieved after not more than 2,000 linear feet (600 m) of single lane paving, complete the balance of the Work with the use of standard metal forms and the formed method of placing and curing. Remove and replace concrete not corrected to permissible tolerances at the Contractor's expense.

501–4.9 STRIKE–OFF OF CONCRETE AND PLACEMENT OF REINFORCEMENT. Following the placing of the concrete, strike it off to conform to the cross section shown on the Plans and to an elevation so 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, strike off the bottom layer to a 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. Next place the reinforcement directly upon the concrete, and then place the top layer of the concrete, struck off, and screeded. Remove and replace (at the Contractor's expense) portions of the bottom layer of concrete with freshly mixed concrete if the bottom layer of concrete is placed more than 30 minutes without being covered with the top layer or if initial set has taken place. 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.

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. Construct joints as shown on the Plans and in accordance with these requirements. Construct all joints with their faces perpendicular to the surface of the pavement and finished or edged as shown on the Plans. Do not vary joints more than 1/2 inch (13 mm) from their designated position and ensure that they are true to line with not more than 1/4–inch (6 mm) variation in 10 feet (3 m). Test the surface across the joints with a Contractor furnished 10–foot (3 m) straightedge as the joints are finished and correct irregularities in excess of 1/4 inch (6 mm) before the concrete has hardened. Prepare, finish, or cut all joints to provide a groove of uniform width and depth as shown on the Plans.

a. Construction. Slip form or form longitudinal construction joints against side forms with or without keyways, as shown in the Plans.

Install transverse construction joints 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. Install the joint at a planned contraction or expansion joint. If placing of the concrete is stopped, remove the excess concrete back to the previous planned joint.

b. Contraction. Install contraction joints at the locations and spacing as shown on the Plans. Install contraction joints 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 finish the sides of the grooves 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. Finish or cut clean the groove so that spalling will be avoided at intersections with other joints. Grooving or sawing shall produce a slot at least 1/8 inch (3 mm) wide and to the depth shown on the Plans.

c. Expansion. Install expansion joints as shown on the Plans. Extend the premolded filler of the thickness as shown on the Plans, for the full depth and width of the slab at the joint, except for space for sealant at the top of the slab. Securely stake or fasten the filler into position perpendicular to the proposed finished surface. Provide a cap to protect the top edge of the filler and to permit the concrete to be placed and finished. After the concrete has been placed and struck off, carefully withdraw the cap leaving the space over the premolded filler. Finish and tool the edges of the joint while the concrete is still plastic. Remove concrete bridging the joint space for the full width and depth of the joint.

NOTE TO SPECIFIER:
An expansion joint is primarily used as an isolation joint to separate structures with different foundations and pavements with different joint patterns. It does not provide for expansion by the material compressing, but rather allowing the joint to slip. There should rarely be an occasion to dowel an expansion joint since it defeats the purpose of the joint and does not permit isolation and slippage. A thickened–edge is the preferred load transfer method for expansion joints.

Keyways. Form keyways in the plastic concrete by means of side forms or the use of keyway liners which are inserted during the slip–form operations. Form the keyway to a tolerance of 1/4 inch (6 mm) in any dimension and ensure it to be of sufficient stiffness to support the upper keyway flange without distortion or slumping of the top of the flange. The dimensions of the keyway forms shall not vary more than plus or

minus 1/4 inch (6 mm) from the mid–depth of the pavement. Liners that remain in place permanently and become part of the keyed joint shall be made of galvanized, copper clad, or of similar rust–resistant material compatible with plastic and hardened concrete and shall not interfere with joint reservoir sawing and sealing.

NOTE TO SPECIFIER:
The Engineer should refer to Advisory Circular 150/5320–6 for guidance on the use of keyways.

e. Tie Bars. Tie bars shall consist of deformed bars installed in joints as shown on the Plans. Place tie bars at right angles to the centerline of the concrete slab and space at intervals shown on the Plans. Hold them in position parallel to the pavement surface and in the middle of the slab depth. 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. Do not paint, grease, or enclose sleeves in the bars. When slip–form operations call for tie bars, two–piece hook bolts can be installed in the female side of the keyed joint provided the installation is made without distorting the keyed dimensions or causing edge slump. If a bent tie bar installation is used, insert the tie bars through the keyway liner only on the female side of the joint. Using a bent tie bar installation for male keyways is not permitted.

f. Dowel Bars. Place dowel bars or other load–transfer units of an approved type across joints in the manner as shown on the Plans. They shall be of the dimensions and spacings as shown and held rigidly in the middle of the slab depth in the proper horizontal and vertical alignment by an approved assembly device to be left permanently in place. The dowel or load–transfer and joint devices shall be rigid enough to permit complete assembly as a unit ready to be lifted and placed into position. Furnish a metal, or other type, dowel expansion cap or sleeve for each dowel bar used with expansion joints. These caps shall be substantial enough to prevent collapse and shall be placed on the ends of the dowels as shown on the Plans. The caps or sleeves shall fit the dowel bar tightly and the closed end shall be watertight. Thoroughly coat the portion of each dowel painted with rust preventative paint, as required under paragraph 501–2.7, with asphalt MC–70, or an approved lubricant, to prevent the concrete from bonding to that portion of the dowel. If free–sliding plastic–coated or epoxy–coated steel dowels are used, use a lubrication bond breaker except when approved pullout tests indicate it is not necessary. Where butt–type joints with dowels are designated, oil the exposed end of the dowel.

Dowel bars at contraction joints may be placed in the full thickness of pavement by a mechanical device approved by the Engineer. The device shall be capable of installing dowel bars within the maximum permissible alignment tolerances. Bond dowels bars at longitudinal construction joints in drilled holes.

g. Installation of Joint Devices. All joint devices shall be approved by the Engineer.

Set the top of an assembled joint device at the proper distance below the pavement surface and check the elevation. Set these devices to the required position and line and securely hold them in place by stakes or other means to the maximum permissible tolerances during the placing and finishing of the concrete. Where premolded joint material is used, place and hold it in a vertical position. If it is constructed in sections, there shall be no offsets between adjacent units.

Check dowel bars and assemblies for position and alignment. The maximum permissible tolerances on dowel bar alignment shall be in accordance with Paragraph 501–5.2e(6). During the concrete placement operation, it is advisable to place plastic concrete directly on dowel assemblies immediately prior to passage of the paver to help maintain dowel position and alignment within maximum permissible tolerances.

When concrete is placed using slip–form pavers, place dowels and tie bars in longitudinal construction joints by bonding the dowels or tie bars into holes drilled into the hardened concrete. Drill holes approximately 1/8–inch to 1/4–inch (3 to 6 mm) greater in diameter than the dowel or tie bar with rotary–type core drills that must be held securely in place to drill perpendicularly into the vertical face of the pavement slab. Rotary–type percussion drills may be used provided that spalling of concrete does not occur. Repair damage to the concrete in a method approved by the Engineer. Bond dowels or tie bars in the drilled holes using an epoxy resin material. Use adequate installation procedures to insure that the area around dowels is completely filled with epoxy grout. Inject Epoxy into the back of the hole and displace it by the insertion of the dowel bar. Completely insert bars into the hole and do not withdraw and reinsert. Furnish a template for checking the position and alignment of the dowels. Dowel bars shall not be less than 10 inches (250 mm) from a transverse joint and shall not interfere with dowels in the transverse direction.

h. Sawing of Joints. Cut joints as shown on the Plans. Equipment shall be as described in Paragraph 501–4.1. Use a circular cutter that is capable of cutting a groove in a straight line and can produce a slot at least 1/8 inch (3 mm) wide and to the depth shown on the Plans. Widen the top portion of the slot by sawing to provide adequate space for joint sealers as shown on the Plans. Commence sawing 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. Sawing can be done both during the day and night as required. Saw the joints at the required spacing, consecutively in sequence of the concrete placement.

501–4.11 FINAL STRIKE–OFF, CONSOLIDATION, AND FINISHING.

a. Sequence. The sequence of operations is the strike–off, floating and removal of laitance, straightedging, and final surface finish. Do not add superficial water to the surface of the concrete to assist in finishing operations.

b. Finishing at Joints. Compact and firmly place the concrete adjacent to joints without voids or segregation against the joint material. Firmly place it without voids or segregation under and around all load–transfer devices, joint assembly units, and other features designed to extend into the pavement. Mechanically vibrate concrete adjacent to joints as required in Paragraph 501–4.8a. After the concrete has been placed and vibrated adjacent to the joints, operate the finishing machine to avoid damage or misalignment of joints. If uninterrupted operations of the finishing machine, to, over, and beyond the joints, cause segregation of concrete, damage to, or misalignment of the joints, stop the finishing machine when the screed is approximately 8 inches (200 mm) from the joint. Remove segregated concrete from the front of and off the joint; and resume the forward motion of the finishing machine. Thereafter, the finishing machine may be run over the joint without lifting the screed, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

c. Machine Finishing. Spread the concrete as soon as it is placed, and strike it off and screed it by using a finishing machine. Go over each area as many times and as often as necessary to give proper consolidation and to leave a surface of uniform texture. Avoid excessive operation over a given area. When side forms are used, keep the tops of the forms clean by using an effective device attached to the machine, and maintain the travel of the machine on the forms true without lift, wobbling, or other variation tending to affect the precision finish. During the first pass of the finishing machine, maintain a uniform ridge of concrete ahead of the front screed for its entire length. When in operation, move the screed forward with a combined longitudinal and transverse shearing motion, always moving in the direction in which the Work is progressing, and so manipulated that neither end is raised from the side forms during the striking–off process. If necessary, repeat this until the surface is of uniform texture, true to grade and cross section, and free from porous areas.

d. Hand Finishing. Hand finishing methods are not 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;

(2) In areas of narrow widths or of irregular dimensions where operation of the mechanical equipment is impractical.

Strike off and screed concrete, as soon as it is placed. Use an approved portable screed. Provide a second screed for striking off the bottom layer of concrete when reinforcement is used.

The screed for the surface shall be at least 2 feet (0.6 m) longer than the maximum width of the slab to be struck off. It shall be of approved design, sufficiently rigid to retain its shape, and shall be constructed either of metal or of other suitable material covered with metal. Attain consolidation by the use of suitable vibrators.

e. Floating. After the concrete has been struck off and consolidated, smooth and true it by means of a longitudinal float using one of the following methods:

(1) Hand Method. Long–handled floats shall not be less than 12 feet (3.6 m) in length and 6 inches (150 mm) in width, stiffened to prevent flexibility and warping. Operate the float from foot bridges spanning but not touching the concrete or from the edge of the pavement. Floating shall pass gradually from one side of the pavement to the other. Forward movement along the centerline of the pavement shall be in successive advances of not more than one–half the length of the float. Remove and waste excess water or laitance in excess of 1/8–inch (3 mm) thick.

(2) Mechanical Method. The Contractor may use a machine composed of a cutting and smoothing float(s), suspended from and guided by a rigid frame and constantly in contact with the side forms or underlying surface. If necessary, long–handled floats having blades not less than 5 feet (1.5 m) in length and 6 inches (150 mm) in width may be used to smooth and fill in open–textured areas in the pavement. When the crown of the pavement will not permit the use of the mechanical float, float the surface transversely by means of a long–handled float. Take care not to work the crown out of the pavement during the operation. After floating, remove and waste any excess water and laitance in excess of 1/8–inch (3 mm) thick. Lap successive drags one–half the length of the blade.

f. Straight–edge Testing and Surface Correction. After the pavement has been struck off and while the concrete is still plastic, test it for trueness with a Contractor furnished 16–foot (4.9 m) straightedge swung from handles 3 feet (1 m) longer than one–half the width of the slab. Hold the straightedge in contact with the surface in successive positions parallel to the centerline and go over the whole area 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. Remove and waste water and laitance in excess of 1/8–inch (3 mm) thick from the surface of the pavement. Immediately fill depressions with freshly mixed concrete, struck off, consolidated, and refinished. Cut down and refinish high areas. Give special attention to assure that the surface across joints meets the smoothness requirements of Paragraph 501–5.2e(3). Continue straightedge testing and surface corrections 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. Confine the use of long–handled wood floats to a minimum. They may be used only in emergencies and in areas not accessible to finishing equipment.

501–4.12 SURFACE TEXTURE. Finish the surface of the pavement with either a broom, burlap drag, or artificial turf finish for all newly constructed concrete pavements.

a. Brush or Broom Finish. If the pavement surface texture is to be a type of brush or broom finish, apply it when the water sheen has practically disappeared. Operate the equipment transversely across the pavement surface, providing corrugations that are uniform in appearance and approximately 1/16 of an inch (2 mm) in depth. It is important that the texturing equipment not tear or unduly roughen the pavement surface during the operation. Correct imperfections resulting from the texturing operation.

b. Burlap Drag Finish. If a burlap drag is used to texture the pavement surface, it shall be at least 15 ounces per square yard (510 g/m^2). To obtain a textured surface, remove the transverse threads of the burlap approximately 1 foot (0.3 m) from the trailing edge. A heavy buildup of grout on the burlap threads produces the desired wide sweeping longitudinal striations on the pavement surface. The corrugations should be uniform in appearance and approximately 1/16 of an inch (2 mm) in depth.

c. Artificial Turf Finish. If artificial turf is used to texture the surface, apply it by dragging the surface of the pavement in the direction of concrete placement with an approved full–width drag made with artificial turf. Securely fasten the leading transverse edge of the artificial turf drag to a lightweight pole on a traveling bridge. Have at least 2 feet (600 mm) of the artificial turf in contact with the concrete surface during dragging operations. A variety of different types of artificial turf are available, and approval of 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–inches–long polyethylene turf blades per square foot. The corrugations should be uniform in appearance and approximately 1/16 of an inch (2 mm) in depth.

NOTE TO SPECIFIER:
The Engineer may specify a particular type of finish by Special Provision.

501–4.13 SKID RESISTANT SURFACES. Provide a skid resistant surface by construction of saw cut grooves or wire combing. Construct saw cut grooves when indicated in the Contract Documents.

SAW–CUT GROOVES. For new concrete pavements that have hardened, saw-cut transverse grooves in the pavement forming a 1/4 inch (6 mm) wide by 1/4 inch (6 mm) deep by 1–1/2 inches (37 mm) center-to-center configuration. Continue the grooves for the entire runway length. Saw–cut them transversely in the runway pavement to within 10 feet (3 m) of the runway pavement edge to allow adequate space for equipment operation. The maximum transverse saw–cut grooves shall not exceed 130 feet (40 m). Meet the following tolerances for the saw–cut grooves:

Alignment tolerance:

- Plus or minus 1–1/2 inches (38 mm) in alignment for 75 feet (23 m).

Groove tolerance:

- Minimum depth 3/16 inch (5 mm), except that not more than 60 percent of the grooves shall be less than 1/4 inch (6 mm).
- Maximum depth 5/16 inch (8 mm).
- Maximum width 5/16 inch (8 mm).

Center–to–center spacing:

- Minimum spacing 1–3/8 inches (35 mm)
- Maximum spacing 1–5/8 inches (38 mm).

Saw–cut grooves shall not be closer than 3 inches (76 mm) or more than 9 inches (229 mm) to transverse paving joints. Grooves shall not be closer than 6 inches (152 mm) and no more than 18 inches (457 mm) from in–pavement light fixtures. Grooves may be continued through longitudinal joints. Where neoprene compression seals have been installed, grooves shall not be closer than 3 inches (76 mm) or more than 5 inches (127 mm) from the longitudinal joints. Cleanup of waste material shall be continuous during the grooving operation. Dispose of waste material in an approved manner. Do not allow waste material to enter the airport storm or sanitary sewer system.

WIRE COMBING. Wire comb the concrete surface unless saw cut grooves are included in the Contract. Use steel combs or tines of various dimensions for the wire combing technique to form a groove–like texture in the plastic concrete pavement and provide grooves that are approximately 1/8 inch (3 mm) by 1/8 inch (3 mm) spaced 1/2 inch (13 mm) center–to center. Construct the wire combing over the full pavement width. Operate the equipment transversely across the pavement surface perpendicular to the pavement centerline.

NOTE TO SPECIFIER:

When a skid–resistant surface is required in the design, the Engineer shall include a Pay Item for saw cut grooving for runway pavements and indicate the location on the Plans. In all cases, a surface texture shall be provided in the plastic concrete prior to construction of the skid–resistant surface. Wirecombing provides skid–resistance but does not prevent hydroplaning.

PLASTIC GROOVES. The grooves formed in the plastic concrete shall be 1/4 inch (6 mm) by 1/4 inch (6 mm) by 1–1/2 inches (38 mm). The grooves shall be continuous for the entire runway length and width. The tolerances for the grooves formed in plastic concrete shall meet the following:

Alignment tolerance.

Plus or minus 3 inches (76 mm) in alignment for 75 feet (23 m).

Groove tolerance.

Minimum depth 1/8 inch (3 mm)

Maximum depth 3/8 inch (10 mm).

Minimum width 1/8 inch (3 mm).

Maximum width 3/8 inch (10 mm).

Center–to–center spacing.

Minimum spacing 1–1/4 inches (32 mm).

Maximum spacing 2 inches (51 mm).

501–4.14 CURING. Immediately after finishing operations are completed and marring of the concrete will not occur, cure the entire surface of the newly placed concrete 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, will be cause for immediate suspension of concreting operations. Do not leave the concrete exposed for more than 1/2 hour during the curing period.

NOTE TO SPECIFIER:
The Engineer shall delete cure types that may not be feasible around aircraft jet blast in operating areas.

a. Impervious Membrane Method. Spray the entire surface of the pavement uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place. Do not apply the curing compound during rainfall. Apply curing compound by mechanical sprayers under pressure at the rate of 1 gallon (4 liters) to not more than 150 square feet (14 square meters). 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 stir the compound continuously by mechanical means. Hand spraying of odd widths or shapes and concrete surfaces exposed by the removal of forms is permitted. The curing compound should be of quality 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, repair the damaged portions immediately with additional compound or other approved means. Upon removal of side forms, protect the sides of the exposed slabs immediately to provide a curing treatment equal to that provided for the surface.

b. Polyethylene Films. Cover entirely the top surface and sides of the pavement entirely with polyethylene sheeting. Lap the units at least 18 inches (457 mm). Place and weight the sheeting causing it to remain in contact with the surface and sides. The sheeting dimensions must extend at least twice the thickness of the pavement beyond the edges of the pavement. Unless otherwise specified, maintain the sheeting in place for 7 days after the concrete has been placed.

c. Waterproof Paper. Cover the top surface and sides of the pavement entirely with waterproofed paper. Lap the units at least 18 inches (457 mm). Place and weight the paper causing it to remain in contact with the surface covered. The paper dimensions must extend at

least twice the thickness of the pavement beyond the edges of the slab. Thoroughly saturate the surface of the pavement prior to placing of the paper. Unless otherwise specified, maintain the paper in place for 7 days after the concrete has been placed.

d. White Burlap–Polyethylene Sheets. Cover the surface of the pavement entirely with the sheeting. The sheeting used must extend at least twice the thickness of the pavement beyond the edges of the slab. Place the sheeting so that the entire surface and both edges of the slab are completely covered. Place and weigh the sheeting to remain in contact with the surface covered, and maintain the covering fully saturated and in position for 7 days after the concrete has been placed.

e. Curing in Cold Weather. Maintain the concrete at a temperature of at least 50°F (10°C) for a period of 72 hours after placing and at a temperature above freezing for the remainder of the curing time. Assume responsibility for the quality and strength of the concrete placed during cold weather. Remove and replace concrete injured by frost action at the Contractor's expense.

501–4.15 REMOVING FORMS. Unless otherwise specified, do not remove forms from freshly placed concrete until it has hardened sufficiently to permit removal without chipping, spalling, or tearing. After the forms have been removed, cure the sides of the slab as outlined in one of the methods indicated in Paragraph 501–4.14. Consider major honeycombed areas as defective work and remove and replace it in accordance with Paragraph 501–5.2(f).

501–4.16 SEALING JOINTS. Seal the joints in the pavement in accordance with Specification P–605.

501–4.17 PROTECTION OF PAVEMENT. Protect the pavement and its appurtenances against both public traffic and traffic caused by the Contractor's employees and agents. This includes workers 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. Repair or replace damage to the pavement occurring prior to final acceptance at the Contractor's expense. Have available at all times, materials for the protection of the edges and surface of the unhardened concrete. These protective materials shall consist of rolled polyethylene sheeting at least 4 mils (0.1 mm) 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, stop all paving operations and have all available personnel begin covering the surface of the unhardened concrete with the protective covering.

501–4.18 OPENING TO TRAFFIC. Do not open the pavement to traffic until test specimens molded and cured in accordance with ASTM C 31 have attained a flexural strength of 550 pounds per square inch (3792 kPa) when tested in accordance with ASTM C 78, or a compressive strength of 3,500 psi (24,130 kPa) when tested in accordance with ASTM C 39. If these tests are not conducted, do not open the pavement to traffic until 14 days after the concrete was placed. Prior to opening to traffic, clean the pavement.

MATERIAL ACCEPTANCE

501–5.1 ACCEPTANCE SAMPLING AND TESTING. All acceptance sampling and testing, with the exception of coring for thickness determination, necessary to determine conformance with the requirements specified in this section will be performed by the Engineer. Concrete will be accepted for strength and thickness on a lot basis.

NOTE TO SPECIFIER:
On small projects it may be appropriate to define lots on a cubic yard basis. When this is the case, refer to the BOA Standard Special Provisions.

A lot shall consist of:

- One day's production not to exceed approximately 2,000 cubic yards (1,530 m^3)
- A half day's production where a day's production is expected to consist of between approximately 2,000 cubic yards (1530 m^3) and approximately 4,000 cubic yards (3,058 m^3)
- Similar subdivisions for a day's production of over 4,000 cubic yards (3,058 m^3)
- If a single day's production is expected to be less than approximately 1,000 cubic yards (765 m^3) but more than approximately 500 cubic yards (382 m^3), it will become two (2) sublots and added to the next lot, i.e., n=6.
- If a single day's production is expected to be less than approximately 500 cubic yards (382 m^3), it will become one sublot for the next lot, i.e., n=5.

For projects where basis of payment is square yards, the Engineer will convert the lot size to an equivalent area.

Testing organizations performing these tests shall meet the requirements of ASTM C 1077. The Contractor shall bear the cost of providing curing facilities for the strength specimens, per Paragraph 501–5.1a(3), and coring and filling operations, per Paragraph 501–5.1b(1).

a. Flexural Strength.

(1) Sampling. Each lot shall be divided into 4 equal sublots. One (1) specimen will be taken for each sublot from the plastic concrete delivered to the job site. The Engineer will determine sampling locations in accordance with random sampling procedures contained in ASTM D 3665. The concrete will be sampled in accordance with ASTM C 172.

(2) Testing. Specimens will be made in accordance with ASTM C 31 and the flexural strength of each specimen shall be determined at 28 days in accordance with ASTM C 78.

(3) Curing. Provide adequate facilities for the initial curing of beams at the contractors expense. During the 24 hours after molding, the temperature immediately adjacent to the specimens must be maintained in the range of 60° to 80°F (16° to 27°C), and loss of moisture from the specimens must be prevented. Store the specimens 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 use other suitable methods, provided the temperature and moisture loss requirements are met.

(4) Acceptance. The Engineer will determine acceptance of pavement for flexural strength in accordance with Paragraph 501–5.2b.

NOTE TO SPECIFIER:
Preventing loss of moisture is extremely important since relatively small amounts of surface drying of flexural specimens can induce tensile stresses in the extreme fibers that will markedly reduce the indicated flexural strength.

When the design strength in paragraph 501–3.1 is based on compressive strength, this paragraph should be revised as follows:

a. Compressive Strength.

(1) Sampling. Each lot shall be divided into four equal sublots. One (1) sample shall be taken for each sublot from the plastic concrete delivered to the job site. Sampling locations shall be determined by the Engineer in accordance with random sampling procedures contained in ASTM D 3665. The concrete shall be sampled in accordance with ASTM C 172.

(2) Testing. Specimens shall be made in accordance with ASTM C 31 and the compressive strength of each specimen shall be determined in accordance with ASTM C 39.

(3) Curing. The Contractor shall provide adequate facilities for the initial curing of cylinders. During the 24 hours after molding, the temperature immediately adjacent to the specimens must be maintained in the range of 60 to 80 degrees F (16 to 27 degrees C), 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 use other suitable methods, provided the temperature and moisture loss requirements are met.

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b. Pavement Thickness.

(1) Sampling. Each lot as defined in Paragraph 501–5.1(a) will be divided into 4 equal sublots and one core shall be taken by the Contractor for each sublot. The Engineer will determine sampling locations in accordance with random sampling procedures contained in ASTM D 3665.

Cut cores neatly with a core drill. Furnish all tools, labor, and materials for cutting samples and filling the cored hole. Fill core holes with a non–shrink grout approved by the Engineer within one day after sampling.

(2) Testing. The Engineer will determine the thickness of the cores by the average caliper measurement in accordance with ASTM C 174.

(3) Acceptance. The Engineer will determine acceptance of pavement for thickness in accordance with Paragraph 501–5.2c.

c. Partial Lots. When operational conditions cause a lot to be terminated before the specified four tests have been made for the lot, the following procedure will be used to adjust the lot size and the number of tests for the lot.

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, i.e., n=5 or n=6.

501–5.2 ACCEPTANCE CRITERIA.

a. General. Acceptance will be based on the following characteristics of the completed pavement:

(1) Flexural strength
(2) Thickness
(3) Smoothness
(4) Grade
(5) Edge slump
(6) Dowel bar alignment

Flexural strength will be evaluated for acceptance by the Engineer in accordance with Paragraph 501–5.2b. The Engineer will evaluate thickness for acceptance in accordance with Paragraph 501–5.2c. Smoothness will be evaluated by the Engineer in accordance with Paragraph 501–5.2e(3).

Acceptance for flexural strength and thickness will be based on the criteria contained in Paragraph 501–5.2e(1). Acceptance for thickness will be based on the criteria contained in Paragraph 501–5.2e(2). Acceptance for smoothness will be based on the criteria contained in Paragraph 501–5.2e(3). Acceptance for grade will be based on the criteria contained in Paragraph 501–5.2e(4).

The Engineer may at any time, not withstanding 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. The rejection may be based on only visual inspection. In the event of a 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 the material was erroneously rejected, payment will be made for the material at the Contract unit price.

b. Flexural Strength. Acceptance of each lot of in–place pavement for flexural strength will be based on the percentage of material within specification limits (PWL). The PWL plan considers the variability (standard deviation) of the material and the testing procedures, as well as the average (mean) value of the test results.

NOTE TO SPECIFIER:
When the design strength in paragraph 501–3.1 is based on compressive strength, substitute compressive strength for flexural strength.

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c. Pavement Thickness. Acceptance of each lot of in–place pavement will be based on the percentage of material within specification limits.

d. Percentage of Material Within Specification Limits (PWL). The percentage of material within specification limits will be determined in accordance with procedures specified in Section 110 of the General Requirements and Covenants.

The lower specification limit (L) for flexural strength and thickness will be:

Lower Specification Limit (L)	
Flexural Strength	Design strength given in Paragraph 501–3.1.
Thickness	0.97 x Plan thickness for the lot

NOTE TO SPECIFIER:
When the design strength in paragraph 501–3.1 is based on compressive strength, substitute compressive strength for flexural strength.

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e. Acceptance Criteria.

(1) Flexural Strength. If the PWL of the lot equals or exceeds 80 percent for flexural strength, the pay factor for the lot will be between 1.0 and 1.06, as determined in accordance with Paragraph 501–8.1a. If the PWL is less than 80 percent, the pay factor for the lot will be less than 1.0, as determined in accordance with Paragraph 501–8.1a.

(2) Thickness. If the PWL of the lot equals or exceeds 90 percent for thickness, the pay factor for the lot will be 1.0, in accordance with Paragraph 501–8.1b. If the PWL is less than 90 percent, the factor for the lot will be less than 1.0, as determined in accordance with Paragraph 501–8.1b.

(3) Smoothness. When the concrete has hardened sufficiently, the pavement surface will be tested with a 16–foot (5 m) straightedge or other specified device. Surface smoothness deviations shall not exceed 1/4 inch (6 mm) from a 16–foot (5 m) straightedge placed in any direction, including placement along and spanning any pavement joint edge.

Areas in a slab showing high spots of more than 1/4 inch (6 mm) but not exceeding 1/2 inch (13 mm) in 16 feet (5 m) will be marked and immediately ground down with an approved grinding machine to an elevation that will fall within the tolerance of 1/4 inch (6 mm) or less. Where the departure from correct cross section exceeds 1/2 inch (13 mm), the pavement shall be removed and replaced at the expense of the Contractor when so directed by the Engineer.

(4) Grade. An evaluation of the surface grade will be made by the Engineer for compliance to the tolerances contained below.

Lateral Deviation. Lateral deviation from established alignment of the pavement edge shall not exceed plus or minus 0.10 foot (30 mm) in any lane.

Vertical Deviation. Vertical deviation from established grade shall not exceed plus or minus 0.04 foot (12 mm) at any point.

(5) Edge Slump. When slip–form paving is used, not more than 15 percent of the total free edge of each 500 feet (152 m) of pavement, or fraction thereof, shall have an edge slump exceeding 1/4–inch (6 mm), and none of the free edge of the pavement shall have an edge slump exceeding 3/8–inch (10 mm). (The total free edge of 500 feet (152 m) of pavement will be considered the cumulative total linear measurement of pavement edge originally constructed as nonadjacent to any existing pavement; i.e., 500 feet (152 m) of paving lane originally constructed as a separate lane will have 1,000 feet (305 m) of free edge, 500 feet (152 m) 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 (457 mm) from the edge. When excessive edge slump cannot be corrected before the concrete has hardened, the area with excessive edge slump shall be removed and replaced at the expense of the Contractor when so directed by the Engineer.

(6) Dowel Bar Alignment. Dowel bars and assemblies shall be checked for position and alignment. The maximum permissible tolerance on dowel bar alignment in each plane, horizontal and vertical, shall not exceed 2 percent or 1/4 inch (6 mm) per foot of dowel bar.

f. Removal and Replacement of Concrete. Any area or section of concrete that is removed and replaced shall be removed and replaced back to planned joints. Replace damaged dowels. The requirements for doweled longitudinal construction joints in Paragraph 501–4.10 shall apply to all contraction joints exposed by concrete removal.

CONTRACTOR QUALITY CONTROL

501–6.1 QUALITY CONTROL PROGRAM. Develop a Quality Control Program in accordance with Section 100 of the General Requirements and Covenants. Address all elements which affect the quality of the pavement including, but not limited to:

a. Mix Design

b. Aggregate Gradation

c. Quality of Materials

d. Stockpile Management

e. Proportioning

f. Mixing and Transportation

g. Placing and Consolidation

h. Joints

i. Dowel Placement and Alignment

j. Flexural or Compressive Strength

k. Finishing and Curing

l. Surface Smoothness

m. Thickness

NOTE TO SPECIFIER:
When the area to be paved is less than 600 square yards (500 square meters), the Engineer may modify this requirement.

501–6.2 QUALITY CONTROL TESTING. 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. Include in the testing program, but not necessarily limited to; tests for aggregate gradation, aggregate moisture content, slump, and air content.

Develop a Quality Control Testing Plan as part of the Quality Control Program.

a. Fine Aggregate.

(1) Gradation. Do a sieve analysis at least twice daily in accordance with ASTM C 136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

(2) Moisture Content. If an electric moisture meter is used, do at least two direct measurements of moisture content per week to check the calibration. If direct measurements are made instead of using an electric meter, conduct two tests per day. Conduct tests in accordance with ASTM C 70 or ASTM C 566.

b. Coarse Aggregate.

(1) Gradation. Do a sieve analysis at least twice daily for each size of aggregate. Tests shall be made in accordance with ASTM C 136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

(2) Moisture Content. If an electric moisture meter is used, do at least two direct measurements of moisture content per week to check the calibration. If direct measurements are made instead of using an electric meter, conduct two tests per day. Conduct tests in accordance with ASTM C 566.

c. Slump. Perform four slump tests for each lot of material produced in accordance with the lot size defined in Section 501–5.1. Conduct one test for each sublot. Perform Slump tests in accordance with ASTM C 143 from material randomly sampled from material discharged from trucks at the paving site. Take material samples in accordance with ASTM C 172.

d. Air Content. Perform four air content tests for each lot of material produced in accordance with the lot size defined in Section 501–5.1. Do one test for each sublot. Perform air content tests in accordance with ASTM C 231 for gravel and stone coarse aggregate and ASTM C 173 for slag or other porous coarse aggregate, from material randomly sampled from trucks at the plant site. Take material samples in accordance with ASTM C 172.

501–6.3 CONTROL CHARTS. Maintain linear control charts for fine and course aggregate, gradation, slump, and air content.

Post control charts in a location satisfactory to the Engineer and keep it up to date at all times. As a minimum, identify in the control charts the project number, the Contract Pay 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. Use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the 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.

a. Fine and Coarse Aggregate Gradation. Record the running average of the last five gradation tests for each control sieve on linear control charts. Specification limits contained in Tables 1 and 2 shall be superimposed on the Control Chart for job control.

b. Slump and Air Content. Maintain linear control charts both for individual measurements and range (i.e., difference between highest and lowest measurements per lot) for slump and air content in accordance with the following Action and Suspension Limits.

CONTROL CHART LIMITS

Control Parameter	**Individual Measurements*	
	Action Limit	*Suspension Limit*
Slump	+/– 1 inch (25 mm)	+/– 1.5 inch (38 mm)
Air Content	+/– 1.2%	+/– 1.8%

* The individual measurement control charts shall use the Contractor's mix design values as indicators of central tendency

RANGE SUSPENSION LIMITS		
n (Number of samples)	Slump	Air
2	+/- 1.8 inch (45 mm)	+/- 2.2%
3	+/- 2.2 inch (55 mm)	+/- 2.6%
4	+/- 2.4 inch (6.0 mm)	+/- 2.8%
5	+/- 2.5 inch (62.5 mm)	+/- 3.0%
6	+/- 2.5 inch (62.5 mm)	+/- 3.0%

501–6.4 CORRECTIVE ACTION. Indicate in the Quality Control Plan the appropriate action to be taken when a process is believed to be out of control. Detail in the Plan what action will be taken to bring a process into control and have 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.

a. Fine and Coarse Aggregate Gradation. When two consecutive averages of five tests are outside of the Tables 1 or 2 specification limits, take immediate steps, including a halt to production, to correct the gradation.

b. Fine and Coarse Aggregate Moisture Content. Whenever the moisture content of the fine or coarse aggregate changes by more than 0.5 percent, adjust the scale settings for the aggregate batcher(s) and water batcher.

c. Slump. Halt production and make appropriate adjustments whenever:

(1) One point falls outside the Suspension Limit line for individual measurements or range; or
(2) Two points in a row fall outside the Action Limit line for individual measurements.

d. Air Content. Halt production and adjust the amount of air–entraining admixture whenever:

(1) One point falls outside the Suspension Limit line for individual measurements or range; or
(2) Two points in a row fall outside the Action Limit line for individual measurements.

Whenever a point falls outside the Action Limits line, calibrate the air–entraining admixture dispenser to ensure that it is operating correctly and with good reproducibility.

METHOD OF MEASUREMENT

501–7.1 Portland cement concrete pavement will be measured by the number of square yards of either plain or reinforced pavement as specified in–place, completed and accepted. Saw Cut Grooving will be measured by the number of square yards of Saw Cut Grooving as constructed in–place and accepted. Portland Cement Concrete Pavement Quality Management Program will be measured by the number of square yards of pavement constructed and accepted.

BASIS OF PAYMENT

501–8.1 GENERAL. Payment for an accepted lot of concrete pavement will be made at the Contract unit price per square yard adjusted in accordance with paragraphs 501–8.1a,b, and c. Payment will be full compensation for all labor, materials, tools, equipment, and incidentals required to complete the Work as specified herein and on the drawings, except for Saw Cut Grooving and Portland Cement Concrete Quality Management Program. Joint sealing filler shall be incidental and the cost included in the price for Portland Cement Concrete Pavement unless separate Pay Item is included in the Schedule of Prices.

a. Basis of Adjusted Payment for Flexural Strength (PFs). A pay factor for flexural strength will be determined in accordance with the following schedule when the percent within specification limits (PWL) equals or exceeds 60 percent.

Percent within Limits (PWL)	**Pay Factor for Flexural Strength (PFs)**
80–100	0.76 + 0.003 PWL
60–79	$0.00017\ PWL^2 – 0.0105\ PWL + 0.75$

When the PWL is below 60 percent, the lot shall be removed and replaced. However, the Engineer may decide to accept the deficient lot. In that case, if the Engineer and Contractor agree in writing that the lot shall not be removed, it will be paid for at 50 percent of the Contract unit price.

NOTE TO SPECIFIER:
When the design strength in paragraph 501–3.1 is based on compressive strength, substitute compressive strength for flexural strength.

b. Basis of Adjusted Payment for Thickness (PFt). A pay factor for thickness will be determined in accordance with the following schedule when the percent within specification limits (PWL) equals or exceeds 25 percent.

Percent within Limits (PWL)	**Pay Factor for Thickness (PFt)**
90–100	1.0
25–89	$0.000034 \times PWL^2 – 0.00006 \times PWL + 0.72$

Remove and replace the lot when the PWL is below 25 percent. However, the Engineer may decide to accept the deficient lot. In that case, if the Engineer and Contractor agree in writing that the lot shall not be removed, it will be paid for at 50 percent of the Contract unit price.

c. Lot Pay Factor. The percent payment for an accepted lot will be arrived at by successively multiplying the Contract unit price by both factors determined in paragraphs 501-8.1a and 501-8.1b.

PFs x PFt x Contract unit price = Adjusted payment for lot

501–8.2 PAYMENT FOR SAW CUT GROOVING. Payment for Saw Cut Grooving will be made at the Contract unit price per square yard and will be full compensation for all labor, materials, tools, equipment and incidentals required to complete the Work as specified.

501–8.3 Payment for Portland Cement Concrete Pavement Quality Management Program will be made at the Contract unit price per square yard and will be full compensation for all labor, materials, tools, equipment, and incidentals required to complete the Work as specified.

501–8.4 Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P50101	Portland Cement Concrete Pavement, 6 inch, per square yard
Pay Item P50102	Portland Cement Concrete Pavement, 7 inch, per square yard
Pay Item P50103	Portland Cement Concrete Pavement, 8 inch, per square yard
Pay Item P50104	Portland Cement Concrete Pavement, 9 inch, per square yard
Pay Item P50105	Portland Cement Concrete Pavement, 10 inch, per square yard
Pay Item P50106	Portland Cement Concrete Pavement, 11 inch, per square yard
Pay Item P50107	Portland Cement Concrete Pavement, 12 inch, per square yard
Pay Item P50108	Portland Cement Concrete Pavement, 13 inch, per square yard
Pay Item P50109	Portland Cement Concrete Pavement, 14 inch, per square yard
Pay Item P50110	Portland Cement Concrete Pavement, 15 inch, per square yard
Pay Item P50111	Portland Cement Concrete Pavement, 16 inch, per square yard
Pay Item P50112	Portland Cement Concrete Pavement, 17 inch, per square yard
Pay Item P50113	Portland Cement Concrete Pavement, 18 inch, per square yard
Pay Item P50114	Portland Cement Concrete Pavement, 19 inch, per square yard
Pay Item P50115	Portland Cement Concrete Pavement, 20 inch, per square yard
Pay Item P50116	Portland Cement Concrete Pavement, 21 inch, per square yard
Pay Item P50117	Portland Cement Concrete Pavement, 22 inch, per square yard
Pay Item P50118	Portland Cement Concrete Pavement, 23 inch, per square yard
Pay Item P50119	Portland Cement Concrete Pavement, 24 inch, per square yard
Pay Item P50131	Portland Cement Concrete Pavement Quality Management Program, per square yard
Pay Item P50132	Saw Cut Grooving, per square yard

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 will be included in the Pay Items contained in the Schedule of Prices.

TESTING REQUIREMENTS

ASTM C 31	Making and Curing Concrete Test Specimens in the Field
ASTM C 39	Compressive Strength of Cylindrical Concrete Specimens
ASTM C 70	Surface Moisture in Fine Aggregate
ASTM C 78	Test for Flexural Strength of Concrete (Using Simple Beam with Third–Point Loading)
ASTM C 131	Test for Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
ASTM C 136	Sieve Analysis of Fine and Coarse Aggregates
ASTM C 138	Test for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
ASTM C 143	Test for Slump of Portland Cement Concrete
ASTM C 172	Sampling Freshly Mixed Concrete
ASTM C 173	Test for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 174	Measuring Length of Drilled Concrete Cores
ASTM C 227	Potential Alkali Reactivity of Cement–Aggregate Combinations (Mortar–Bar Method)
ASTM C 231	Test for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 289	Potential Reactivity of Aggregates (Chemical Method)
ASTM C 295	Petrographic Examination of Aggregates for Concrete
ASTM C 311	Sampling and Testing Fly Ash for Use as an Admixture in Portland Cement Concrete
ASTM C 535	Test for Resistance to Abrasion of Large Size Coarse Aggregate by Use of the Los Angeles Machine
ASTM C 566	Total Moisture Content of Aggregates by Drying
ASTM C 1077	Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM D 3665	Random Sampling of Construction Materials
ASTM D 4791	Test Method for Flat or Elongated Particles in Coarse Aggregate
AASHTO T 26	Quality of Water to be Used in Concrete

MATERIAL REQUIREMENTS

ASTM A 184	Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	Specification for Welded Steel Wire Fabric for Concrete Reinforcement
ASTM A 497	Specification for Welded Deformed Steel Wire Fabric for Concrete Pavement
ASTM A 615	Specification for Deformed and Plain Billet–Steel Bars for Concrete Reinforcement
ASTM A 616	Specification for Rail–Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 617	Specification for Axle–Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 704	Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
ASTM A 714	Specification for High–Strength Low–Alloy Welded and Seamless Steel Pipe
ASTM C 33	Specification for Concrete Aggregates
ASTM C 94	Specification for Ready–Mixed Concrete
ASTM C 150	Specification for Portland Cement
ASTM C 171	Specification for Sheet Materials for Curing Concrete
ASTM C 260	Specification for Air–Entraining Admixtures for Concrete
ASTM C 309	Specification for Liquid Membrane–Forming Compounds
ASTM C 494	Specification for Chemical Admixtures for Concrete
ASTM C 595	Specification for Blended Hydraulic Cements
ASTM C 618	Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 666	Test Method for Resistance of Concrete to Rapid Freezing and Thawing
ASTM C 881	Specification for Epoxy–Resin Base Bonding System for Concrete
ASTM C 989	Specification for Ground Granulated Blast–Furnace Slag for Use in Concrete and Mortars
ASTM D 1751	Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
AASHTO M 254	Specification for Coated Dowel Bars
ACI 305R	Hot Weather Concreting
ACI 306R	Cold Weather Concreting
TT–P–644	Federal Specification for Primer Coating, Alkyd, (Rev. D) Corrosion–Inhibiting, Lead and Chromate Free, VOC–Compliant

SPECIFICATION P-602. BITUMINOUS PRIME COAT

DESCRIPTION

602–1.1 This Work consists of an application of bituminous material on the prepared base course in accordance with these Specifications and in reasonably close conformity to the lines shown on the Plans.

MATERIALS

602–2.1 BITUMINOUS MATERIAL. Provide Type SS–1 or Type SS–1h emulsified asphalt in accordance with ASTM D 977. The application temperature shall be 70 to 160°F (20° to 70°C).

NOTE TO SPECIFIER:
TABLE 1. BITUMINOUS MATERIAL
[1] The maximum temperature for cutback asphalt shall be that at which fogging occurs.

The FAA allows use of materials listed in Table 1. Highways recommends Type SS–1 or SS1h. If cutbacks are specified in the Special Provisions, their use is limited.

Prime coats are only applied to untreated aggregate base prior to placing bituminous concrete. The benefit of prime coat is questionable and is generally used as a dust palliative in Wisconsin.

CONSTRUCTION METHODS

602–3.1 WEATHER LIMITATIONS. Apply prime coat only when the existing surface is dry or contains sufficient moisture to get uniform distribution of the bituminous material, when the atmospheric temperature is above 60°F (15°C), and when the weather is not foggy or rainy.

NOTE TO SPECIFIER:
The FAA specification allows the Engineer to waive the 60°F temperature requirement. WDOT allows applying prime coat at temperatures above 40°F.

602–3.2 EQUIPMENT. Provide a self–powered pressure bituminous material distributor and equipment for heating bituminous material.

Design, equip, maintain, and operate the distributor so that bituminous material at even heat may be applied uniformly on variable widths of surface at the specified rate. The allowable variation from the specified rate shall not exceed 10 percent. Distributor equipment shall include a tachometer, pressure gages, volume–measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. The distributor shall be self–powered and shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically.

Provide a power broom and/or blower for any required cleaning of the surface to be treated.

602–3.3 APPLICATION OF BITUMINOUS MATERIAL. Remove all loose dirt and other objectionable material immediately before applying the prime coat.

Uniformly apply the bituminous material, including solvent, with a bituminous distributor at the rate of 0.25 to 0.50 gallons per square yard (1.20 to 2.40 liters per square meter) depending on the base course surface texture. The Engineer will approve the type of bituminous material and application rate prior to application.

Following the application, allow the primed surface to dry more than 48 hours without being disturbed or for additional time as necessary to permit drying of the prime until it will not be picked up by traffic or equipment. The Engineer will approve this period. Maintain the surface until placement of the prime coat. Take suitable precautions to protect the primed surface against damage during this interval, including supplying and spreading any sand necessary to blot up excess bituminous material.

602–3.4 BITUMINOUS MATERIAL CONTRACTOR'S RESPONSIBILITY. Submit samples of the bituminous materials with a statement documenting their source and character. Obtain approval before applying material. Require the manufacturer or producer of the bituminous materials to furnish material subject to this and all other pertinent requirements of the Contract. Only satisfactory materials, demonstrated by service tests, will be acceptable.

Furnish vendor's certified test reports for each carload, or equivalent, of bituminous material shipped to the project. Deliver the report to the Engineer before permission is granted for use of the material. Furnishing the vendor's certified test report for the bituminous material shall not be interpreted as basis for final acceptance. All of these test reports are subject to verification by testing samples of materials received for use on the project.

602–3.5 FREIGHT AND WEIGH BILLS. Before the final estimate is allowed, file receipted bills with the Engineer when railroad shipments are made, and certified weigh bills when materials are otherwise received, of the bituminous materials actually used in the construction covered by the Contract. Do not remove bituminous material from the tank car or storage tank until the initial outage and temperature measurements have been taken by the Engineer. Do not release the car or tank until the final outage has been taken by the Engineer.

Furnish copies of freight bills and weigh bills to the Engineer during the progress of the Work.

METHOD OF MEASUREMENT

602–4.1 The bituminous material for prime coat will be measured by the gallon or ton. Volume shall be corrected to the volume at 60°F (15°C) in accordance with Table IV–3 of The Asphalt Institute's Manual MS–6 for emulsified asphalt.

BASIS OF PAYMENT

NOTE TO SPECIFIER:
If cutback asphalt is allowed by Special Provision, add a provision requiring volume correction in accordance with ASTM D 1250.

602–5.1 Payment will be made at the Contract unit price per gallon or ton for Bituminous Prime Coat. This price will be full compensation for furnishing all materials, for all preparation, delivering, and applying the materials, and for all labor, equipment, tools, and incidentals necessary to complete this Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P60201	Bituminous Prime Coat, per gallon
Pay Item P60202	Bituminous Prime Coat, per ton

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 will be included in the Pay Items contained in the Schedule of Prices.

MATERIAL REQUIREMENTS

ASTM D 977	Emulsified Asphalt
ASTM D 2028	Asphalt, Cutback (Rapid Curing Grade)
ASTM D 2397	Cationic Emulsified Asphalt

TESTING REQUIREMENTS

ASTM D 1250	Petroleum Measurement Tables
Asphalt Institute Manual MS–6 Table IV–3	Temperature–Volume Corrections for Emulsified Asphalts

SPECIFICATION P–603. BITUMINOUS TACK COAT

DESCRIPTION

603–1.1 This Work consists of preparing and treating a bituminous or concrete surface with bituminous material in accordance with these Specifications and in reasonably close conformity to the lines shown on the Plans.

MATERIALS

603–2.1 BITUMINOUS MATERIALS. Provide Type SS–1 or Type SS–1h emulsified asphalt in accordance with ASTM D 977. The application temperature shall be 70° to 130°F (20° to 55°C).

NOTE TO SPECIFIER:
TABLE 1. BITUMINOUS MATERIAL

The FAA allows use of the materials listed in Table 1. Highways recommends Type SS–1 or SS–1h, which has been incorporated into the Standard Specifications.

Tack coats are used to bond overlays to existing bituminous or P.C. pavement. The benefit of tack coats have been questioned; therefore, whether to use the tack coat or not is left to the Engineer's judgment.

CONSTRUCTION METHODS

603–3.1 WEATHER LIMITATIONS. Apply tack coat only when the existing surface is dry and the atmospheric temperature is above 60°F (15°C).

NOTE TO SPECIFIER:
The FAA allows the Engineer to waive the temperature requirement. WDOT allows applying tack above 40°F (4°C).

603–3.2 EQUIPMENT. Provide equipment for heating and applying the bituminous material. The distributor shall be designed, equipped, maintained, and operated so that bituminous material at even heat may be applied uniformly on variable widths of surface at the specified rate. The allowable variation from the specified rate shall not exceed 10 percent. Distributor equipment shall include a tachometer, pressure gages, volume–measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. The distributor shall be self–powered and equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically.

Provide a power broom and/or blower for required cleaning of the surface to be treated.

603–3.3 APPLICATION OF BITUMINOUS MATERIAL. Remove all loose dirt and other objectionable material immediately before applying the tack coat.

Dilute emulsified asphalt by the addition of water when directed by the Engineer and apply a sufficient time in advance of the paver to ensure that all water has evaporated before the overlying mixture is placed on the tacked surface.

Uniformly apply the bituminous material including vehicle or solvent with a bituminous distributor at the rate of 0.025 to 0.15 gallons per square yard (0.11 to 0.68 liters per square meter) depending on the condition of the existing surface. The Engineer will approve the type of bituminous material and application rate prior to application.

Following the application, allow the surface to cure without being disturbed for a period of time to permit drying and setting of the tack coat. The Engineer will approve this period. Maintain the surface until placement of the next course. Take precautions to protect the surface against damage during this interval.

603–3.4 BITUMINOUS MATERIAL–CONTRACTOR'S RESPONSIBILITY. Submit samples of the bituminous material with documentation of its source and character. Obtain approval before applying material. Require the manufacturer or producer of the bituminous material to furnish material subject to this and all other pertinent requirements of the Contract. Only satisfactory materials that are demonstrated by service tests will be acceptable.

Furnish the vendor's certified test reports for each carload, or equivalent, of bituminous material shipped to the project. Deliver the report to the Engineer before permission is granted for use of the material. Furnishing the vendor's certified test report for the bituminous material shall not be interpreted as a basis for final acceptance. Test reports are subject to verification by testing samples of material received for use on the project.

603–3.5 FREIGHT AND WEIGH BILLS. Before the final estimate is allowed, file receipted bills with the Engineer when railroad shipments are made, and certified weigh bills when materials are otherwise received, of the bituminous materials actually used in the construction covered by the Contract. Do not remove bituminous material from the tank car or storage tank until the Engineer has taken initial outage and temperature measurements. Do not release the car or tank until the final outage has been taken by the Engineer. Furnish copies of freight bills and weigh bills to the Engineer during the progress of the Work.

METHOD OF MEASUREMENT

603–4.1 The bituminous material for tack coat will be measured by the gallon or ton. Volume will be corrected to the volume at 60°F (15°C) in accordance with Table IV–3 of The Asphalt Institute's Manual MS–6 for emulsified asphalt. Water added to emulsified asphalt will not be measured for payment.

NOTE TO SPECIFIER:
If cutback asphalt is allowed by Special Provision, add a provision requiring volume correction in accordance with ASTM D 1250.

Normally, Tack Coat will be measured by the gallon.

BASIS OF PAYMENT

603.5–1 Payment will be made at the Contract unit price per gallon or ton of bituminous material. This price will 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.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P60301	Bituminous Tack Coat, per gallon
Pay Item P60302	Bituminous Prime Coat, per ton

Measurement and payment will only be made for Pay Items listed in the Schedule of Prices. If Tack Coat is required in the Contract Documents and a Pay Item for Tack Coat is not included in the Schedule of Prices, this Work will be considered incidental. The cost of all Work required by the Contract Documents will be included in the Pay Items contained in the Schedule of Prices.

MATERIAL REQUIREMENTS

ASTM D 633	Volume Correction Table for Road Tar
ASTM D 977	Emulsified Asphalt
ASTM D 1250	Petroleum Measurement Tables
ASTM D 2028	Liquid Asphalt (Rapid–Curing Type)
ASTM D 2397	Cationic Emulsified Asphalt
AASHTO M 52	Tar for Use in Road Construction
Asphalt Institute Manual MS–6 Table IV–3	Temperature–Volume Corrections for Emulsified Asphalts

SPECIFICATION P–605. JOINT SEALING FILLER

DESCRIPTION

605–1.1 This Work consists of providing and installing a resilient and adhesive joint sealing filler capable of effectively sealing joints and cracks in pavements.

MATERIALS

605–2.1 JOINT SEALERS. Joint sealing materials shall meet the requirements of the Specifications indicated below.

Deliver each lot or batch of sealing compound to the job site in the manufacturer's original sealed container. Mark each container with the manufacturer's name, batch or lot number, and the safe heating temperature, and accompany it with the manufacturer's certification stating that the compound meets the requirements of this Specification.

Accompanying each lot of preformed joint sealer delivered to the job with the manufacturer's certification stating that it meets the requirements of this Specification.

Provide the type of sealer indicated in the Schedule of Prices, Special Provisions, or Plans.

NOTE TO SPECIFIER:
The standard Joint Sealing Filler utilized in Wisconsin for aprons and other areas requiring jet fuel resistance is Type 1. Type 4 is commonly used for runways and taxiways. Types 2, 6, and 7 can be hazardous.

If a particular type of sealant is not specified, indicate the type required on the Plans or by Special Provision.

Type 1: Fed. Spec. SS–S–200 – Sealing Compounds, Two–Component, Elastomeric, Polymer Type, Jet–Fuel–Resistant, Cold Applied.

Type 2: ASTM D 1854 – Jet–Fuel–Resistant Concrete Joint Sealer, Hot–Poured Elastic Type

Type 3: ASTM D 2628 – Preformed Polychloroprene Elastomeric Joint Seats for Concrete Pavements

Type 4: ASTM D 3405 – Joint Sealants, Hot–Poured, for Concrete and Asphalt Pavements

Type 5: ASTM D 3406 – Joint Sealants, Hot–Poured, Elastomeric–Type, for Portland Cement Concrete Pavements

Type 6: ASTM D 3569 – Joint Sealants, Hot–Poured, Elastomeric, Jet–Fuel–Resistant type, for Portland Cement Concrete Pavements

Type 7: ASTM D 3581 – Joint Sealant, Hot–Poured, Jet–Fuel–Resistant Type, for Portland Cement Concrete and Tar–Concrete Pavements

If preformed joint sealer is specified, the manufacturer shall certify that the preformed seal will exert a minimum pressure of 3.0 pounds per square inch (21 kPa) when compressed to 80 percent of nominal width and a maximum of 25.0 pounds per square inch (172 kPa) when compressed to 50 percent of nominal width.

605–2.2 LUBRICANT. Lubricant for installation of preformed joint seal shall be a one–component polychloroprene compound containing only soluble phenolic resins blended together with anti–oxidants and acid acceptors in aromatic hydrocarbon solvent mixture and shall meet the following requirements:

	Requirements	ASTM
Average weight lbs/gal (kg/m^3)	7.8 (934)	
Solids content, percent by weight	22–28	D1644, Method A
Film strength, psi	2,300 min.	D412
Elongation, percent	750 min. D412	

Deliver each shipment of lubricant to the job site in the manufacturer's original sealed container. Mark each container with the manufacturer's name, batch or lot number, and the date of manufacture, and accompany with it the manufacturer's certification stating that the lubricant meets the requirements of the Specification.

Store this lubricant at a temperature between 50°F (10°C) and 80°F (30°C) and use it within 270 days of its manufacture.

CONSTRUCTION METHODS

605–3.1 TIME OF APPLICATION. Seal joints 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 above 40°F (4°C) at the time of installation of preformed joint seal or above 50°F (10°C) at the time of installation of poured joint sealing material, unless manufacturer’s recommendations state otherwise.

If the pavement must be opened to traffic prior to placement of the sealant, temporarily fill the joint with a polyethylene closed cell backer rod or with a jute or nylon rope immediately after the joint is sawed. The rope should be slightly larger than the joint and should be forced into the joint so that the top of the rope is 1/4 inch (6 mm) below the pavement surface. Remove the rope immediately prior to cleaning.

605–3.2 PREPARATION OF JOINTS. Immediately before sealing, thoroughly clean the joints of all laitance, curing compound, and other foreign material. Accomplish cleaning by sand blasting or high pressure water blast. Upon completion of cleaning, blow out the joints with compressed air. The joint faces must be surface dry when the seal is applied.

Prior to resealing joints, remove the existing joint material to the depth as shown on the Plans. If joint sealer other than that originally used is specified, remove all existing joint sealer.

NOTE TO SPECIFIER:
Sandblasting or wire brushing is the recommended method of cleaning since the joints can be primed immediately after the cleaning. High pressure water blast is included in the WBOA Standard Specifications.

605–3.3 INSTALLATION OF SEALANTS. Joints will be inspected for proper width, depth, alignment, and preparation and will be approved by the Engineer before sealing is allowed. Install sealants in accordance with the following requirements:

Hot Poured Sealants. Apply the joint sealant uniformly solid from bottom to top and fill without formation of entrapped air or voids. Place a backing material as shown on the Plans that is nonadhesive to the concrete or the sealant material. Use an indirect heating type heating kettle, constructed as a double boiler. Provide a positive temperature control and mechanical agitation. Do not heat the sealant to more than 20°F (11°C) below the safe heating temperature. The safe heating temperature can be obtained from the manufacturer's shipping container. Provide a direct connecting pressure type extruding device with nozzles shaped for insertion into the joint. Remove sealant spilled on the surface of the pavement.

Cold Applied Sealants. Apply cold applied joint sealing compound by means of pressure equipment that will force the sealing material to the bottom of the joint and completely fill the joint without spilling the material on the surface of the pavement. Place a backing material as shown on the Plans that is nonadhesive to the concrete or the sealant material. Sealant that does not bond to the concrete surface of the joint walls, contains voids, or fails to set to a tack–free condition will be rejected and replaced by the Contractor at no additional cost. Before sealing the joints, demonstrate that the equipment and procedures for preparing, mixing, and placing the sealant will produce a satisfactory joint seal. This includes the preparation of two small batches and the application of the resulting material.

Provide backup material or bond breaker in the bottom of the joint to be filled to control the depth of the sealant, to achieve the desired shape factor, and to support the sealant against indentation and sag. Use backup materials and bond breakers that are compatible with the sealant, will not adhere to the sealant, will be compressible without extruding the sealant, and will recover to maintain contact with the joint faces when the joint is open.

Preformed Elastomeric Joint Seals. Place preformed joint sealer using equipment capable of installing the sealer in the upright position, without cutting, nicking, distorting, or otherwise damaging the seal. Apply lubricant to the concrete or the preformed seal, or both, and install the seal in a substantially compressed condition and at the depth below the surface of the pavement as shown in the Plans. When installing the joint sealer do not stretch the sealer more than 5 percent of the minimum theoretical length, or compress it more than 2 percent. Check the method of installation for stretching or compression when using transverse joint sealer. The check shall consist of installing sealer in five joints of at least 25 feet (7.5 m) in length, removing the sealer immediately after installation, and checking the length. This check may be modified by

premarking or precutting the sealer to length prior to installation if this is compatible with the equipment being used. If the measured length of any of these five sealers indicated that the sealer is stretched or compressed beyond these limits, modify the installation to correct the situation. Once satisfactory sealing operations have started, remove and check one joint length per every hundred. If the limits are exceeded, the joint sealers on either side should be removed until the condition disappears. Reseal the affected joints in a satisfactory manner at no cost to the Department, and check the method of installation again for satisfactory procedure. Install the seal in the longest practicable lengths in longitudinal joints and cut at the joint intersections for continuous installation of the seal in the transverse joints.

METHOD OF MEASUREMENT

605–4.1 Joint sealing material will be measured by the gallon, pound, or linear foot of sealant in place, complete, and accepted.

BASIS OF PAYMENT

605–5.1 Payment for joint sealing material will be made at the Contract unit price per gallon, pound, or linear foot. The price will be full compensation for furnishing all materials, for all preparation, delivering, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P60501 through P60510	Joint Sealing Filler, Type ___, per gallon
Pay Item P60511 through P60520	Joint Sealing Filler, Type ___, per pound
Pay Item P60521 through P60530	Joint Sealing Filler, Type ___, per linear foot

Measurement and Payment will only be made for Pay Items included in the Schedule of Prices. If a Pay Item is not included in the Schedule of Prices, the Work specified herein shall be considered incidental and the cost included in prices Bid for Portland Cement Concrete Pavement.

TESTING REQUIREMENTS

ASTM D 412	Tests for Rubber Properties in Tension
ASTM D 1644	Tests for Nonvolatile Content of Varnishes

MATERIAL REQUIREMENTS

ASTM D 1854	Jet–Fuel–Resistant Concrete Joint Sealer, Hot–Poured Elastic Type
ASTM D 2628	Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 3405	Joint Sealants, Hot–Poured, for Concrete and Asphalt Pavements
ASTM D 3406	Joint Sealants, Hot–Poured, Elastomeric–Type, for Portland Cement Concrete Pavements
ASTM D 3569	Joint Sealant, Hot–Poured, Elastomeric, Jet–Fuel–Resistant Type, for Portland Cement Concrete Pavements
ASTM D 3581	Joint Sealant, Hot–Poured, Jet–Fuel–Resistant Type, for Portland Cement Concrete and Tar–Concrete Pavement
Fed. Spec. SS–S–200	Sealing Compounds, Two Component, Elastomeric, Polymer Type, Jet–Fuel Resistant, Cold Applied

SPECIFICATION P–606. ADHESIVE COMPOUNDS, TWO–COMPONENT FOR SEALING WIRE AND LIGHTS IN PAVEMENT

DESCRIPTION

606–1.1 This Specification 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 Paragraph 606–2.4. Materials supplied for use with bituminous concrete pavements must be formulated so they are compatible with the bituminous concrete.

NOTE TO SPECIFIER:
If the material is to be used on bituminous concrete pavements and it is not formulated for this use, cracking and separation of the material from sawed wireway kerfs and around light fixtures may occur.

EQUIPMENT AND MATERIALS

606–2.1 CURING. When prewarmed to 77°F (25°C), mixed, and placed in accordance with manufacturer's directions, the materials shall cure at temperatures of 45°F (7°C) or above without the application of external heat.

606–2.2 STORAGE. Do not store the adhesive components at temperatures over 86°F (30°C).

606–2.3 MANUFACTURER'S RECOMMENDATION. Install and use in accordance with the manufacturer's recommended procedures.

606–2.4 CHARACTERISTICS. When mixed and cured in accordance with the manufacturer's directions, the materials shall have the properties shown in Table 1.

SAMPLING, INSPECTION, AND TEST PROCEDURES

606–3.1 TENSILE PROPERTIES. Manufacturer’s tests for tensile strength and elongation shall be conducted in accordance with ASTM D 638.

606–3.2 EXPANSION. Manufacturer’s tests for coefficients of linear and cubical expansion shall be conducted in accordance with ASTM D 1168, Method B, except that mercury shall be used instead of glycerin. The test specimen(s) shall be mixed in the proportions specified by the manufacturer, and cured in a glass tub approximately 2 inches (50 mm) long by 3/8 inch (9 mm) in diameter. The interior of the tube shall be precoated with a silicone mold release agent. The hardened sample shall be removed from the tube and aged at room temperature for 1 week before conducting the test. The test temperature range shall be from 35°F (2°C) to 140°F (60°C).

606–3.3 TEST FOR DIELECTRIC STRENGTH. Manufacturer’s test for dielectric strength will be conducted in accordance with ASTM D 149 for sealing compounds to be furnished for sealing electrical wires in pavement.

TABLE 1. PROPERTY REQUIREMENTS

Physical or Electrical Property	*Minimum*	*Maximum*	*ASTM Method*
Tensile			
Portland Cement Concrete	1,000 psi (6895 kPa)		D 638
Bituminous Concrete	500 psi (3448 kPa)		
Elongation			
Portland Cement Concrete	8%[1]		D 638
Bituminous Concrete	50%		D 638
Coef. of cub. exp.			
cu. cm/cu. cm/degree C	0.00090	0.00120	D 1168
Coef. of lin. exp.			
cm/cm/degree C	0.00030	0.00040	D 1168
Dielectric Strength,			
short time test	350 volts/mil.		D 149
Arc resistance	125 secs.		D 495
Adhesion to steel	1,000 psi (6895 kPa)		
Adhesion to portland			
cement concrete	200 psi (1380 kPa)		
Adhesion to asphalt concrete	(no test available)		

[1] 20 percent or more (without filler) for formulations to be supplied for areas subject to freezing.

606–3.4 TEST FOR ARC RESISTANCE. Manufacturer's test for arc resistance shall be conducted in accordance with ASTM D 495 for sealing compounds to be furnished for sealing electrical wires in pavement.

606–3.5 TEST FOR ADHESION TO STEEL. The manufacturer's test for adhesion to steel by using ends of two smooth, clean, steel specimens of convenient size (1 inch by 1 inch by 6 inches (25 by 25 by 150 mm) would be satisfactory) and bond together with adhesive mixture and allow to cure at room temperature for a period of time to meet formulation requirements and then test to failure on a Riehle (or similar) tensile tester. The thickness of adhesive to be tested shall be 1/4 inch (6 mm).

606–3.6 ADHESION TO PORTLAND CEMENT CONCRETE

a. Concrete Test Block Preparation. The concrete test block for the manufacturer's test for adhesion to Portland cement concrete shall have an aggregate grade as shown in Table 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 (21 liters) of water per bag of cement, a cement factor of 6 (±0.5) bags of cement per cubic yard (0.76 cubic meter) of concrete, and a slump of 2–1/2 inches. The ratio of fine aggregate to total aggregate shall be approximately 40 percent by solid volume. The air content shall be 5 percent (±0.5%) and it shall be obtained by the addition to the batch of an air–entraining admixture such as vinsol resin. Provide metal mold with a metal base plate. Provide means for securing the base plate to the mold. The assembled mold and base plate must be watertight and should be oiled with mineral oil before use. The inside measurement of the mold shall be such that several 1-inch by 2-inch by 3-inch (25 by 50 by 75 mm) test blocks can be cut from the specimen with a concrete saw having a diamond blade. Prepare and cure the concrete in accordance with ASTM C 192.

TABLE 2. AGGREGATE FOR BOND TEST BLOCKS

Type	*Sieve Size*	*Percent Passing*
Coarse Aggregate	3/4 inch (19.0 mm) 1/2 inch (12.5 mm) 3/8 inch (9.5 mm) No. 4 (4.75 mm)	97 to 100 63 to 69 30 to 36 0 to 3
Fine Aggregate	No. 4 (4.75 mm) No. 8 (2.36 mm) No. 16 (1.18 mm) No. 30 (600 micro–m) No. 50 (300 micro–m) No. 100 (150 micro–m)	100 82 to 88 60 to 70 40 to 50 16 to 26 5 to 9

b. Bond Test. Prior to use, oven–dry the test blocks to constant weight at a temperature of 220° to 230°F (104° to 110°C), cool to room temperature, 73.4° plus or minus 3°F (23° plus or minus 1.6°C), 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 1–inch by 3–inch (25 by 75 mm) 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 (6 mm).

606–3.7 COMPATIBILITY WITH ASPHALT CONCRETE. The manufacturer shall test for compatibility with asphalt in accordance with ASTM D 3407.

606–3.8 ADHESIVE COMPOUNDS – CONTRACTOR'S RESPONSIBILITY. Furnish the vendor's certified test reports for each batch of material delivered to the project. The report must certify that the material meets Specification requirements and is suitable for use with the type of pavement to be installed under this Contract. Deliver the report to the Engineer before permission is granted for use of the material. In addition 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. Apply adhesive 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.

NOTE TO SPECIFIER:
Installation methods such as surface preparation, mixing ratios, and pot life are as important to satisfactory performance as the properties of the material itself. Therefore, the Engineer may wish to require a manufacturer's representative to be present during the initial installation of the material to ensure the installation procedures are in accordance with the manufacturer's directions. This requirement, if needed, should be added by Special Provision.

METHOD OF MEASUREMENT

606–4.1 The adhesive compound will be measured by the pound or gallon of adhesive as specified, in place, complete and accepted. When required in the installation of an in–runway lighting system or portion thereof, no measurement will be made for direct payment of adhesive, as the cost of furnishing and installing will be considered as a subsidiary obligation in the completion of the installation.

BASIS OF PAYMENT

606–5.1 Payment will be made, where applicable, at the Contract unit price per pound or gallon for the adhesive. This price will 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.

Standard Bid Items for Work covered by the Specification are as follows:

Pay Item P60601	Adhesive Compound, per pound
Pay Item P60602	Adhesive Compound, per gallon

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 will be included in the Pay Items contained in the Schedule of Prices.

TESTING REQUIREMENTS

ASTM C 192	Making and Curing Concrete Compression and Flexure Test Specimens in the Laboratory
ASTM D 149	Tests for Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulating Materials at Commercial Power Frequencies
ASTM D 495	Test for High–Voltage, Low–Current, Arc Resistance of Solid Electrical Insulating Materials
ASTM D 638	Test for Tensile Properties of Plastics
ASTM D 1168	Testing Hydrocarbon Waxes Used for Electrical Insulation
ASTM D 3407	Joint Sealants, Hot–Poured, For Concrete and Asphalt Pavements

SPECIFICATION P–610. STRUCTURAL PORTLAND CEMENT CONCRETE

DESCRIPTION

610–1.1 This Work consists of plain or reinforced structural Portland cement concrete, prepared and constructed in accordance with these Specifications, at the locations and of the form and dimensions shown on the Plans.

MATERIALS

610–2.1 GENERAL. Use only approved materials, conforming to the requirements of these Specifications. They may be subjected to inspection and tests at any time during the progress of their preparation or use. The Engineer must approve the source of supply of each of the materials before delivery or use is started. Submit representative preliminary samples of the materials, when required, for examination and test. Store and handle materials to insure the preservation of their quality and fitness for use and locate the materials to facilitate prompt inspection. Equipment for handling and transporting materials and concrete must be clean before any material or concrete is placed.

Using pit–run naturally mixed aggregates is not permitted. Screen and wash naturally mixed aggregate. Fine and coarse aggregates shall be stored separately and kept clean. Mixing different kinds of aggregates from different sources in one storage pile or alternating batches of different aggregates will not be permitted.

610–2.2 COARSE AGGREGATE. Coarse aggregate meeting the requirements of ASTM C 33 shall be well graded from coarse to fine and shall meet one of the gradations shown in Table 1, using ASTM C 136.

610–2.3 FINE AGGREGATE. Fine aggregate meeting the requirements of ASTM C 33 shall be well graded from fine to coarse and shall meet the requirements of Table 2, when tested in accordance with ASTM C 136:

TABLE 1. GRADATION FOR COARSE AGGREGATE

Sieve Designation (square openings)	*Percentage by Weight Passing Sieves*						
	2"	*1 1/2"*	*1"*	*3/4"*	*1/2"*	*3/8"*	*No. 4*
No. 4 to 3/4 in.(4.75–19.0 mm)			100	90–100		20–55	0–10
No. 4 to 1 in.(4.75–25.0 mm)		100	90–100		25–60		0–10
No. 4 to 1 1/2 in.(4.75–38.1 mm)	100	95–100		35–70		10–30	0–5

TABLE 2. GRADATION FOR FINE AGGREGATE

Sieve Designation (square openings)	*Percentage by Weight Passing Sieves*
3/8 inch (9.5 mm)	100
No. 4 (4.75 mm)	95–100
No. 16 (1.18 mm)	45–80
No. 30 (0.60 mm)	25–55
No. 50 (0.30 mm)	10–30
No. 100 (0.15 mm)	2–10

Blending will be permitted, if necessary, in order to meet the gradation requirements for fine aggregate. Fine aggregate that is deficient in the percentage of material passing the No. 50 mesh sieve may be accepted, provided that such deficiency does not exceed 5 percent and is remedied by the addition of pozzolanic or cementitious materials other than Portland cement, as specified in Subsection 610–2.6 on admixtures, in sufficient quantity to produce the required workability as approved by the Engineer.

610–2.4 CEMENT. Cement shall conform to the requirements of ASTM C 150 Type I, IA, II, IIA, III, or IIIA.

NOTE TO SPECIFIER:

The FAA Advisory Circular allows the Engineer to specify one of the following: ASTM C 150 – Type I, IA, II, IIA, III, IIIA; ASTM C 595 – Type IP, IP–A, IS, IS–A for FAA projects.
The WBOA Standard Specification lists the following cement types as options:

1. **I – General Use**
2. **IA – General Use, Air–entrained**
3. **II – Sulfate resistant**
4. **IIA – Sulfate resistant, Air–entrained**
5. **III – High early strength**
6. **IIIA – High early strength, air–entrained**

If ASTM C 595 cement will be allowed, a Special Provision should be written.

Furnish vendors' certified test reports for each carload, or equivalent, of cement shipped to the project. Deliver the report to the Engineer before permission to use the cement is granted. Test reports will be subject to verification by testing sample materials received for use on the project.

610–2.5 WATER. Use water in concrete that is free from sewage, oil, acid, strong alkalis, vegetable matter, and clay and loam. If the water is of questionable quality, it will be tested in accordance with AASHTO T 26.

610–2.6 ADMIXTURES. The use of material added to the concrete mix must be approved by the Engineer. Before approval of material, submit the results of complete physical and chemical analyses made by an acceptable testing laboratory. Subsequent tests may be made on 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.

Pozzolanic admixtures shall be fly ash or raw or calcined natural pozzolans meeting the requirements of ASTM C 618.

Air–entraining admixtures shall meet the requirements of ASTM C 260. Add air–entraining admixtures at the mixer in the amount necessary to produce the specified air content.

Water–reducing, set–controlling admixtures shall meet the requirements of ASTM C 494, Type A, water–reducing or Type D, water–reducing and retarding. Add Water–reducing admixtures at the mixer separately from air–entraining admixtures in accordance with the manufacturer's printed instructions.

610–2.7 PREMOLDED JOINT MATERIAL. Premolded joint material for expansion joints shall meet the requirements of ASTM D 1751 or D 1752.

NOTE TO SPECIFIER:
The FAA allows the Engineer to designate either ASTM D 1751 or ASTM D 1752. The Standard Specifications allows use of either type of material; however, either option can be deleted by Special Provision.

610–2.8 JOINT FILLER. The filler for joints shall meet the requirements of Specification P–605, unless otherwise specified in the Proposal.

610–2.9 STEEL REINFORCEMENT. Provide reinforcing in accordance with the Plans and the following Specifications:

a. Welded steel wire fabric shall conform to the requirements of ASTM A 185,

b. Welded deformed steel fabric shall conform to requirements of ASTM A 497,

c. Bar mats shall conform to requirements of ASTM A 184.

NOTE TO SPECIFIER:
The Engineer shall designate one of the following on the Plans:

Welded Steel Wire Fabric	**ASTM A 185**
Welded Deformed Steel Fabric	**ASTM A 497**
Bar Mats	**ASTM A 184 or A 704**

610–2.10 COVER MATERIALS FOR CURING. Curing materials shall conform to one of the following Specifications:

a. Waterproof paper for curing concrete	ASTM C 171
b. Polyethylene Sheeting for Curing Concrete	ASTM C 171
c. Liquid Membrane–Forming Compounds for Curing Concrete	ASTM C 309, Type 2

CONSTRUCTION METHODS

610–3.1 GENERAL. Furnish all labor, materials, and services necessary for, and incidental to, the completion of all Work as shown on the Drawings and specified herein. Machinery and equipment owned or controlled by the Contractor, that is proposed to be used on the Work, shall be of sufficient size to meet the requirements of the Work, and shall be such as to produce satisfactory Work. All Work is subject to the inspection and approval of the Engineer.

610–3.2 CONCRETE COMPOSITION. The concrete shall develop a compressive strength of 3,500 psi (24,130 kPa) in 28 days as determined by test cylinders made in accordance with ASTM C 31 and tested in accordance with ASTM C 39. The concrete shall contain not less than 470 pounds of cement per cubic yard (280 kg per cubic meter). The concrete shall contain 5 percent of entrained air, plus or minus 1 percent, as determined by ASTM C 231 and shall have a slump of not more than 4 inches (100 mm) as determined by ASTM C 143.

NOTE TO SPECIFIER:
The Engineer shall designate the compressive strength in the Special Provision if a value other than 3500 psi (24130 kPa) is required. The minimum allowable strength is 3000 psi (20680 kPa).

610–3.3 ACCEPTANCE SAMPLING AND TESTING. Concrete for each structure will be accepted on the basis of the compressive strength specified in Paragraph 3.2. The concrete will be sampled in accordance with ASTM C 172. Compressive strength specimens will be made in accordance with ASTM C 31 and tested in accordance with ASTM C 39.

Concrete cylindrical test specimens will be made in accordance with ASTM C 31 and tested in accordance with ASTM C 39. Cure and store the test specimens under such conditions as directed. The Engineer will make the actual tests on the specimens at no expense to the Contractor.

610–3.4 PROPORTIONING AND MEASURING DEVICES. When package cement is used, the quantity for each batch shall be equal to one or more whole sacks of cement. The aggregates shall be measured separately by weight. If aggregates are delivered to the mixer in batch trucks, the exact amount for each mixer charge shall be contained in each batch compartment. Weighing boxes or hoppers will be approved by the Engineer and shall provide means of regulating the flow of aggregates into the batch box so that the required and exact weight of aggregates can be readily obtained.

610–3.5 CONSISTENCY. Check the consistency of the concrete shall be checked by the slump test specified in ASTM C 143.

610–3.6 MIXING. Concrete may be mixed at the construction site, at a central point, or wholly or in part in truck mixers. Mix and deliver the concrete in accordance with the requirements of ASTM C 94.

610–3.7 MIXING CONDITIONS. Mix concrete only in quantities required for immediate use. Do not mix concrete while the air temperature is below 40°F (4°C) without permission of the Engineer. If permission is granted for mixing under such conditions, heat aggregates or water, or both, and place the concrete at a temperature not less than 50°F (10°C) nor more than 100°F (38°C). The Contractor is responsible for any defective Work, resulting from freezing or injury during placing and curing, and shall replace the Work at Contractor's expense.

Do not retemper concrete by adding water or other materials.

Schedule concrete delivery to the job to assure batches of concrete will be deposited at uninterrupted intervals.

610–3.8 FORMS. Do not place concrete until all the forms and reinforcements have been inspected and approved by the Engineer. Use forms of suitable material and of the type, size, shape, quality, and strength to build the structure as designed on the Plans. Forms shall be true to line and grade, mortar–tight and sufficiently rigid to prevent displacement and sagging between supports. The Contractor shall bear responsibility for their adequacy. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes.

Arrange the internal ties so that, when the forms are removed, no metal will show in the concrete surface or discolor the surface when exposed to weathering. Wet the forms with water or with a nonstaining mineral oil that is applied shortly before the concrete is placed. Construct forms to allow removal without injuring the concrete or concrete surface. Do not remove forms before the expiration of at least 30 hours from vertical faces, walls, slender columns, and similar structures; forms supported by falsework under slabs, beams, girders, arches. Do not remove similar construction until tests indicate that at least 60 percent of the design strength of the concrete has developed.

610–3.9 PLACING REINFORCEMENT. Place reinforcement accurately, as shown on the Plans, and fasten it firmly to hold its position during placement of concrete. Fasten bars together at intersections. Support reinforcement by approved metal chairs. Supply shop drawings, lists, and bending details..

610–3.10 EMBEDDED ITEMS. Before placing concrete, firmly embed items and securely fasten them in place as indicated. Items must be clean and free from coating, rust, scale, oil, or foreign matter. Avoid embedding wood. Spade and consolidate concrete around and against embedded items.

610–3.11 PLACING CONCRETE. Place concrete during daylight, unless otherwise approved. Do not place concrete until the depth and character of foundation, the adequacy of forms and falsework, and the placing of the steel reinforcing have been approved. Place concrete as soon as practical after mixing and in no case later than 1 hour after water has been added to the mix. Place concrete to avoid segregation and displacement of the reinforcement. Use troughs, pipes, and chutes as an aid in placing concrete. Dropping the concrete a distance of more than 5 feet (1.5 m), or depositing a large quantity at one point, is not permitted. Place concrete upon clean, damp surfaces, free from running water, or upon properly consolidated soil.

Compact concrete with suitable mechanical vibrators operating within the concrete. When necessary, supplement vibrating by hand spading with suitable tools to assure proper and adequate compaction. Manipulate vibrators to work the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms. Vibration must be of sufficient duration to accomplish compaction but not to the point where segregation occurs. Concrete deposited under water must be carefully placed in a compact mass in its final position by means of a tremie, a closed bottom dump bucket, or other approved method and should not be disturbed after being deposited.

610–3.12 CONSTRUCTION JOINTS. When the placing of concrete is suspended, make necessary provisions for joining future Work before the placed concrete takes its initial set. Make provisions for proper bonding of old and new concrete by constructing grooves, steps, keys, dovetails, reinforcing bars or other devices. Schedule Work to assure that a section begun will be finished during daylight of the same day. Before depositing new concrete on or against concrete that has hardened, clean the surface of the hardened concrete with a heavy steel broom, roughened slightly, wetted, and covered with a neat coating of cement paste or grout.

610–3.13 EXPANSION JOINTS. Construct expansion joints at locations and dimensions indicated on the drawings. Cut premolded filler to the same shape as the surfaces being joined. Firmly fix filler against the surface of the concrete already in place in a manner to prevent displacement when concrete is deposited.

610–3.14 DEFECTIVE WORK. Immediately remove and replace defective Work disclosed after the forms have been removed. If dimensions are deficient, or if the surface of the concrete is bulged, uneven, or shows honeycomb, which in the opinion of the Engineer cannot be repaired satisfactorily, remove and replace the entire section at the expense of the Contractor.

610–3.15 SURFACE FINISH. Exposed concrete surfaces shall be true, smooth, free from open or rough spaces, depressions, or projections. Bring concrete in horizontal plane surfaces flush with the finished top surface at the proper elevation and strike–off with a straightedge and float. Mortar finishing is not permitted, and do not spread dry cement or sand–cement mortar over the concrete during the finishing of horizontal plane surfaces.

When required on Plans, the surface finish of exposed concrete shall be a rubbed finish. If forms can be removed while the concrete is still green, point and wet the surface and then rub it with a wooden float until all irregularities are removed. If the concrete has hardened before being rubbed, use a carborundum stone to finish the surface. When approved, the finishing can be done with a rubbing machine.

610–3.16 CURING AND PROTECTION. Properly cure and protect the concrete. Protect the Work from the elements, flowing water, and from defacement of any nature during the building operations. Cure concrete when it has sufficiently hardened by covering with an approved material. Thoroughly saturate water–absorptive coverings when placed and keep saturated for a period of at least 3 days. Weight or sufficiently tie down curing mats or blankets to keep the concrete surface covered and to prevent the surface from being exposed to currents of air. Where wooden forms are used, keep them wet at all times until removed to prevent the opening of joints and drying out of the concrete. Do not allow traffic on concrete surfaces for 7 days after the concrete has been placed.

610–3.17 DRAINS OR DUCTS. Install drainage pipes, conduits, and ducts that are to be encased in concrete before the concrete is placed. Hold drains or ducts rigidly and do not displace or move them during placing of concrete.

610–3.18 COLD WEATHER PROTECTION. When concrete is placed at temperatures below 40°F (4°C), provide satisfactory methods and means to protect the mix from injury by freezing. Heat the aggregates, or water, or both, in order to place the concrete at temperatures between 50° and 100°F (10° and 38°C).

Calcium chloride may be incorporated in the mixing water when approved by the Engineer. Do not add more than 2 pounds (908 grams) of Type 1 or more than 1.6 pounds (726 grams) of Type 2 per bag of cement. After the concrete has been placed, provide sufficient protection such as cover, canvas, framework, and heating apparatus, to enclose and protect the structure and maintain the temperature of the mix at not less than 50°F (10°C) until at least 60 percent of the designed strength has been attained.

610–3.19 FILLING JOINTS. Thoroughly clean joints which require filling, and cut out excess mortar or concrete with proper tools. Do not start joint filling until after final curing and only when the concrete is completely dry. Do cleaning and filling carefully with proper equipment and in a manner to obtain a neat looking joint free from excess filler.

METHOD OF MEASUREMENT

610–4.1 Structural Portland Cement Concrete will be measured by the number of cubic yards of concrete complete in place and accepted. In computing the yardage of concrete for payment, the dimensions used will be those shown on the Plans or ordered by the Engineer. No measurements or other allowances will be made for forms, falsework, cofferdams, pumping, bracing, expansion joints, or finishing of the concrete. No deductions in yardage will be made for the volumes of reinforcing steel or embedded items.

610–4.2 Steel Reinforcement will be measured by the calculated theoretical number of pounds placed, as shown on the Plans, complete in place and accepted. The unit weight used for deformed bars will 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 will include the weight of metal pipes and drains, metal conduits and ducts, or similar materials indicated and included.

BASIS OF PAYMENT

610–5.1 Payment will be made at the Contract unit price per cubic yard for Structural Portland Cement Concrete and per pound for Steel Reinforcement. These prices will be full compensation for furnishing all materials and for all preparation, delivering and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the Work. If Steel Reinforcement is required on the Plans and a Pay Item is not included in the Schedule of Prices, the cost of furnishing and placing the Steel Reinforcement will be included in the prices for Structural Portland Cement Concrete.

Standard Pay Items for Work specified covered by this Specification are as follows:

Pay Item P61001	Structural Portland Cement Concrete, per cubic yard
Pay Item P61002	Steel Reinforcement, per pound

Measurement and Payment will only be made for Pay Items included in the Schedule of Prices. When Portland Cement Concrete (PCC) and steel reinforcement are specified under other Specifications, furnishing and constructing the PVC and steel reinforcement will be incidental and the cost included in the Pay Item of Work included in that Specification. The cost of all Work required by the Contract Documents will be included in the Pay Items contained in the Schedule of Prices.

TESTING REQUIREMENTS

ASTM C 31	Making and Curing Test Specimens in the Field
ASTM C 39	Compressive Strength of Cylindrical Concrete Specimens
ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregate
ASTM C 138	Unit Weight, Yield, and Air Content of Concrete
ASTM C 143	Slump of Portland Cement Concrete
ASTM C 231	Air Content of Freshly Mixed Concrete by the Pressure Method

MATERIAL REQUIREMENTS

ASTM A 184	Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	Welded Steel Wire Fabric for Concrete Reinforcement
ASTM A 497	Specification for Welded Deformed Steel Wire Fabric for Concrete Pavement
ASTM A 615	Deformed and Plain Billet–Steel Bars for Concrete Reinforcement
ASTM C 33	Concrete Aggregates
ASTM C 94	Ready–Mixed Concrete

ASTM C 150	Portland Cement
ASTM C 171	Sheet Materials for Curing Concrete
ASTM C 260	Air–Entraining Admixtures for Concrete
ASTM C 309	Liquid Membrane–Forming Compounds for Curing Concrete
ASTM C 595	Blended Hydraulic Cements
ASTM C 618	Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM D 1751	Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 1752	Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

SPECIFICATION P–620. RUNWAY AND TAXIWAY PAINTING

DESCRIPTION

620–1.1 This Work consists of painting numbers, markings, and stripes, which are referred to as markings, on the surface of runways, taxiways, taxilanes, and aprons, in accordance with these Specifications and at the locations shown on the Plans, or as directed by the Engineer.

MATERIALS

620–2.1 MATERIALS ACCEPTANCE. Furnish manufacturer's certified test reports for materials shipped to the project. The certified test reports shall include a statement that the materials meet the Specification requirements. The reports may be used for material acceptance or the Engineer may perform verification testing. The reports shall not be interpreted as a basis for payment. Notify the Engineer upon arrival of a shipment of materials to the site.

620-2.2 PAINT. Provide waterborne, epoxy, methacrylate, or solvent base paint in accordance with the requirements of this Specification. Furnish Type I for Standard drying time or Type II for Fast drying time in accordance with ASTM D 711. Supply paint colors in accordance with Federal Standard No. 595 and the following list:

- White 37925
- Yellow 33538 or 33655
- Red 31136
- Black 7038

NOTE TO SPECIFIER:
The Engineer shall specify paint type(s) and appropriate paragraph number(s).

The Engineer shall insert the colors to be used on a project from the following list:

White - 37925
Yellow - 33538 or 33655
Red - 31136
Black - 37038
Pink - 2 parts Red - 31136 to 1 part White - 37925

Waterborne or solvent base black paint can be used to outline a border at least 6 inches (150 mm) wide around markings on light colored pavements.

Type I is intended for those locations where slower tracking is not an inconvenience.
Type II is intended for striping locations where faster curing is desirable.

The color pink, for geographic position markings, shall be 2 parts red and one part white paint.

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a. WATERBORNE. Provide waterborne paint meeting the requirements of Federal Specification TT-P-1952.

b. EPOXY. Provide a two component paint with a minimum 99 percent solids type system conforming to the following:

(1) Pigments. Component A. Percent by weight.

(a) White:
Titanium Dioxide, ASTM D 476, type II shall be 18 percent minimum
(16.5 percent minimum at 100 percent purity).

(b) Yellow and Colors:
Titanium Dioxide, ASTM D 476, type II shall be 14 to 17 percent.
Organic yellow, other colors, and tinting as required to meet color standard.
Epoxy resin shall be 75 to 79 percent.

(2) Epoxy Content. Component A. The weight per epoxy equivalent, when tested in accordance with ASTM D 1652 shall be the manufacturer's target plus or minus 50.

(3) Amine Number. Component B. When tested in accordance with ASTM D 2074 shall be the manufacturer's target plus or minus 50.

(4) Prohibited Materials. 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.

(5) Daylight Directional Reflectance:

(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 Federal Test Method Standard No. 141, Method 6121.

(b) Yellow: The daylight directional reflectance of the yellow paint shall not be less than 38 percent (relative to magnesium oxide), when tested in accordance with Federal Test Method Standard No. 141. 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

(6) Accelerated weathering.

(a) Sample preparation. Apply the paint at a wet film thickness of 0.013 inch (0.33 mm) to four 3 by 6 inch (8 by 15 cm) aluminum panels prepared as described in Federal Test Method Standard No. 141, Method 2013. Air dry the sample 48 hours under standard conditions.

(b) Testing conditions. Test in accordance with ASTM G 53 using both Ultra Violet (UV-B) Light and condensate exposure, 72 hours total, alternating 4 hour UV exposure at 60 degree C, and 4 hours condensate exposure at 40 degrees C.

(c) Evaluation. Remove the samples and condition for 24 hours under standard conditions. Determine the directional reflectance and color match using the procedures in Paragraph 620-2.2b(5) above. Evaluate for conformance with the color requirements.

(7) Volatile Organic Content. Determine the volatile organic content in accordance with 40 CFR Part 60 Appendix A, Method 24.

(8) Dry opacity. Use Procedure B, Method B of Method 4121 of Federal Test Method Standard No. 141. The wet film thickness shall be 0.015 inch (0.12 mm). The minimum opacity for white and colors shall be 0.92.

(9) Abrasion resistance. Subject the panels prepared in Paragraph 620-2.2b(6) to the abrasion test in accordance with ASTM D 968, Method A, except that the inside diameter of the metal guide tube shall be from 0.747 to 0.750 inch (18.97 to 19.05 mm). Use 5 liters of unused sand for each test panel. Run the test on two test panels. [Note: 5 liters of sand weighs 17.5 lb. (7.94 kg).] Both baked and weathered paint films shall require not less than 150 liters of sand for the removal of the paint films.

(10) Hardness, Shore. Hardness shall be at least 80 when tested in accordance with ASTM D 2240.

c. METHACRYLATE. Paint shall be a two component, minimum 99 percent solids type system conforming to the following:

(1) Pigments. Component A. Percent by weight.

(a) White:

Titanium Dioxide, ASTM D 476, type II shall be 6 percent minimum.
Methacrylate resin shall be 18 percent minimum.

(b) Yellow and Colors:

Titanium Dioxide, ASTM D 476, type II shall be 6 percent minimum.
Organic yellow, other colors, and tinting as required to meet color standard.
Methacrylate resin shall be 18 percent minimum.

(2) Prohibited Materials. 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.

(3) Daylight Directional Reflectance:

(a) White: The daylight directional reflectance of the white paint shall not be less than 80 percent (relative to magnesium oxide), when tested in accordance with Federal Test Method Standard No. 141, Method 6121.

(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 Federal Test Method Standard No. 141. 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

(4) Accelerated weathering.

(a) Sample preparation. Apply the paint at a wet film thickness of 0.013 inch (0.33 mm) to four 3 by 6 inch (8 by 15 cm) aluminum panels prepared as described in Method 2013 of Federal Test Method Standard No. 141. Air dry the sample 48 hours under standard conditions.

(b) Testing conditions. Test in accordance with ASTM G 53 using both Ultra Violet (UV-B) Light and condensate exposure, 72 hours total, alternating 4 hours UV exposure at 60 degree C, and 4 hours condensate exposure at 40 degrees C.

(c) Evaluation. Remove the samples and condition for 24 hours under standard conditions. Determine the directional reflectance and color match using the procedures in Paragraph 620-2.2c(3) above. Evaluate for conformance with the color requirements.

(5) Volatile Organic Content. Determine the volatile organic content in accordance with 40 CFR Part 60 Appendix A, Method 24.

(6) Dry opacity. Use Procedure B, Method B of Method 4121 of Federal Test Method Standard No. 141. The wet film thickness shall be 0.015 inch (0.12 mm). The minimum opacity for white and colors shall be 0.92.

(7) Abrasion resistance. Subject the panels prepared in Paragraph 620-2.2c(4) to the abrasion test in accordance with ASTM D 968, Method A, except that the inside diameter of the metal guide tube shall be from 0.747 to 0.750 inch (18.97 to 19.05 mm). Five liters of unused sand shall be used for each test panel. The test shall be run on two test panels. [Note: 5 liters of sand weighs 17.5 lb. (7.94 kg).] Both baked and weathered paint films shall require not less than 150 liters of sand for the removal of the paint films.

(8) Hardness, Shore. Hardness shall be at least 80 when tested in accordance with ASTM D 2240.

d. SOLVENT BASE. Provide solvent based paint meeting the requirements of Federal Specification TT-P-85, or TT-P-110.

620-2.3 REFLECTIVE MEDIA. Glass beads shall meet the requirements of Fed. Spec. TT-B-1325, Type I, Gradation A, or Type III. Treat glass beads with adhesion promoting and/or flotation coatings as specified by the manufacturer of the paint.

NOTE TO SPECIFIER:
Glass beads improve the conspicuity and the friction characteristics of markings. Where beads are used, the Engineer shall specify: Type I--gradation A or Type III.

620-2.4 SILICA SAND. Provide foundry grade silica sand composed of at least 99.5 percent silicon dioxide when tested in accordance with ASTM C 146. The gradation of the silica sand shall meet the paint manufacturer's recommendations and shall approximate a 50/60 graded sand when tested in accordance with ASTM C-136.]

NOTE TO SPECIFIER:
Silica sand improves the friction characteristics of markings and may reduce the rate of accumulation of rubber deposits. The Engineer shall specify glass beads or silica sand in all epoxy and methacrylate paints to improve friction characteristics of the paint.

CONSTRUCTION METHODS

620-3.1 WEATHER LIMITATIONS. Perform the painting only when the surface is dry and when the surface temperature is at least 45 degrees F (7 degrees C) and rising.

NOTE TO SPECIFIER:
The Engineer may specify a lower temperature based on paint manufacturer's recommendations.

620-3.2 EQUIPMENT. Equipment shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, a bead and/or silica sand dispensing machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.

The mechanical marker shall be an atomizing spray-type marking machine suitable for application of traffic paint. It shall produce an even and uniform film thickness at the required coverage and shall apply markings of uniform cross sections and clear-cut edges without running or spattering and without over spray.

620-3.3 PREPARATION OF SURFACE. Immediately before application of the paint, dry the surface and free the area from dirt, grease, oil, laitance, or other foreign material that would reduce the bond between the paint and the pavement. Clean the area to be painted by sweeping and blowing or by other methods as required to remove all dirt, laitance, and loose materials.

Do not apply paint to Portland cement concrete pavement until the areas to be painted are clean of curing material. Use sandblasting or high pressure water to remove curing materials.

NOTE TO SPECIFIER:
The Engineer should specify any additional surface preparation required and should specify the type of surface preparation to be used when existing markings interfere with or would cause adhesion problems with new markings.

620-3.4 LAYOUT OF MARKINGS. Lay out proposed markings in advance of the paint application. Incorporate glass beads and silica sand where shown on the Plans. The locations of markings to receive silica sand are shown on the Plans.

620-3.5 APPLICATION. Apply paint at the locations and to the dimensions and spacing shown on the Plans. Do not apply paint until the layout and condition of the surface have been approved by the Engineer.

Mix the paint in accordance with the manufacturer's instructions and apply it to the pavement with a marking machine at the rate(s) shown in Table 1. The addition of thinner will not be permitted. A period of 30 days shall elapse between placement of a bituminous surface course or seal coat and application of the paint.

TABLE 1. APPLICATION RATES FOR PAINT, GLASS BEADS, AND SILICA SAND

Paint Type	Paint Square feet per gallon, ft^2/gal (Square meters per liter, m^2/l)	Glass Beads, Type I, Gradation A Pounds per gallon of paint--lb./gal. (Kilograms per liter of paint--kg/l)	Glass Beads, Type III Pounds per gallon of paint--lb./gal. (Kilograms per liter of paint--kg/l	Silica Sand Pounds per gallon of paint--lb./gal. (Kilograms per liter of paint--kg/l
Waterborne	115 ft^2/gal. maximum (2.8 m^2/l)	7 lb./gal. Minimum (0.85 kg/l)	12 lb./gal. minimum (1.45 kg/l)	4 lb./gal. minimum (0.5 kg/l)
Solvent Base	115 ft^2/gal. maximum (2.8 m^2/l)	7 lb./gal. Minimum (0.85 kg/l)	12 lb./gal. minimum (1.45 kg/l)	4 lb./gal. minimum (0.5 kg/l)
Epoxy	90 ft^2/gal. maximum (2.2 m^2/l)	15 lb./gal. Minimum (1.8 kg/l)	24 lb./gal. minimum (2.9 kg/l)	8 lb./gal. minimum (1.0 kg/l)
Methacrylate	45 ft^2/gal. maximum (1.1 m^2/l)	15 lb./gal. minimum (1.8 kg/l)	24 lb./gal. minimum (2.9 kg/l)	8 lb./gal. minimum (1.0 kg/l)

NOTE TO SPECIFIER:
The Engineer should select the application rates for paint, glass beads, and silica sand from the following table.

APPLICATION RATES FOR PAINT, GLASS BEADS, AND SILICA SAND FOR TABLE 1

The Engineer shall specify the time period in order to allow adequate curing of the pavement surface. The Engineer should contact the paint manufacturer to determine the wait period.

Due to the increased surface area to cover, the following should be substituted when painting P-402 Porous Friction Course with waterborne or solvent based paints: "The paint shall be mixed in accordance with the manufacturer's instructions and applied to the pavement with a marking machine from two directions at 75 percent of the rate(s) shown in Table 1 from each direction."

Markings may be required before paving operations are complete. The Engineer may wish to include a Special Provision specif markings at 50 percent of the specified application rates.

The edges of the markings shall not vary from a straight line more than 1/2 inch (12 mm) in 50 feet (15 m), and the dimensions shall be within a tolerance of plus or minus 5 percent.

Distribute glass beads, when required, upon the marked areas at the locations shown on the Plans immediately after application of the paint. Furnish a dispenser which is properly designed for attachment to the marking machine and suitable for dispensing glass beads. Apply glass beads at the rate(s) shown in Table 1. Do not apply glass beads to black paint. Distribute silica sand, when required, upon the marked areas at the locations shown on the Plans immediately after application of the paint. Furnish a dispenser that is properly designed for attachment to the marking machine and suitable for dispensing silica sand. Apply silica sand at the rate(s) shown in Table 1. Glass beads and silica sand shall adhere to the cured paint or all marking operations shall cease until corrections are made.

Return all emptied containers to the paint storage area. Do not remove or destroy the containers from the airport until authorized by the Engineer.

620-3.6 OBLITERATE EXISTING MARKING. Obliterate existing markings, when included in the Contract Documents, by application of gray paint mixed to match existing pavement color. Blend gray paint by mixing white and black paint meeting the requirements of Federal Specification TT-P-1952.

620-3.7 PROTECTION. After application of the paint, protect markings from damage until the paint is dry. Protect surfaces from disfiguration by spatter, splashes, spillage, or drippings of paint.

METHOD OF MEASUREMENT

620-4.1 Quantities to be measured for payment will be the number of square feet of painting, the number of pounds of silica sand, and the number of pounds of reflective media performed in accordance with the Contract Documents and accepted by the Engineer.

BASIS OF PAYMENT

620-5.1 Payment will be made at the respective Contract price per square foot for the various colors and types of painting, price per pound for silica sand, and price per pound for the various types of reflective media**.** This price will be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P62001	Painting, White, Waterborne, Type I, per square foot
Pay Item P62002	Painting, White, Epoxy, Type I, per square foot
Pay Item P62003	Painting, White, Methacrylate, Type I, per square foot
Pay Item P62004	Painting, White, Solvent Base, Type I, per square foot
Pay Item P62005	Painting, White, Waterborne, Type II, per square foot
Pay Item P62006	Painting, White, Epoxy, Type II, per square foot
Pay Item P62007	Painting, White, Methacrylate, Type II, per square foot
Pay Item P62008	Painting, White, Solvent Base, Type II, per square foot
Pay Item P62009	Painting, Yellow, Waterborne, Type I, per square foot
Pay Item P62010	Painting, Yellow, Epoxy, Type I, per square foot
Pay Item P62011	Painting, Yellow, Methacrylate, Type I, per square foot
Pay Item P62012	Painting, Yellow, Solvent Base, Type I, per square foot
Pay Item P62013	Painting, Yellow, Waterborne, Type II, per square foot
Pay Item P62014	Painting, Yellow, Epoxy, Type II, per square foot
Pay Item P62015	Painting, Yellow, Methacrylate, Type II, per square foot
Pay Item P62016	Painting, Yellow, Solvent Base, Type II, per square foot
Pay Item P62017	Painting, Red, Waterborne, Type I, per square foot
Pay Item P62018	Painting, Red, Epoxy, Type I, per square foot
Pay Item P62019	Painting, Red, Methacrylate, Type I, per square foot
Pay Item P62020	Painting, Red, Solvent Base, Type I, per square foot
Pay Item P62021	Painting, Red, Waterborne, Type II, per square foot
Pay Item P62022	Painting, Red, Epoxy, Type II, per square foot
Pay Item P62023	Painting, Red, Methacrylate, Type II, per square foot
Pay Item P62024	Painting, Red, Solvent Base, Type II, per square foot
Pay Item P62025	Painting, Black, Waterborne, Type I, per square foot
Pay Item P62026	Painting, Black, Epoxy, Type I, per square foot
Pay Item P62027	Painting, Black, Methacrylate, Type I, per square foot
Pay Item P62028	Painting, Black, Solvent Base, Type I, per square foot
Pay Item P62029	Painting, Black, Waterborne, Type II, per square foot
Pay Item P62030	Painting, Black, Epoxy, Type II, per square foot
Pay Item P62031	Painting, Black, Methacrylate, Type II, per square foot
Pay Item P62032	Painting, Black, Solvent Base, Type II, per square foot
Pay Item P620\41	Reflective Media, Type I, Gradation A, per pound
Pay Item P62042	Reflective Media, Type III, per pound
Pay Item P62043	Silica Sand, per pound
Pay Item P62050	Obliterate Existing Marking, per square foot

Measurement and Payment will only be made for Pay Items contained in the Schedule of Prices.

TESTING REQUIREMENTS

ASTM C-146	Chemical Analysis of Glass Sand
ASTM C 371	Wire-Cloth Sieve Analysis of Nonplastic Ceramic Powders
ASTM D 92	Test Method for Flash and Fire Points by Cleveland Open Cup
ASTM D 711	No-Pick-Up Time of Traffic Paint
ASTM D 968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1652	Test Method for Epoxy Content of Epoxy Resins
ASTM D 207	Test Method for Total Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D 2240	Test Method for Rubber Products-Durometer Hardness
ASTM G 53	Operating Light and Water-Exposure Apparatus (Florescent UV-Condensation Type) for Exposure of Nonmetallic Materials.
Federal Test Method Standard No. 141	Paint, Varnish, Lacquer and Related Materials; Methods of Inspection, Sampling and Testing

MATERIAL REQUIREMENTS

ASTM D 476	Specifications for Titanium Dioxide Pigments
Code of Federal Regulations	40 CFR Part 60, Appendix A 9 CFR Part 1910.1200
Fed. Spec. TT-B-1325	Beads (Glass Spheres) Retroreflective
Fed. Spec. TT-P-85	Paint, traffic and Airfield Marking, Solvent Base
Fed. Spec. TT-P-110	Paint, Traffic Black (Nonreflectorized)
Fed. Spec. TT-P-1952	Paint, traffic and Airfield Marking, Waterborne
Federal Standard 595	Colors used in Government Procurement

SPECIFICATION P–625. RUBBERIZED COAL TAR PITCH EMULSION SEAL COAT

DESCRIPTION

625–1.1 This Work consists of an application of a rubberized coal tar emulsion seal coat, with mineral aggregate, and with the use of a latex rubber applied on an existing, previously prepared bituminous surface, in accordance with these Specifications for the area shown on the Plans or as designated by the Engineer. The material is intended for use as a fuel resistant sealer and to even out small irregularities in the pavement.

MATERIALS

625–2.1 AGGREGATE. The aggregate shall either be a natural or manufactured angular aggregate and shall be composed of clean, hard, durable, uncoated particles, free from lumps of clay and all organic matter. The aggregate shall meet the gradation in Table 1, when tested in accordance with ASTM C 136. When applied to runways and taxiways, provide aggregate with 90 percent angular particles by count.

TABLE 1. GRADATION OF AGGREGATES

Sieve Size	*Percentage by Weight Passing Sieves*
No. 8 (2.36 mm)	100
No. 16 (1.18 mm)	97 – 100
No. 20 (0.85 mm)	85 – 100
No. 30 (0.60 mm)	15 – 85
No. 40 (0.40 mm)	2 – 15
No. 50 (0.30 mm)	–
No. 100 (0.15 mm)	0 – 2

When applied to aprons, tiedowns, fueling areas, or other low speed operation areas, the gradation shown in Table 1 may be varied to conform with the recommendations of the latex supplier.

625–2.2 BITUMINOUS MATERIALS. The bituminous material shall be a milled coal tar pitch emulsion prepared from a high temperature, coal tar pitch conforming to the requirements of ASTM D 490, grade 11/12. Do not use oil and water gas tar even though they comply with ASTM D 490. The coal tar pitch emulsion shall conform to all requirements of Federal Specification R–P–355 except that the water content shall not exceed 50 percent.

625–2.3 WATER. Use potable water, free from harmful soluble salts, in mixing. The temperature of the water added during mixing shall be at least 50°F (10°C). The pH of the water added during mixing shall conform to the requirements of the coal tar emulsion manufacturer.

625–2.4 LATEX RUBBER. Use copolymer rubber latex containing 51–70 parts butadiene and 30–49 parts acrylonitrile or styrene with a minimum solids content of 40 percent with a particle size less than 80 nanometers and silicones at 4 percent of the rubber content. The rubber shall be compatible with the coal tar pitch emulsion used by the Contractor and must mix homogeneously with the coal tar emulsion, water, and sand in the proportions specified to produce a mixture that will adequately suspend the aggregate during mixing and application.

COMPOSITION AND APPLICATION

625–3.1 COMPOSITION. The rubberized coal tar pitch emulsion seal coat shall consist of a mixture of coal tar pitch emulsion, water, latex rubber, and aggregate in proportions that fall within the ranges shown in Table 2.

625–3.2 JOB MIX FORMULA. Submit the supplier's recommended formulation and application rate to a testing laboratory together with sufficient materials to verify the formulation. The laboratory shall verify the proportions of emulsion, water, aggregate and rubber using the mix design procedures contained at the end of this Specification. The mix design shall be within the range shown in Table 2 and meet the

requirements of Table 3. Submit a copy of the mix design and test data to the Engineer for approval at least 14 days prior to the start of operations and include as a minimum:

a. Water (gal/gal of emulsion)

b. Aggregate (lbs/gal of emulsion)

c. Rubber (gal/gal of emulsion)

d. Viscosity of total liquid

e. Viscosity of composite mix

f. pH of water

g. Mixing sequence of materials

h. Scuff resistance, freeze-thaw, adhesion, and fuel resistance.

No seal coat shall be produced for payment until a job mix formula has been approved by the Engineer.

Rubberized coal tar emulsion seal coat formulations are sensitive to the characteristics of individual latex additives. Not all products will provide satisfactory seal coat formulations for all combinations of coal tar emulsion, water, aggregate and rubber additive.

Water used in the job mix design should be obtained from the source the Contractor proposes to use in the field.

The job mix formula for each mixture shall be in effect until modified in writing by the Engineer.

NOTE TO SPECIFIER:
Improper formulations of coal–tar pitch emulsion seal produce coatings that crack prematurely or do not adhere properly to the pavement surface.

The mix design procedure may be deleted by Special Provision for State Aid Projects.

TABLE 2. COMPOSITION OF MIXTURE

Type of Seal Coat	*Composition and Quantities*			
	Water gal./gal. of emul.	*Aggregate lbs/ga. of emul.*	*Rubber gal./gal. of emul.*	*Application Rate gal./sq.yd. (per application)*
Tack	3	–	–	0.05–0.10
Rubberized Sand Slurry	0.80(max)	16–20	0.10-0.14	0.35-0.55
Rubberized Emulsion	0.80(max)	–	0.03–0.05	0.20-0.25

TABLE 3. DESIGN CRITERIA

Test Property	*Purpose*	*Criterion*
Brookfield Viscosity posies @ 77°F	Incompatibility between latex and coal tar	10–90
Brookfield Viscosity poises @ 77°F	Workability of composite mix	10–90
Scuff Resistance torque @ 8 hours	Rate of set	>100 in-lbs
Scuff Resistance torque @ 24 hours	Final scuff	>8 hr. torque
Freeze–Thaw @ 5 cycles @ 10 cycles	Cracking	 <1 <3
Adhesion	Loss of adhesion	Rating = 5A
Fuel Resistance	Fuel penetration Loss of adhesion	No penetration or loss of adhesion

NOTE TO SPECIFIER:
Table 3 may be deleted if a non–rubberized seal coat is specified. However, rubberized sealer is standard in Wisconsin and is specified throughout this Specification.

625–3.3 APPLICATION RATE. Apply the rubberized coal tar emulsion seal coat in three coats. The first and second coats shall consist of a rubberized sand slurry; the third coat shall consist of a rubberized emulsion. Verify that the application rate submitted with the job mix formula during placement of the test section falls within the limits shown in Table 2.

625–3.4 TEST SECTION. Prior to full production, prepare a quantity of mixture in the proportions shown in the approved mix design. The amount of mixture shall be sufficient to place a test section a minimum of 250 square yards (209 square meters) at the rate specified in the job mix formula. The area to be tested will be designated by the Engineer and will be located on a representative section of the pavement to be sealcoated.

NOTE TO SPECIFIER:
On State Aid Projects, the test section can be eliminated by Special Provision or the entire area to be sealcoated can be considered the same as the test section.

The test section will be used to verify the adequacy of the mix design. The same equipment and method of operations shall be used on the test section as will be used on the remainder of the Work.

Two viscosity tests each will be made on the total liquid and the composite mix. The average viscosity shall be within $\pm$15 poises of the job mix viscosity determined in the job mix formula. Test results will be available within 2 days.

If the test section should prove to be unsatisfactory, the necessary adjustments to the mix composition, application rate, placement operations, and equipment shall be made. Additional test sections shall be placed and evaluated, if required. Do not begin full production without the Engineer's approval. Acceptable test sections will be paid for in accordance with Paragraph 625–7.1.

NOTE TO SPECIFIER:

The test section affords the Contractor and the Engineer an opportunity to determine the quality of the mixture in place as well as the performance of the equipment.

If operational conditions preclude placement of a test section on the pavement to be sealed, it may be applied on a pavement with similar surface texture.

CONSTRUCTION METHODS

625–4.1 WEATHER LIMITATIONS. Do not apply the seal coat when the surface is wet or when the humidity or impending weather conditions will not allow proper curing. Apply the seal coat only when the atmospheric or pavement temperature is 50 degrees F (10 degrees C) and rising and is expected to remain above 50 degrees F (10 degrees C) for 24 hours, unless otherwise directed by the Engineer.

625–4.2 EQUIPMENT AND TOOLS. Furnish all equipment, tools, and machinery necessary for the performance of the Work.

a. Distributors. Spray distributors or spray units used for the spray application of the seal coat shall be self–propelled and capable of uniformly applying material over the required width of application at the rate required in Table 2. Equip distributors with removable manhole covers, tachometers, pressure gauges, and volume–measuring devices.

Use a mix tank that is a mechanically powered, full–sweep, mixer with sufficient power to move and homogeneously mix the entire contents of the tank.

Equip the distributor with a positive placement pump so that a constant pressure can be maintained on the mixture to the spray nozzles.

b. Mixing Equipment. Use a mixing machine that has a continuous flow mixing unit capable of accurately delivering a predetermined proportion of aggregate, water, emulsion and rubber and of discharging the thoroughly mixed product on a continuous basis. The mixing unit shall be capable of thoroughly blending all ingredients together and discharging the material to box without segregation.

c. Spreading Equipment. Spreader box and squeegee are not permitted.

d. Calibration. Furnish all equipment and materials and labor necessary to calibrate the equipment. Calibrate it to assure that it will produce and apply a mix that conforms to the job mix design. Provide commercial equipment with a method of calibration by the manufacturer. Make all calibrations with the approved job materials prior to applying the seal coat to the pavement. Furnish a copy of the calibration test results to the Engineer.

625–4.3 PREPARATION OF PAVEMENT SURFACE. Remove bituminous pavement surfaces, which have been softened by petroleum derivatives or have otherwise failed, to the full depth of the damage and replace with new bituminous concrete similar to that of the existing pavement. The Work will be considered Extra Work in accordance with Section 90, unless otherwise provided for in the Contract Documents. Areas of the pavement surface to be treated shall be in a firm consolidated condition. The area shall be sufficiently cured so that there is no concentration of oils on the surface.

A period of 90 days shall elapse between the placement of a bituminous surface course and the application of the seal coat.

NOTE TO SPECIFIER:
The engineer may change the time period by Special Provision. In order to ensure adequate adhesion and minimize cracking and curling, the pavement surface must be sufficiently cured prior to applying the seal coat. Experience in Wisconsin has shown that 30 90 days is sufficient, provided the daytime temperature reaches 70 degrees F.

One means of determining if the pavement cured adequately is to pour a cup of water on the pavement surface and observe if any oils appear in the standing water. If oils appear, the surface is not sufficiently cured to accept a seal coat.

625–4.4 CLEANING EXISTING SURFACE. Prior to placing the seal coat, clean the surface of the pavement and free it from dust, dirt, or other loose foreign matter, grease, oil, or any type of objectionable surface film. When directed by the Engineer, clean the existing surface with wire brushes and a power blower.

Remove vegetation that exists in cracks. Wire brush areas that have been subjected to fuel or oil spillage to remove any dirt accumulations. Then prime the area with shellac or a synthetic resin to prevent the seal coat from debonding.

NOTE TO SPECIFIER:
The Engineer shall specify the appropriate method of treating cracks. Use of the WBOA specification is normal practice for Wisconsin. This includes routing and filling with a compatible crack filler. Include separate Pay Items for maintenance and repair work.

625–4.5 TACK COAT. After the surface has been prepared, apply a tack coat of 3 parts water to 1 part emulsified binder, as specified in Paragraph 625–2.2, at the rate specified in Table 2..

625–4.6 APPLICATION OF RUBBERIZED SAND SLURRY. Apply the rubberized sand slurry at a uniform rate with a spray distributor or spray unit at the rate submitted with the JMF. When the emulsion, water, aggregate, and rubber are blended, premix the material to produce a homogeneous mixture of uniform consistency. The quantities of materials to be combined in each batch must be in accordance with the approved mix design.

Use the same mixing sequence of the various components as is indicated in the job mix formula. After all constituents are in the mixer, continue the mixing for approximately 5 minutes or longer, if necessary. The mixing should produce a smooth, free flowing homogeneous mixture of uniform consistency. Continue slow mixing from the time the emulsion is placed into the mixer until the slurry is applied by distributor truck. During the entire mixing process, breaking, segregating, or hardening of the emulsion, balling, lumping, or swelling of the aggregate is not permitted. Apply the slurry at a uniform rate to provide the quantity determined in the JMF and verified during placement of the test strip.

Follow manufacturer's recommendations regarding spray application. In areas inaccessible to equipment, the slurry may be applied by means of a hand spray unit.

Upon completion of the Work, there should be no pin holes, bare spots, or cracks in the seal coat through which liquids or foreign matter could penetrate to the underlying pavement. The finished surface shall present a uniform texture.

Allow each application to dry thoroughly before the next coat is applied.

625–4.7 CURING. Permit the mixture to dry for a minimum of 24 hours after the final application before opening to traffic and sufficiently cure it to drive over without damage to the seal coat. Repair damage to the uncured mixture at no additional cost.

625–4.8 HANDLING. Continuously agitate the mixture from the initial mixing until its application on the pavement surface. Maintain the distributor or applicator, pumps, and all tools in satisfactory working condition.

QUALITY CONTROL

625–5.1 CONTRACTOR'S CERTIFICATION. Furnish the manufacturer's certification that each consignment of emulsion shipped to the project meets the requirements of Federal Specification R–P–355, except that the water content shall not exceed 50 percent. The certification shall also indicate the solids and ash content of the emulsion and the date the tests were conducted.

Furnish the manufacturer's certification to the Engineer that the latex rubber shipped to the project meets the requirements or the material specified in Paragraph 2.4. The certificate shall also indicate that the latex and coal tar emulsion proposed for use are compatible and that the latex is recommended for combining with the coal tar emulsion, water, and aggregate. Deliver the certifications to the Engineer at least 5 days prior to the beginning of Work. The manufacturer's certification for the emulsion and rubber shall not be interpreted as a basis for final acceptance. Certifications received will be subject to verification by testing samples received for project use.

Furnish a manufacturer's certification that the combination of latex and coal tar emulsion proposed for use has been successfully used in coal tar emulsion seal coat mixtures for a minimum of 3 years. Furnish a certification demonstrating their experience in the application of a rubberized coal tar emulsion seal coat for a minimum of 3 years.

625–5.2 QUALITY CONTROL. When a Pay Item for Independent Consultant Services is included in the Schedule of Prices, have an independent technical consultant on the job site at the beginning of operations for application of rubberized seal coats. The consultant shall have knowledge of the materials, procedures, and equipment described in this Specification and shall assist the Contractor regarding proper

mixing of the component materials and application of the seal coat. The consultant shall have a minimum of 3 years experience in the use of rubberized coal tar seal coats. Furnish documentation of this experience to the Engineer prior to the start of operations.

Prior to the start of operations, the independent technical consultant shall perform the viscosity tests in Table 3. The results shall be within ±15 poises of the job mix viscosity.

NOTE TO SPECIFIER:
Include a Pay Item for Independent Consultant Services in the Schedule of Prices on FAA funded work and on larger projects funded by the WBOA. Independent Consultant Services are not required on smaller WBOA funded projects.

625–5.3 SAMPLING. Two random samples of the composite rubberized mix, from each day's production, will be tested for viscosity to determine conformance with the requirements of the job mix formula viscosity for the composite mix, ±15 poises. One sample per day may be tested for the other properties of Table 3. In addition, a one–quart sample will be obtained daily and stored in a glass container. The container will be sealed against contamination and retained in storage by the Department for a period of 6 months. Samples will be stored at room temperature and will not be subjected to freezing temperatures.

A sample of undiluted coal tar emulsion and latex will be sampled from each consignment shipped to the job.

NOTE TO SPECIFIER:
ENGINEER'S RECORDS. The Engineer should keep an accurate record of each batch of materials used in the formulation of the seal coat.

METHOD OF MEASUREMENT

625–6.1 COAL TAR PITCH EMULSION. Measurement of the Rubberized Coal Tar Pitch Emulsion Seal Coat will be by the square yard in place in accordance with this Specification. A tack coat, two coats of rubberized sand slurry, and a final coat of rubberized emulsion will be applied to each square yard measured for payment. Payment at the Contract unit price will be full compensation for all testing, materials, equipment, and labor necessary to construct the Rubberized Coal Tar Pitch Emulsion Seal Coat as detailed in these Specifications.

625–6.2 INDEPENDENT CONSULTANT SERVICES. Independent Consultant Services will be measured by the day. In order to receive payment for one day, the Consultant is required to spend a minimum of 8 hours on site. Measurement and payment in excess of the Plan quantity will not be made unless ordered in writing by the Department.

BASIS OF PAYMENT

625–7.1 Payment at the Contract unit price will fully compensate the Contractor for furnishing all materials; and for all labor, equipment, tools, and incidentals necessary to complete the Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P62501	Rubberized Coal Tar Pitch Emulsion Seal Coat, per square yard
Pay Item P62502	Independent Consultant Services, per day

Measurement and Payment will only be made for Items contained 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.

TESTING REQUIREMENTS

ASTM C 136	Standard Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM D 693	Crushed Stone, Crushed Slag, and Crushed Gravel for Dry- or Water-Bound Macadam Base Courses and Bituminous Macadam Base and Surface Courses of Pavements

MATERIAL REQUIREMENTS

Fed. Spec. R-P–355	Pitch, Coal Tar Emulsion (Coating for Bituminous Pavements)

ASTM D 490 Tars, (For Use In Road Construction)

MIX DESIGN PROCEDURE

Specification P–625
MIX DESIGN PROCEDURE Specification P–625
TEST METHODS
CRITERION

This procedure shall be used to determine the capability of the materials furnished by the Contractor to produce a seal coat mix within the range of TABLE 2 and meeting the requirements of TABLE 3.

The formulation is a combination of coal tar pitch emulsion, water, sand, and latex rubber. The samples furnished by the Contractor shall be combined in the proportions recommended by the supplier and subjected to a sequence of six tests designed to eliminate materials or combination of materials which do not meet the test criteria. Unacceptable materials in the formulation will be eliminated from further consideration.

BROOKFIELD VISCOSITY
Step 1 & Step 2

1. Scope

This method covers the determination of the Brookfield viscosity, using materials and recommended formulations provided by the Contractor. It is designed to detect formulations that have incompatible quantities of latex and coal tar emulsion, that might flocculate, that have viscosities too low to suspend sand, and to identify any incompatibilities created by introducing sand.

2. Definitions

2.1 Brookfield viscosity – the viscosity determined by this method. The viscosity is expressed in centipoises (100 centipoises = 1 poise). Its value may vary with the spindle speed (shear rate) due to the non–Newtonian behavior of the coal tar emulsion, additive, and the water added. 2.2 Total liquids – coal tar emulsion, additive, and water. 2.3 Composite system – total liquids and sand.

2.2 Total liquids – coal tar emulsion, additive, and water.

2.3 Composite system – total liquids and sand.

3. Apparatus

3.1 Brookfield digital viscometer (model DV–II) and stand.

3.2 Number 1 and 3 HB spindles for DV–II viscometer.

3.3 Paint cans

3.3.1 quart capacity.

3.3.2 gallon capacity.

4. Sample Preparation for Step 1 (4.1–4.3) and Step 2(4.1–4.4)

4.1 Allow components (coal tar emulsion, water, sand, and additive) to reach 77°F (25°C). This should take approximately 24 hours.

4.2 Mix coal tar emulsion and water in container specified in 3.3.2 with 50 strokes of a large laboratory mixing spoon.

4.3 Introduce additive to the mixture with an additional 50 strokes of the laboratory mixing spoon. Proceed to Step 1.

4.4 Add sand to total liquids with 50 strokes of a large laboratory mixing spoon, for composite mixture. Sand must be added slowly to avoid trapping air in the mixture. Stir composite mixture for 5 minutes and immediately proceed to Step 2.

5. Procedure

Step 1

5.1 Fill quart paint can specified in 3.3.1 to within one inch of the top with the material prepared in accordance with 4.1 through 4.3.

5.2 Insert spindle No. 3 HB in the material until the mixture level coincides with the immersion groove on the spindle shaft.

5.3 Avoid trapping air bubbles underneath the spindle.

5.4 Adjust rotational speed on the Brookfield viscometer to 50 revolutions per minute (rpm).

5.5 Start motor and record viscosity value in centipoises after 5 seconds of rotation. If the viscosity reading is too low for spindle 3, repeat procedure 5.1 through 5. 5, using spindle No. 1.

Step 2

5.6 Repeat 5.1 – 5.5 with the composite mixture prepared in accordance with 4.1 through 4.4.

5.7 If the composite mixture does not fall within the acceptance criterion of 10 to 90 poises the following procedure for combining materials shall be used.
5.7.1 Discard materials from Step 1.
5.7.2 Mix coal tar emulsion and water in container specified in 3.3.2 with 50 strokes of a large laboratory mixing spoon.
5.7.3 Add sand to the mixture with 50 strokes of the laboratory mixing spoon.
5.7.4 Introduce additive to the mixture with 50 strokes of the laboratory mixing spoon, for composite mixture. Stir composite mixture for 5 minutes and immediately proceed to Step 1.

6. Report
6.1 The report should include:
6.1.1 Date of test and complete identification of the coal tar formulation tested.
6.1.2 Spindle number and rpm setting.
6.1.3 Temperature of the sample tested.
6.1.4 Viscosity of total liquids in poises. (Step 1)
6.1.5 Viscosity of composite system in poises. (Step 2)

Step 1 Criterion: Viscosities between 10 and 90 poises are acceptable
Step 2 Criterion: Viscosities between 10 and 90 poises are acceptable

For materials to move into Step 2 testing the viscosity range must be met in Step 1. Likewise Step 3 will not be continued until viscosity range is met in Step 2 testing. If a material fails to meet testing criteria in any step it will be eliminated from further testing.

SCUFF RESISTANCE TEST

Step 3

1. Scope
This method covers the determination of the initial set and final scuff resistance characteristics of coal tar emulsion seal coat.

2. Definitions
2.1 Initial set - torque reading at 8 hours of curing.
2.2 Final scuff resistance - torque reading at 24 hours of curing.

3. Apparatus
3.1 "Scuff" resistance tester similar to the cohesion tester in ASTM D 3910-80a, but modified as follows:
3.1.1 Proving ring used to measure applied load.
3.1.2 Screw jack used to apply load.
3.1.3 5" x 3/4" ID 1 7/32" OD reinforced rubber hose (two braid, 300 psi, green, oil resistant cover) for use in abrasion head.
3.2 Torque wrench with 300 inch pound capacity.
3.3 6" x 6" square 16 gauge sheet metal mask with 4" x 4" square center removed.
3.4 6" x 6" square aluminum panel.

4. Procedure
4.1 Using mask described in 3.3, apply uniform thickness of coal tar emulsion mixture to two panels as described in 3.4.
4.2 Allow the sample to cure at 77 degrees F and 50-10 percent relative humidity.
4.3 Test the first panel after 8 hours of curing.
4.4 Place panel on lower platen and secure with "c" clamps.
4.5 Raise platen with screw jack until sample comes in contact with the rubber abrasion head.
4.6 Continue raising the platen until a normal load of 28 psi, as measured through the dial gage, is applied to the sample.
4.7 Tap platen to ensure proper load is applied to the sample.
4.8 Pull the torque wrench through an arc of 180 degrees in 1-2 seconds.
4.9 Record torque reading in inch-pounds.
4.10 Repeat procedures 4.4 through 4.9 on second sample after 24 hours of curing and record the torque reading in inch-pounds.

5. Report
5.1 Report the following information
5.1.1 Date and material tested.
5.1.2 Initial set as the torque reading at 8 hours of curing.
5.1.3 Final scuff resistance as the torque reading at 24 hours of curing.

CYCLIC FREEZE THAW CONDITIONING

Step 4

1. Scope

This method covers the analysis of crack development in a composite rubberized coal tar emulsion seal coat when exposed to multiple cycles of freezing and thawing.

2. Apparatus

2.1 12" x 12" square 16 gauge sheet metal mask with an 11" x 11" square center removed.
2.2 12" x 12" square section of aluminum panel 3/16" thick.
2.3 Oven capable of maintaining 140°F (60°C).
2.4 Freezer capable of maintaining 10°F (–12°C).

3. Procedure

3.1 Using mask described in 2.1, apply uniform thickness of the composite rubberized coal tar emulsion mixture to a panel as described in 2.2.
3.2 Allow material to cure at 77 ±2°F and 50 ±10 percent relative humidity for 24 hours.
3.3 Place sample in the 140°F (60°C) oven for 24 hours.
3.4 Remove sample and record crack development.
3.5 Place sample in 10°F (–12°C) freezer for 24 hours.
3.6 Remove from freezer; this constitutes one freeze–thaw cycle.
3.7 Repeat procedures 3. 3 through 3. 6 for a total of 10 cycles.
3.8 Inspect the samples after 5 and 10 cycles and rate the cracking in accordance with Table 2 and the following procedure.

3.8.1 Using a commercially available thickness gauge, estimate the width of the largest crack appearing on the surface.
3.8.2 Next, please a grid frame over the coal tar seal coated shingle (after freeze/thaw conditioning). The grid is a wood frame with an inside diameter of 12x12-inches. A grid is formed across the inside opening of the frame by subdividing the opening into 10 equal divisions both horizontally and vertically with twine anchored to the frame. This will provide 100 equally sized squares.
3.8.3 Count the number of squares in which a crack occurs. The percent cracking is equal to the number of squares.
3.8.4 Compare the results to Table 1 below:

TABLE 1.

Severity of Cracking	Width of Widest Crack	Percent of Cracking
Hairline	0.010 mm	NA-Cracks are barely visible
Slight Cracking	0.015 mm	<25%
Moderate Cracking	0.020 mm	>25%
Severe Cracking	0.020 mm or greater	>50%

TABLE 2.

0	No cracking
1	Hairline cracking
2	Slight cracking
4	Moderate cracking
5	Severe cracking

4. Report

4.1 Report the crack rating at 5 and 10 cycles.

Step 4 Criterion: Rating of 1 or less at 5 cycles is required.
Rating of 3 or less at 10 cycles is required.

Materials not meeting this requirement shall be eliminated from Step 4.

ADHESION
Step 4

1. Scope

This method covers the determination of adhesion of a composite rubberized coal tar emulsion seal coat and retention of sand by applying pressure sensitive tape.

2. Apparatus

2.1 12" X 12" square 16 gauge sheet metal with 3" X 6" rectangular center removed.
2.2 12" X 12" aluminum panel 3/16" (5 mm) thick.
2.3 Razor sharp blade, scalpel, or other cutting device with cutting edge in good condition.
2.4 Steel straight edge.
2.5 One inch wide semi–transparent pressure sensitive tape with an adhesion strength of 38 + 5 oz./in. when tested in accordance with ASTM D 3330. The backing of the tape may consist of fiber–reinforced cellulose acetate, unplasticized polyvinyl chloride, or polyester film.
2.6 Hard, small head rubber eraser.
2.7 Table lamp.

3. Procedure

3.1 Using the mask described in 2.1, apply a uniform thickness of the composite mixture to the aluminum panel as described in 2.2.
3.2 Allow mix to cure at 77 ±2°F at 50 ±10 percent relative humidity for 24 hours.
3.3 Select a representative area.
3.4 Make a horizontal cut of about 1.5 inches (38 mm). Then make another cut of 1.5 inches (38 mm) about 40 degrees to the horizontal cut. The cuts should intersect each other at their centers. When making the cuts, use the straight edge and cut through the coating to the substrate in on steady motion. Brush off dislodged materials.
3.5 Inspect the cuts for reflection of light from the metal substrate to establish that the coating has been cut through completely. If the substrate has not been reached, do not attempt to deepen the cut. Instead, make another "X" in a different location. Remove the dislodged materials by brushing lightly.
3.6 Remove two laps of the pressure sensitive tape from the roll and discard. Remove an additional length at a steady rate and cut a piece about 3 inches long.
3.7 Place the center of the tape at the intersection of the cuts with the tape running in the same direction as the smaller angles. Smooth out the tape in the area of the cuts and then rub firmly with the eraser.
3.8 Wait for 60 seconds, then rapidly pull one end of the tape back on itself with the non–stick surfaces touching and running parallel to each other.
3.9 Inspect the "X" cut area for removal of the coating from the substrate and rate the adhesion in accordance with the following scale:

5A	No Peeling or removal
4A	Trace peeling or removal along incisions
3A	Jagged removal along incisions up to 1/16 inch 1.6 mm) either side to 1/8 inch (3 mm)
2A	Jagged removal along most incisions Up to l/8 inch (3 mm) on either side
1A	Removal from most of the area of the "X" under the tape
0A	Removal beyond the area of the "X"

3.10 Inspect the tape for adhesion of sand.
3.11 Repeat the test in two other locations on the test panel

4. Report

4.1 Report the number of tests, their mean value and range.
4.2 Report whether sand adhered to the tape as yes or no.

Step 5 Criterion: No sand can adhere to the tape. No debonding of the seal coat or the test medium is allowed (adhesion rating of 5A is required).

Materials not meeting this requirement shall be eliminated from being tested in Step 5.

FUEL RESISTANCE
Step 5

1. Scope

This method determines the resistance of the composite rubberized coal tar emulsion seal coat to kerosene.

2. Apparatus

2.12 6 inch X 6 inch square 16 gauge sheet metal masks with a 4 inch by 4 inch square center removed.
2.2 6 inch X 6 inch unglazed white ceramic tile with an absorption rate of 10–18 percent (determined in accordance with ASTM C 67.

2.3 Brass ring, 2 inch diameter and 2 inches high.
2.4 Kerosene meeting requirements of ASTM D 3699.
2.5 Silicone rubber sealant.

3. Procedure

3.1 Immerse the ceramic tile in distilled water for a minimum of 10 minutes.
3.2 Remove excess water from the tile to produce a damp surface before applying the seal coat.
3.3 Using the mask described in 2.1 apply one layer of the composite coal tar emulsion mixture to the tile. Spread even with the top of the mask using a spatula or other straight edge.
3.4 Allow the sample to cure for 96 hours at 77 ±2°F and 50 ±10 percent relative humidity.
3.5 After curing, affix the brass ring to the seal coat on the tile with silicone rubber.
3.6 Fill the brass ring with kerosene.
3.7 After 24 hours, remove the kerosene from the brass ring, blot dry and immediately examine the film for softness and loss of adhesion. Immediately after the film is examined, break the tile in half, exposing that part of the tile whose film was subjected to the kerosene.
3.8 Evaluate for penetration of kerosene through the sealer and loss of adhesion.

4. Report

4.1 Report the results as pass or fail. Visible evidence of leakage or discoloration shall constitute failure of the test.

Step 6 Criterion: A "pass" rating in the fuel resistance test is required.

SPECIFICATION P–626. EMULSIFIED ASPHALT SLURRY SEAL SURFACE TREATMENT

DESCRIPTION

626–1.1 This Work consists of a mixture of emulsified asphalt, mineral aggregate, and water, properly proportioned, mixed, and spread evenly on a prepared underlying course or existing wearing course in accordance with these Specifications and shall conform to the dimensions shown on the Plans or as directed by the Engineer.

MATERIALS

626–2.1 AGGREGATE. 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. Wet bottom boiler slag shall constitute 40 to 65 percent by weight of the aggregate mixture. Smooth–textured sand of less than 1.25 percent water absorption, as tested by ASTM C 128, 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 45 when tested in accordance with ASTM D 2419. The aggregate shall show a loss of not more than 35 percent when tested in accordance with ASTM C 131. The sodium sulfate soundness loss shall not exceed 9 percent, or the magnesium soundness loss shall not exceed 12 percent after five cycles when tested in accordance with ASTM C 88. Aggregate retained on the No. 50 sieve (300 micro m) shall be 100 percent crushed.

NOTE TO SPECIFIER:
The following FAA requirements were incorporated into the standard specification. The percent loss when tested under ASTM C131 should not exceed 35. The sodium sulfate loss should not exceed 9 percent; the magnesium sulfate loss should not exceed 12 percent. In certain specific cases, where aggregates complying with those maximums cannot be economically obtained, aggregates with a higher percentage loss or wear may be specified, provided a satisfactory service record under similar conditions of service and exposure has been demonstrated.

The combined aggregate shall conform to the gradation shown in Table 1 when tested in accordance with ASTM C 136.

TABLE 1. GRADATION OF AGGREGATES

Sieve Size	*Percentage by Weight Passing Sieves Type II*
3/8 in. (9.5 mm)	100
No. 4 (4.75 mm)	98 – 100
No. 8 (2.36 mm)	75 – 90
No. 16 (1.18 mm)	50–75
No. 30 (600 micro m)	30 – 50
No. 50 (300 micro m)	18 – 35
No. 100 (150 micro m)	10 – 21
No. 200 (75 micro m)	5 – 15
Residual asphalt content Percent dry aggregate	7.5 – 13.5
Pounds of aggregate per square yard	17 ±2

The aggregate, as finally selected, shall have a gradation within the limits designated in Table 1, and should not vary from the low limit on one sieve to the high–limit on the adjacent sieve and vice versa.

NOTE TO SPECIFIER:
The aggregate gradation bands allowed by the FAA are shown in this note. Gradation II was inserted in Table 1 of the Standard Specification.

The Type I gradation is used for maximum crack penetration and is usually used in low density traffic areas where the primary objective is sealing.

The Type II gradation is used to seal and improve skid resistance.

The Type III gradation is used to correct surface conditions and provide skid resistance.

GRADATION OF AGGREGATES

Sieve Size	Percentage by Weight Passing Sieves	
	Type I	Type III
3/8 in. (9.5 mm)	——	100
No. 4 (4.75 mm)	100	70–90
No. 8 (2.36 mm)	90–100	45–70
No. 16 (1.18 mm)	65–90	28–50
No. 30 (600 micro m)	40–60	19–34
No. 50 (300 micro m)	25–42	12–25
No. 100 (150 micro m)	15–30	7–18
No. 200 (75 micro m)	10–20	5–15
Residual asphalt content		
Percent dry aggregate	10–16	6.5–12
Pounds of aggregate per square yard	6–10	15–20
Kilograms of aggregate per square meter	3.2–5.4	8.1–10.8

Take precautions to prevent segregation of the aggregate in storing and handling. Keep the stockpile in areas that drain readily.

Deliver samples of the aggregate to be furnished to the Engineer 14 days prior to beginning construction.

626–2.2 FILLER. If filler, in addition to that naturally present in the aggregate, is necessary, it shall meet the requirements of ASTM D 242 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.

626–2.3 EMULSIFIED ASPHALT. The emulsified asphalt shall conform to the requirements of ASTM D 2397 for type CSS–1h emulsion.

626–2.4 WATER. Use potable water, free from harmful soluble salts, in making the slurry.

626–2.5 TACK COAT. 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 applied by approved pressure distribution. Tack coat all areas to be seal coated.

CONSTRUCTION METHODS

626–3.1 WEATHER LIMITATIONS. The slurry seal shall not be applied if either the pavement or the air temperature is 55°F (13°C) or below or when rain is imminent.

NOTE TO SPECIFIER:
The Engineer should not specify a lower permissible temperature since slurry placed at lower temperatures usually will not cure properly due to poor dehydration and poor asphalt coalescence.

626–3.2 EQUIPMENT AND TOOLS. Maintain all equipment, tools, and machines used in the performance of this Work in satisfactory working order at all times. Submit descriptive information on the slurry mixing and applying equipment to be used to the Engineer for approval not less than 10 days before Work starts.

a. Pressure Distributors. 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 (0.23 to 0.68 liter per square meter) of the diluted emulsion over the required width of application. Distributors shall be equipped with tachometers, pressure gages, and volume–measuring devices.

b. Slurry Mixing Equipment. Use a slurry mixing machine with 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. Prewet the aggregate immediately prior to mixing with the emulsion. The mixing unit of the mixing chamber shall be capable of thoroughly blending all ingredients together. Excessive mixing is not permitted. Equip the mixing machine 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. Use the fines feeder whenever added mineral filler is part of the aggregate blend.

Equip the mixing machine 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 (0.23 to 0.45 liter per square meter) preceding the spreading equipment.

Provide sufficient machine storage capacity to mix properly and apply a minimum of 5 tons (4,500 kg) of the slurry. Calibrate proportioning devices prior to placing the slurry seal.

c. Slurry Spreading Equipment. Attach to the mixing machine a mechanical–type squeegee distributor equipped with flexible material in contact with the surface to prevent loss of slurry from the distributor. Maintain it 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. Keep the box clean. Built–up asphalt and aggregate on the box is not be permitted. The Engineer will approve the use of burlap drags or other drags.

d. Auxiliary Equipment. Provide other tools or equipment such as brushes, hand squeegees, hose equipment, tank trucks, water distributors and flushers, power blowers, and barricades as required.

626–3.3 EQUIPMENT CALIBRATION. Calibrate each slurry mixing unit to be used on the project 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. Include in the documentation 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.

626–3.4 CLEANING EXISTING SURFACE. Prior to placing the tack coat and slurry seal coat, repair unsatisfactory areas and clean the surface of dust, dirt, or other loose foreign matter, grease, oil, or any type of objectionable surface film. Clean the surface with power broom.

Remove loose paint on the surface to be treated before applying the tack coat.

NOTE TO SPECIFIER:
Existing pavement that is irregular or broken should be repaired. Cracks wider than 3/8 inch should be sealed. Repairs to portions of pavement that are in poor condition should be completed and paid under other Contract Pay Items.

Prior to applying Slurry Seal Surface Treatment, route and seal cracks under the Specification for crackfilling asphalt pavement.

626–3.5 APPLICATION OF BITUMINOUS TACK COAT Following the preparation for sealing, apply the diluted emulsion tack coat by means of a pressure distributor in amounts between 0.05 and 0.15 gallon per square yard (0.23 to 0.68 liter per square meter) as directed by the Engineer. Apply the tack coat at least 2 hours before the slurry seal, but within the same day.

626–3.6 COMPOSITION OF SLURRY MIX. Apply 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.

The laboratory report must indicate the proportions of aggregates, mineral filler (minimum and maximum), water (minimum and maximum) 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.

The percent of aggregate passing each sieve shall not vary more than +/–4.0 percent from the mix design formula. The residual asphalt content shall not vary more than +/–1.0 percent from the mix design quantity.

NOTE TO SPECIFIER:
The main items of design in emulsified asphalt slurry seals are aggregate gradation, emulsified asphalt content, and consistency of the mixture. The aggregates, emulsified asphalt, and water should form a creamy–textured slurry that, when spread, will flow in a wave ahead of the strike off squeegee. This will allow the slurry to flow down into the cracks in the pavement and fill them before the strike–off passes over. Technical Bulletin No. 111, "Outline Guide Design Procedure for Slurry Seal," published by the International Slurry Seal Association contains information to aid designers of slurry mixes.

626–3.7 TEST SECTIONS. Place test sections 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.

Test strips shall be made by each machine after calibration. Samples of the slurry seal will be taken and the mix consistency and proportions verified. The rate of application will also be verified. If tests do not meet Specification requirements, additional tests will be made at the Contractor's cost until an acceptable test strip is placed.

626–3.8 APPLICATION OF SLURRY SEAL COAT. Prewet the surface by fogging ahead of the slurry spreader box. Apply water used in prewetting the surface 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. Do not exceed a total mixing time of 5 minutes. Carry a sufficient amount of slurry in all parts of the spreader box at all times so that complete coverage of all surface voids and cracks is obtained. Take care not to overload the spreader box which should be towed at a slow and uniform rate not to exceed 5 miles per hour (8 kilometers per hour). Lumping, balling, or unmixed aggregate is not 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, remove the slurry from the pavement surface. Feed a sufficient amount of slurry in the box to keep a full supply against the full width of the squeegee. Do not allow the mixture to overflow the front sides of the spreader box. No excessive breaking of the emulsion will be allowed in the spreader box. No streaks such as caused by oversized aggregate will be left in the finished pavement.

Lap adjacent lanes at the edges a minimum of 2 inches (50 mm) to provide complete sealing at the overlap. Feather all edges.

After application of the slurry seal, roll the surface with a pneumatic–tired roller a minimum of 4 coverages.

NOTE TO SPECIFIER:
Generally, where normal traffic will iron out the slurry and close any hairline cracks of dehydration, it is not necessary to roll a normal thickness (1/4 inch (6 mm) or less) of slurry seal.

However, in some instances the somewhat lattice–like structure of the slurry should probably be densified by pneumatic–tire rolling to improve durability, such as areas subjected to severe braking or acceleration. Rolling of the slurry seal is at the option of the Engineer, but if desired, it will need to be added by Special Provision since it is not the practice of the WBOA and is not included in the Standard Specification.

Example Special Provision:
"After application of the slurry seal, the surface shall be rolled with a pneumatic-tired roller a minimum of 4 coverages."

Protect the fresh slurry seal application by barricades and markers and allow it to dry for 4 to 24 hours, depending on weather conditions. Damage to uncured slurry shall be repaired at the Contractor's expense.

In areas where the spreader box cannot be used, apply the slurry by means of a hand squeegee. Fill joints or cracks that are not filled by the slurry mixture by using hand squeegees. Do not allow excessive buildup or unsightly appearance on longitudinal or transverse joints. Upon completion of the Work, the seal coat cannot have holes, bare spots, or cracks through which liquids or foreign matter could penetrate to the underlying pavement. The finished surface must present a uniform and skid resistant texture satisfactory to the Engineer. Remove all wasted and unused material and all debris from the site prior to final acceptance.

NOTE TO SPECIFIER:

The cured slurry shall have a homogeneous appearance, fill all cracks, adhere firmly to the surface, and have skid resistant texture.

626–3.9 EMULSION MATERIAL (CONTRACTOR'S RESPONSIBILITY). 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. Furnish the Engineer a manufacturer's certified report for each consignment of the emulsion. The manufacturer's certified report cannot be interpreted as a basis for final acceptance. All these reports may be subject to verification by testing samples of the emulsion as received for use on the project.

METHOD OF MEASUREMENT

626–4.1 Emulsified Asphalt Slurry Seal (including emulsified asphalt tack coat) will be measured by the square yard based on the actual quantity of Work shown on the Plans or ordered by the Engineer.

BASIS OF PAYMENT

626–5.1 Payment will be made at the Contract unit price per square yard for Emulsified Asphalt Slurry Seal Coat. This price will be full compensation for furnishing all materials, for preparing, mixing, and applying these materials, and for all labor, equipment, tools, and incidentals necessary to complete the Work. The test strip will be included in the prices for Emulsified Asphalt Slurry Seal Coat.

Standard Pay items for Work covered by this Specification are as follows:

Pay Item P62601	Emulsified Asphalt Slurry Seal Coat, per square yard

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 will be included in the Pay Items contained in the Schedule of Prices.

TESTING REQUIREMENTS

ASTM C 88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 128	Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	Resistance to Abrasion of Small Size Course Aggregate by Use of the Los Angeles Machine
ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM D 2419	Sand Equivalent Value of Soils and Fine Aggregate

MATERIAL REQUIREMENTS

The Asphalt Institute Manual MS–6 Table IV-3	Temperature–Volume Corrections for Emulsified Asphalts
ASTM D 242	Mineral Filler for Bituminous Paving Mixtures
ASTM D 977	Emulsified Asphalt
ASTM D 2397	Cationic Emulsified Asphalt

SPECIFICATION P–628. CRACK SEALING ASPHALT PAVEMENT

DESCRIPTION

628–1.1 This Work consists of routing, cleaning, preparing and sealing 1/4 inch (6 mm) wide or wider cracks in existing bituminous pavement. Seal cracks with a petroleum–based crack sealant.

628–1.2 EXPERIENCE. 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. (33440 m^2) 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.

MATERIALS

628–2.1 Crack sealing materials shall be a high performance Specification petroleum–based polymeric hot pour sealant. The sealant shall meet the requirements of ASTM D 3405. Submit a sample of sealant material to be used to the Engineer.

Deliver each lot or batch of sealing compound 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, present the manufacturer's certification stating that the compound meets the requirements of this Specification.

CONSTRUCTION METHODS

628–3.1 EQUIPMENT. 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 1.0:1.0.

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. Existing cracks to be sealed will be marked by the Engineer. Route cracks to be sealed to a minimum width of 3/4 inch (19 mm) and a minimum depth of 3/4 inch (19 mm). Where existing cracks have been previously sealed, remove failed sealant to the depth of the route, and overbond.

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. Remove vegetation from cracks.

Provide a power vacuum or equivalent to immediately remove all debris, including failed sealant, as soon as the cracks are cleaned.

Prior to sealing, dry the cleaned cracks, either by air drying or a high capacity torch. Immediately prior to sealing, blow out the dried crack with compressed air, 80 psi (550 kPa) minimum.

Apply crack sealant as per manufacturer's instructions and as outlined in Specification P–605. Overfill the crack to approximately three times the width of the routed crack and approximately 1/8 inch (3 mm) thick on adjacent pavement surfaces.

In wide cracks, 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 1.0 to 1.0 depth to width ratio of the sealant and to reduce the amount of material used. Install backer rod as necessary to limit the amount of sealing material on average (for the project) to 0.5 lbs. per linear foot (.74 kg/m) of cracks sealed.

At locations where crack sealant settles into the crack opening more than 1/4 inch (9 mm) below adjacent pavement, apply additional material to meet filling Specifications.

Hot Poured Sealants. Apply the joint sealant uniformly from bottom to top and seal it without formation of entrapped air or voids. Place backing material as required above. Use an indirect heating type heating kettle, constructed as a double boiler. Provide a positive temperature control and mechanical agitation. Do not heat the sealant to more than 20°F (7°C) below the safe heating temperature. The safe heating temperature can be obtained from the manufacturer's shipping container. Provide a direct connecting pressure type extruding device with nozzles shaped for insertion into the joint. Immediately remove sealant spilled on the surface of the pavement.

628–3.3 GUARANTEE OF WORK. Guarantee crack repairs for a period of 2 years following acceptance of the Work. Not more than 5 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 5 percent of the footage of cracks is judged to have failed, repair the failed cracks to the Engineer's satisfaction. If less than 5 percent of the cracks have failed, repairs will not be necessary. The Engineer will determine which cracks have failed.

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.

METHOD OF MEASUREMENT

628–4.1 METHOD OF MEASUREMENT. Crack Sealing Asphalt Pavement will be measured by the pound of sealant installed and accepted.

BASIS OF PAYMENT

628–5.1 BASIS OF PAYMENT. Crack Sealing Asphalt Pavement will be paid for at the Contract unit price per pound of crack sealant used. The price bid will be full compensation for labor, materials, equipment required to rout cracks, clean and dry, install sealant, and appurtenant Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P62801	Crack Sealing Asphalt Pavement, per pound.

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 will be included in the Pay Items contained in the Schedule of Prices.

MATERIAL REQUIREMENTS

ASTM D 3405	Joint Sealants, Hot–Poured, for Concrete and Asphalt Pavements

SPECIFICATION P–630. SAW CUTTING BITUMINOUS PAVEMENT

DESCRIPTION

630–1.1 DESCRIPTION. Work under this Specification includes sawing existing bituminous pavement at locations shown on Plans or directed by the Engineer. Make saw cuts to the full depth of the bituminous surface. Remove and dispose of waste material resulting from saw cutting operations.

METHOD OF MEASUREMENT

NOTE TO SPECIFIER:
When saw cutting existing pavement is required, the location should be shown on the Plans and a Pay Item included in the Schedule of Prices.

630–2.1 METHOD OF MEASUREMENT. Saw Cutting Bituminous Pavement will be measured by the linear foot of complete Work. Saw cuts beyond the limits shown on the Plans or directed by the Engineer will not be measured for payment.

BASIS OF PAYMENT

630–3.1 BASIS OF PAYMENT. Saw Cutting Bituminous Pavement, measured as provided above, will be paid for at the Contract unit price per linear foot, which price will be payment in full for all sawcuts and furnishing all labor, tools, equipment, and incidentals necessary to complete the Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P63001	Saw Cutting Bituminous Pavement, per lineal foot.

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 will be included in the Pay Items contained in the Schedule of Prices.

SPECIFICATION P–631. MILLING BITUMINOUS PAVEMENT

DESCRIPTION

631–1.1 DESCRIPTION. This Work consists of removing existing bituminous pavement by milling at the location and to the thickness indicated on the Plans, and includes hauling and disposing of the salvaged material. Milling may be required to construct butt joints, to restore pavement cross slopes, or for other purposes indicated on the Plans.

CONSTRUCTION METHODS

631–2.1 EQUIPMENT. Use a self-propelled milling machine that is especially designed and constructed for milling pavements. Mill without tearing or gouging the underlying surface. The machine shall consist of a cutting drum with carbide or diamond tip teeth. Space the teeth on the drum to mill a uniform surface free of large detrimental scarification marks. Shroud the drum to prevent discharge of loosened material into adjacent Work areas.

Furnish a dust control system. Equip the machine with electronic devices that will provide accurate depth, grade, and slope control.

631–2.2 CONSTRUCTION. Perform the milling operation in a manner to preclude damage to the remaining pavement intended to remain in place, which should result in a reasonably uniform plane surface, free of excessively large scarification marks, having a uniform transverse slope. Milling locations are shown on the Plans.

METHOD OF MEASUREMENT

631–3.1 METHOD OF MEASUREMENT. This Pay Item will be measured by area in square yards. The quantity to be measured for payment will be the area of pavement removed in accordance with the Plans.

BASIS OF PAYMENT

631–4.1 BASIS OF PAYMENT. Milling Bituminous Pavement, measured as provided herein, will be paid for at the Contract unit price per square yard, which price will be full compensation for milling, hauling, and disposing of milled bituminous pavement, and for furnishing all labor, equipment, tools, and incidentals necessary to complete the Work.

Standard Pay Items for the Work covered by this Specification are as follows:

Pay Item P63101	Milling Bituminous Pavement, per square yard.
Pay Item P63102	Milling Bituminous Pavement, Butt Joints, per square yard.

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 will be included in the Pay Items contained in the Schedule of Prices.

SPECIFICATION P–632. CONSTRUCTION FIELD FACILITIES

DESCRIPTION

632–1.1 DESCRIPTION. This Work consists of furnishing, placing or erecting, equipping, and maintaining field offices and field laboratories during the life of the Contract.

Furnish a field office when required by the Contract. The field office shall be of the type designated in the Contract.

Furnish a field laboratory when required by the Contract.

The Engineer will have sole use of the field facilities, and upon completion of the Contract the field facilities shall remain the property of the Contractor.

MATERIALS

632–2.1 GENERAL. Field offices and laboratories shall consist of mobile, house–type trailers or houses or other approved types that are floored, roofed and weatherproofed with a minimum ceiling height of 6 feet 9 inches. Equip them with suitable artificial lighting and adequate heating equipment with the necessary fuel to maintain a minimum temperature of 68°F (20°C) during the hours of occupancy. Maintain an adequate supply of potable water.

Provide and maintain suitable interior or exterior sanitary facilities meeting State and local health requirements in clean and good working condition and stocked with sanitary supplies at all times during the life of the Contract.

Provide a first aid kit in each field office and field laboratory provided under the Contract. The kits shall be readily accessible to project personnel. Check the contents of each kit at least once each week and replenish expended items. Each kit shall contain, 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.

In situations where the eyes or body of a worker may be exposed 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.

632–2.2 FIELD OFFICE. Provide the field office with two telephones and two exchange services at no cost to the Department. One telephone must include a suitable answering device. The Department staff will have sole use of the telephone. The cost of toll service incurred by the Department staff is not the responsibility of the Contractor.

Air Condition all field offices.

Equip the outside doors of field offices with heavy duty hasps bolted through the door and jamb and with heavy duty padlocks.

Securely fasten heavy screening over all windows. The screening shall be No. 2 mesh, 14 gauge or heavier steel wire cloth galvanized after weaving.

Field Office, Type A, shall have minimum exterior dimensions of 8 feet (2.4 m) in width and 12 feet (3.7 m) in length, excluding hitch, and shall be equipped with the following: Minimum electrical service of 60 amperes and 120 volts AC, one air conditioner, at least two windows with provision for cross–ventilation and equipped with adequate locks and screens, an outside door with an adequate lock and screen, a suitable work table, an office chair, a drafter's stool and a 6 pound or larger fire extinguisher meeting the requirements for Classes A, B, and C of the National Fire Protection Association (NFPA) Code.

Field Office, Type B, shall have minimum exterior dimensions of 8 feet (2.4 m) in width and 20 feet (6.1 m) in length, excluding hitch, and shall be equipped with the following: Minimum electrical service of 60 amperes and 120 volts AC, two rooms, an interior door and padlock, at least four windows with provision for cross–ventilation and equipped with adequate locks and screens, at least one outside door with required lock and screen, one suitable drafting table, two suitable office desks with drawers and locks, two office chairs, one drafter's stool and a 6 pound or larger fire extinguisher meeting the requirements for Classes A, B, and C of the NFPA Code.

Field Office, Type C, shall have minimum exterior dimensions of 10 feet (3.0 m) in width and 30 feet (9.1 m) in length, excluding hitch, and shall be equipped with the following: Minimum electrical service of 100 amperes and 120 volts AC, two rooms each with an air conditioner and an exterior door with required lock and screen, an interior door with padlock, at least four windows with provision for cross–ventilation and equipped with adequate locks and screens, one suitable drafting table, two suitable office desks with drawers and locks, two office chairs, one drafter's stool and a 6 pound or larger fire extinguisher meeting the requirements for Classes A, B and C of the NFPA Code.

632–2.3 FIELD LABORATORY. The Field Laboratory shall have minimum interior dimensions of 8 feet (2.4 m) in width and 16 feet (4.9 m) in length, excluding hitch, and shall be equipped with the following: At least four windows with provision for cross ventilation and equipped with required locks and screens, an outside door with required lock and screen, a suitable work bench, a minimum of 15 linear feet (4.6 m) of shelving approximately 14 inches (360 mm) wide, an adequate water supply for testing purposes, and a 6 pound or larger fire extinguisher meeting the requirements for Class A, B and C of the NFPA code.

Equip the outside doors of field laboratories with heavy duty hasps bolted through the door and jamb and with heavy duty padlocks.

Fasten securely heavy screening over all windows. The screening shall be No. 2 mesh, 14 gage or heavier steel wire cloth galvanized after weaving.

Equip the laboratory with a suitable fan having a minimum capacity of 1,000 cubic feet (28.3 m^3) per minute, in good working condition. The fan should be installed in an outside wall above the work bench used for asphaltic extraction testing. Enclose the fan inlet and work bench top in a suitable hood or enclosure that will permit effective exhaustion by the fan of the fumes from the extraction testing.

CONSTRUCTION METHODS

632–3.1 CONSTRUCTION METHODS. Do not combine field offices and field laboratories, together or attach them to any buildings used by the Contractor, unless permitted by the Engineer in writing. Anchor or secure field offices and field laboratories to preclude overturning caused by high velocity winds. Locate the field office in a dust–reduced and vibration–free environment.

Do not start construction operations until the required field office and laboratory are furnished, leveled, secured, and made ready for use at locations directed by the Engineer.

The Contractor may elect, when permitted by the Contract, to furnish field office and field laboratory facilities jointly in cooperation with other contractors on designated projects.

Upon completion of the Contract, remove construction field facilities and restore the site to the condition that existed prior to Construction.

METHOD OF MEASUREMENT

632–4.1 FIELD OFFICE. Field Office of the type designated will be measured for payment as a single complete unit of work, per lump sum furnished, equipped and satisfactorily maintained.

632–4.2 FIELD LABORATORY. Field Laboratory will be measured for payment as a single complete unit of work per lump sum furnished, equipped and satisfactorily maintained.

BASIS OF PAYMENT

632–5.1 BASIS OF PAYMENT. These Pay Items, measured as provided above, will be paid for at the Contract lump sum price for Field Office or Field Laboratory, which price will be payment in full for furnishing, equipping, securing and maintaining the facility; for furnishing utilities, fuel, ventilation and toilet facilities as required, equipment, telephone and telephone exchange service for the life of the Contract; and for removing the facility and restoring the site. The cost of telephone toll service incurred by the Engineer will not be chargeable to the Contractor.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P63201	Field Office, Type A, per lump sum.
Pay Item P63202	Field Office, Type B, per lump sum.
Pay Item P63203	Field Office, Type C, per lump sum.
Pay Item P63204	Field Laboratory, per lump sum.

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.

SPECIFICATION P–634. TRAFFIC CONTROL

DESCRIPTION

634-1.1 DESCRIPTION. This Work consists of furnishing, erecting, maintaining and removing traffic signs, drums, barricades, lights and signals, and shall include flagging and guidance of traffic as required for the Contractor to conduct construction operations. Do this Work in accordance with requirements shown on the Construction Operations Sheet and the latest revision of Part VI, Traffic Controls for Construction and Maintenance Operations of the Wisconsin Manual of Traffic Control Devices. Do not use sign sizes smaller than the standard sizes described in the manual.

NOTE TO SPECIFIER:
The WBOA provisions for operations on the Airport, the requirements of AC 150/5370–3C, and project phasing should be coordinated with this Specification and the Construction Operations Sheet contained in the Plans. A scope of the Work required under the Pay Item for Traffic Control should be included on the Construction Operations Sheet or in the Special Provisions.

MATERIALS

634–2.1 GENERAL. Materials used in the Work shall conform to the requirements specified in the Manual of Traffic Control Devices and the following:

Traffic Control shall be in accordance with the FHWA's Manual of Standard Highway Signs and the Construction Operations Sheet.

The materials and methods of manufacture and assembly of all signs shall be in accordance with the requirements for Type II Signs as specified in Section 637 of the State of Wisconsin, Department of Transportation Standard Specifications for Road and Bridge Construction (State Highway Specifications), except that a good exterior Grade A–B plywood with a ½ inch minimum thickness will be acceptable as a sign base alternate and the sign face colors shall include the color orange described in the Manual of Traffic Control Devices.

The sign face material for signs R1–1 (STOP), R1–2 (YIELD), R5–1 (DO NOT ENTER), and R5–1a (or R5–9) (WRONG WAY) shall conform to the requirements of Subsection 637.2.2.2 of the State Highway Specifications, Type H Reflective Sheeting. All other sign face material shall conform to the requirements of Subsection 637.2.2.1 of the State Highway Specifications, Standard Reflective Sheeting, unless otherwise provided.

Keep retroreflective sheeting on signs, drums, barricades, and other devices clean. Promptly correct scratches, rips, and tears in the sheeting.

Maintain the retroreflectance of all orange signs and all drums, posts and barricades at a level not less than 75 percent of the minimum value required in Subsection 637.2.2.1 of the State Highway Specifications for Standard Reflective Sheeting and not less than 50 percent of the minimum value required in Subsection 637.2.2.2 of the State Highway Specifications for Type H Reflective Sheeting.

634–2.2 DRUMS. Make drums for traffic control of nonmetallic material. Fabricate each drum to accept, and equip with a Type C Steady Burn or Type A Low Intensity Flashing Warning Light securely attached to the drum. Weight each drum sufficiently with sand bags or other approved material to keep the drum in its intended location.

The material used for reflectorization shall conform to the requirements of Subsection 637.2.2.2 of the State Highway Specifications, Type H Reflective Sheeting and shall be suitable for use on reboundable traffic control devices.

634–2.3 BARRICADES. The reflective sheeting for all barricades shall conform to the requirements of Subsection 637.2.2.2 of the State Highway Specifications, Type H reflective sheeting, designed specifically for use on rigid traffic control devices.

634–2.4 HAND SIGNALING DEVICES. Use a sign paddle as the primary hand–signaling device. Limit flag use to emergency situations.

CONSTRUCTION METHODS

634–3.1 GENERAL. Review all traffic signs and control devices furnished for location, position, visibility, adequacy and manner of use under specific job conditions at least once every 24 hours and more frequently as necessary to assure that all such signs and control devices are continuously in compliance with the requirements of this Section.

Provide equipment, forces and materials to promptly restore traffic control devices that are damaged or disturbed. The cost of maintaining and restoring these devices shall be considered incidental and no additional or separate payment will be made.

All traffic control devices are the property of the Contractor upon completion of the Work.

Show the name and telephone number of the agency, Contractor, supplier or person responsible for 24–hour emergency service on the back face of each sign, a rail of each barricade and on each drum in letters at least 3/4 inch (19 mm) in height.

When the Plans or Special Provisions contain specific sign details, sequence of erection or special instructions for handling traffic, do the Work accordingly, unless otherwise directed by the Engineer.

Properly place and have in operation signs and control devices before construction Work affected by such signs or devices can begin. When Work is phased, perform necessary relocation of signs as required.

634–3.2 SIGNS. When the sign message is not pertinent, promptly remove the sign or completely cover the sign face so the reflectively of the sign face is not evident.

634–3.3 WARNING LIGHTS.

Type B. Mount each Type B light installed in conjunction with a warning sign on the back of the sign. Position the light so the lens is outside the edge of the sign, to the traffic side of the sign and between the midpoint and the top of the sign. Use a one–way or lens–directed light to be visible only to traffic approaching the message side of the sign, unless otherwise ordered by the Engineer.

Types A and C. Mount each Type A (flashing) light installed in conjunction with a warning sign on the back of the sign. Position the light so the lens is outside the edge of the sign, to the traffic side of the sign and between the midpoint and the top of the sign. The light shall be one–way or lens–directed to be visible only to traffic approaching the message side of the sign, unless otherwise ordered by the Engineer.

634–3.4 RUNWAY AND TAXIWAY CLOSED CROSSES. Provide temporary runway and taxiway closed crosses in accordance with the Construction Operations Sheet and detail shown on the Plans. Coordinate temporary runway and taxiway closings with the Airport Manager and place, maintain, remove, and replace as required to construct the Work.

METHOD OF MEASUREMENT

634–4.1 TRAFFIC CONTROL. Traffic Control will be measured as a single complete unit of Work per lump sum, acceptably performed.

BASIS OF PAYMENT

634–5.1 BASIS OF PAYMENT. Traffic Control, measured as provided above, will be paid for at the Contract lump sum price for Traffic Control, which price will be full compensation for constructing, assembling, painting, hauling, erecting, re–erecting, maintaining and removing traffic signs, drums, barricades and similar control devices; for furnishing, placing and maintaining lights and signals; for supplying and performing all flagging and guidance services; and for all labor, tools, equipment, services and incidentals necessary to complete the Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P63401	Traffic Control, per lump sum

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 will be included in the Pay Items contained in the Schedule of Prices.

SPECIFICATION P–635. GEOTEXTILE FABRICS

DESCRIPTION

635–1.1 DESCRIPTION. This Work consists of furnishing and installing geotextile fabrics for subgrade separation and stabilization, drainage filtration, subgrade reinforcement, and under culverts and riprap in accordance with the Contract Documents.

MATERIALS

635–2.1 GENERAL. The geotextile fabric shall consist of either woven or nonwoven polyester, polypropylene, stabilized nylon, polyethylene or polyvinylidene chloride. All fabric shall have the minimum strength values in the weakest principle direction. Nonwoven fabric may be needle punched, heat bonded, resin bonded, or combinations thereof.

The geotextile fabric shall be insect, rodent, mildew, and rot resistant.

Furnish the geotextile fabric in a wrapping that will protect the fabric from ultraviolet radiation and from abrasion due to shipping and hauling. The geotextile is to be kept dry until installed.

Clearly mark the geotextile fabric rolls showing the type of fabric.

Samples of fabric for testing may be obtained from the job site as specified herein or as determined by the Engineer.

If sewn seams are used, furnish a field sewn seam sample produced from the geotextile fabric and thread and with the equipment to be used on the project, prior to its incorporation into the Work.

Minimum values when not specified herein shall be as specified in the Special Provisions.

In the following tables, numerical values (1) represent minimum/maximum average roll values (i.e., the average of minimum test results on rolls in a lot should meet or exceed the minimum specified values).

635–2.2 GEOTEXTILE FABRIC, TYPE SAS (Subgrade Aggregate Separation). The fabric shall comply with the following physical properties

TABLE 1. GEOTEXTILE FABRIC, TYPE SAS

Test	*Method*	*Value*$_{(1)}$
Grab Tensile Strength, N	ASTM D–4632	750 minimum
Puncture Strength, N	ASTM D 4833	300 minimum
Apparent Opening Size, µm (U.S. Standard Sieve)	ASTM D 4751	212 maximum
Permittivity, S-1	ASTM D 4491	0.35 minimum

For quantities over 20,000 square yards (17,000 m^2), furnish to the Engineer at least 10 days prior to use in the Work a manufacturer's Certified Report of Test or Analysis that the geotextile fabric delivered for use in the Work meets the above requirements. The delivered geotextile fabric shall bear markings to clearly identify it with the applicable test report furnished to the Engineer. Samples of fabric for testing will be obtained from the job site for each 20,000 square yards (17,000 m^2) or portion thereof used in the Work.

635–2.3 GEOTEXTILE FABRIC, TYPE MS (Marsh Stabilization). The following test methods will be used to confirm the values shown in the Special Provisions or shown on the Plans.

TABLE 2. GEOTEXTILE FABRIC, TYPE MS

Test	*Method*	*Value*$_{(1)}$
Tensile Strength (N/m) machine direction	ASTM D 4595	___ minimum
Tensile Strength (N/m) cross direction	ASTM D 4595	___ minimum
Elongation at Required Strength (%)	ASTM D 4595	___maximum
Puncture, (N)	ASTM D 4833	___ minimum
Apparent Opening Size, µm	ASTM D 4751	___maximum
Permittivity, S-1	ASTM D 4491	___ minimum

Deliver to the Engineer a sample of the geotextile material at least 15 days prior to its incorporation into the Work. At the same time, also 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.

Furnish to the Engineer at least 15 days prior to use in the Work a Manufacturer's Certified Report of Test or Analysis that the geotextile fabric delivered for use in the Work meets the above requirements. The delivered geotextile fabric shall bear markings to clearly identify it with the applicable test report furnished to the Engineer. Samples of fabric for testing will be obtained from the job site for each 10,000 square yards (8500 m^2) or portion thereof used on the Contract.

635–2.4 GEOTEXTILE FABRIC, TYPE DF (Drainage Filtration). The fabric shall comply with the physical requirements of Table 3A unless Table 3B (Schedule B) is indicated on the Plans or in the Special Provisions.

TABLE 3A. GEOTEXTILE FABRIC, TYPE DF, SCHEDULE A

Test	*Method*	*Value*$_{(1)}$
Grab Tensile Strength, N	ASTM D 4632	500 minimum
Puncture Strength, N	ASTM D 4833	200 minimum
Apparent Breaking Elongation (%)	ASTM D 4632	30 minimum
Apparent Opening Size, µm	ASTM D 4751	300 maximum
Permittivity, S-1	ASTM D 4491	0.72 minimum

TABLE 3B. GEOTEXTILE FABRIC, TYPE DF, SCHEDULE B

Test	*Method*	*Value*$_{(1)}$
Grab Tensile Strength, N	ASTM D 4632	800 minimum
Puncture Strength, N	ASTM D 4833	300 minimum
Apparent Breaking Elongation (%)	ASTM D 4632	30 minimum
Apparent Opening Size, µm	ASTM D 4751	300 maximum
Permittivity, S-1	ASTM D 4491	1.35 minimum

Slit film woven fabric shall not be used for this Work.

For quantities over 2,000 square yards (1700 m^2), furnish to the Engineer at least 10 days prior to use in the Work a manufacturer's Certified Report of Test or Analysis that the geotextile fabric delivered for use in the Work meets the above requirements. The delivered geotextile fabric shall bear markings to clearly identify it with the applicable test report furnished to the Engineer. Samples of fabric for testing will be obtained from the job site for each 2,000 square yards (1700 m^2) or portion thereof used in the Work.

635–2.5 GEOTEXTILE FABRIC, TYPE SR (Subgrade Reinforcement). The following test methods will be used to confirm the values shown in the Special Provisions or shown on the Plans.

TABLE 4. GEOTEXTILE FABRIC, TYPE SR

Test	*Method*	*Value*$_{(1)}$
Tensile Strength, N/m	ASTM D 4595	minimum
Puncture Strength, N	ASTM D 4833	minimum
Elongation at Required Strength (%)	ASTM D 4595	maximum
Apparent Opening Size, µm	ASTM D 4751	maximum
Permittivity, S-1	ASTM D 4491	minimum

For quantities over 10,000 square yards (8500 m^2), furnish to the Engineer at least 10 days prior to use in the Work a Manufacturer's Certified Report of Test or Analysis that the geotextile fabric delivered for use in the Work meets the above requirements. The delivered geotextile fabric shall bear markings to clearly identify it with the applicable test report furnished to the Engineer. Samples of fabric for testing will be obtained from the job site for each 10,000 square yards (8500 m^2) or portion thereof used on this Contract.

635–2.6 GEOTEXTILE FABRIC, TYPE R (Riprap). The fabric shall comply with the following physical properties:

TABLE 5. GEOTEXTILE FABRIC, TYPE R

Test	*Method*	*Value*$_{(1)}$
Grab Tensile Strength, N	ASTM D 4632	900 minimum
Puncture Strength, N	ASTM D 4833	350 minimum
Apparent Breaking Elongation (%)	ASTM D 4632	20 minimum
Apparent Opening Size, µm	ASTM D 4751	600 maximum
Permittivity, S-1	ASTM D 4491	0.12 minimum

635–2.7 GEOTEXTILE FABRIC, TYPE HR (Heavy Riprap). The fabric shall comply with the following physical properties:

TABLE 6. GEOTEXTILE FABRIC, TYPE HR

Test	*Method*	*Value*$_{(1)}$
Grab Tensile Strength, N	ASTM D 4632	1350 minimum
Puncture Strength, N	ASTM D 4833	450 minimum
Apparent Breaking Elongation (%)	ASTM D 4632	20 minimum
Apparent Opening Size, µm	ASTM D 4751	600 maximum
Permittivity, S-1	ASTM D 4491	0.40 minimum

635–2.8 GEOTEXTILE FABRIC, TYPE C (Modified SAS). The fabric shall comply with the following physical properties:

TABLE 7. GEOTEXTILE FABRIC, TYPE C

Test	*Method*	*Value*$_{(1)}$
Grab Tensile Strength, N	ASTM D 4632	900 minimum
Puncture Strength, N	ASTM D 4833	300 minimum
Apparent Opening Size, µm	ASTM D 4751	300 maximum
Permittivity, S-1	ASTM D 4491	0.12 minimum

635–2.9 GEOTEXTILE FABRIC, TYPE ES (Embankment Stabilization). The following test methods shall be used to confirm the values required in the Contract Document..

TABLE 8. GEOTEXTILE FABRIC, TYPE ES

Test	*Method*	*Value*$_{(1)}$
Tensile Strength, N/m Machine Direction	ASTM D 4595	___ minimum
Tensile Strength, N/m Cross Direction	ASTM D 4595	___ minimum
Elongation at Required Strength, Percent	ASTM D 4595	___ maximum
Apparent Opening Size, µm	ASTM D 4751	___ maximum
Permittivity, S-1	ASTM D 4491	___ minimum

Deliver to the Engineer a sample of the geotextile material at least 15 days prior to its incorporation into the Work. At the same time, also 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.

Furnish to the Engineer at least 15 days prior to use in the Work a manufacturer's Certified Report of Test or Analysis that the geotextile fabric delivered for use in the Work meets the above requirements. The delivered geotextile fabric shall bear markings to clearly identify it with the applicable test report furnished to the Engineer. Samples of fabric for testing will be obtained from the job site for each 10,000 m^2 or portion thereof used on the Contract.

CONSTRUCTION METHODS

635–3.1 SEWING. Sew all factory and field seams with a thread having the same or greater durability as the material in the fabric. Use a 401 stitch conforming to Federal Standard No. 751a for all seams. All seams should develop a tensile strength equal to or greater than 60 percent of the specified grab tensile strength of the fabric, unless otherwise specified.

635–3.2 GEOTEXTILE FABRIC, TYPE SAS. Smooth, shape, and compact the subgrade to the required grade, section, and density prior to the placement of the geotextile fabric. After the fabric has been placed on the subgrade area, no traffic or construction equipment will be permitted to travel directly on the fabric.

Roll out the fabric on the subgrade and pull taut manually to remove wrinkles. Join separate pieces of fabric by overlapping or sewing. Place the fabric in the overlapped joints with a minimum overlap of 18 inches (460 mm).

Weight or pins may be required to prevent lifting of the fabric by wind.

After placement, expose the fabric no longer than 48 hours prior to covering.

Place the base course material over the fabric by back dumping with trucks and leveling with a crawler dozer. Construction equipment shall be such that ruts do not exceed 3 inches in depth. Fill all ruts with additional material. The smoothing of ruts without adding additional material will not be permitted. Cover damaged areas with a patch of fabric using a 3 foot (0.9 m) overlap in all directions.

635–3.3 GEOTEXTILE FABRIC, TYPE MS. Complete clearing operations prior to placement of the fabric. Within the area to be covered by fabric, cut off level with the ground surface all stumps and sharp objects. Do not remove sod, grass, and roots that extend beneath the ground surface. Carefully place the geotextile fabric on the existing ground using hand methods to avoid disturbing the existing root mat and vegetation. Roll out the fabric as smoothly as possible and pull taut manually to remove wrinkles. Weight or pins may be required to prevent lifting of the fabric by wind. After placement, expose the fabric no longer than 48 hours prior to covering. If defects are observed, replace the section of the fabric containing the defect with a new section of fabric containing no defects.

Place the geotextile fabric with the machine direction of fabric perpendicular to the centerline alignment. Sew all seams with a minimum lap of 3 inches (75 mm) using two parallel stitch lines. The parallel stitching should be spaced no more than 1 inch apart. Orient all seams perpendicular to the centerline alignment and shall be placed facing upward. The seams shall develop at least 80 percent of the specified cross direction tensile strength of the fabric, as determined by the same testing methods. No butt splices between individual roll ends will be allowed. Do not cross stitch lines. Repair all breaks or faults in any seam as directed by the Engineer.

Carefully bend, dump, and push on to the fabric, the initial fill layer to a nominal 2-foot depth (610 mm) depth. Construction equipment will be such that ruts do not exceed 3 inches (75 mm) in depth and excessive deformation of the marsh surface does not occur. Do not allow vehicles to drive on the fabric. Complete the initial 2 foot (610 mm) lift and install all instrumentation before any additional material is placed. After the initial 2 foot (610 mm) lift, all subsequent lifts shall be of a nominal 1 foot (305 mm) depth. Do not start a lift until the preceding lift is completed and approval of the Engineer is obtained. Conduct spreading operations so that damage to the fabric does not occur. Unless otherwise directed by the Engineer, place and spread lifts by expanding outward from the center line of the fill. If the fabric is damaged during fill placement, remove the fill material around the damaged area and cover that area with a patch of fabric having a 3 foot (0.9 m) overlap in all directions.

635–3.4 GEOTEXTILE FABRIC, TYPE DF. Before placement of the geotextile fabric in trench drains, bring the trench to the grades and dimensions shown on the Plans. Remove protruding stones and other items that may damage the geotextile fabric from the trench walls and base prior to placement of the fabric. Place the geotextile fabric in the trench in such a manner as to conform to the trench walls and remain in proper position during drain construction and backfilling. Separate pieces of fabric may be joined by overlapping or sewing. Place the fabric in overlap joints with a minimum overlap of 1.5 feet (450 mm) in the direction of drain flow. Correct misaligned fabric. Damaged fabric areas shall be treated as directed by the Engineer, by either:

a. Placing an additional section of fabric extending at least 2.0 feet (600 mm) beyond any point of the damaged area and positioned between the trench walls and the damaged fabric; or

b. Removing the section of fabric containing the damaged area and replacing it with a new section of fabric. After placement, the fabric shall remain exposed no longer than 48 hours prior to covering.

For applications other than trench drains, bring to the grades and dimension shown on the Plan the surface upon which the fabric is to be located. Prepare the application surface by removing or covering all objects that may damage the fabric. Carefully place the fabric to prevent damage and secure it in position. Conduct backfilling or covering operations in such a manner so as to prevent damage or misalignment of the fabric. Treat damage or misalignment of the fabric as described previously in this Subsection. After placement, expose the fabric no longer than 48 hours prior to covering or backfilling.

635–3.5 GEOTEXTILE FABRIC, TYPE SR. Prior to placement of the fabric, smooth and shape the earth grade to the required grade and section, and when required, compact it to the specified density. After the fabric has been placed on the earth grade, no traffic or construction equipment will be permitted to travel directly on the fabric.

Roll the fabric out on the earth and pull it taut manually to remove wrinkles. Join parallel strips of fabric by overlapping or sewing. Sewn seams shall comply with the requirements of Subsection 635-3.1, but shall develop a tensile strength equal to or greater than 60 percent of the specified directional tensile strength of the fabric. Place the fabric in the overlapped joints with a minimum overlap of 24 inches (610 mm). Lapp butt splices between fabric rolls a minimum of 36 inches (0.9 m). After the fabric has been placed on the prepared surface, make provisions to prevent the fabric from being lifted or moved by the wind.

Cover tears, holes, or rips in the fabric with a patch of fabric overlapping the defect 3 feet (0.9 m) in all directions.

Cover all fabric within 72 hours of the time of placement.

Place the backfill material with an initial lift of 12 inches (305 mm). Do not exceed 12 inches (305 mm) in thickness for subsequent lifts. Spread each lift with a crawler type tractor and compact it with suitable compaction equipment. Do not exceed 4 inches for the maximum wheel or tread rut depth caused by the operation of construction equipment on backfill lifts. No turning movements for hauling or spreading equipment will be allowed over the fabric until at least two lifts of backfill with a minimum total depth of 18 inches (460 mm) have been placed and compacted. Subsequent lifts may not be started until at least 1,000 feet (305 m) of the previous lift has been spread and compacted. A 1,000 foot (305 m) interval shall be maintained between subsequent lifts until each lift is completed. If ruts greater than 4 inches (100 mm) develop during construction operations, the Engineer reserves the right to require the Contractor to use lighter equipment, equipment with lower contact pressure, or smaller loads on existing equipment.

Fill all ruts in the surface of each lift of backfill with additional material. Smoothing of ruts without adding additional backfill will not be permitted.

635–3.6 GEOTEXTILE FABRIC, TYPE R. Grade the area smooth and remove all stones, roots, sticks, or other foreign material that would interfere with the fabric being completely in contact with the soil prior to placing the fabric.

Place the fabric loosely and lay it parallel to the direction of water movement. Pinning or stapling may be required to hold the geotextile in place. Join separate pieces of fabric by overlapping or sewing. Place the fabric in the overlapped joints with a minimum overlap of 24 inches (610 mm) in the direction of flow. After placement, do not expose the fabric longer than 48 hours prior to covering.

Cover damaged areas with a patch of fabric using a 3 foot (0.9 m) overlap in all directions.

Placement of riprap shall be from the base of the slope upward. Height of freefall of riprap shall be determined by the Engineer but in no case shall this height exceed 1 foot (305 mm).

635–3.7 GEOTEXTILE FABRIC, TYPE HR. The construction methods for Type HR fabric shall conform to the requirements of Subsection 635–3.6, except that the height of freefall of riprap shall not exceed 6 inches (150 mm).

635–3.8 GEOTEXTILE FABRIC, TYPE C. Prior to the placement of geotextile fabric, grade the earth smooth and shape it to the required grade and section. After the fabric has been placed, no traffic or construction equipment will be permitted to travel directly on the fabric.

Roll out the fabric on the excavation and manually pull it taut to remove wrinkles. Join separate pieces of fabric by overlapping or sewing. Place the fabric in the overlapped joints with a minimum overlap of 18 inches (460 mm). Weights or pins may be required to prevent lifting of the fabric by wind.

After placement, do not expose the fabric longer than 48 hours prior to covering.

Place the granular material over the fabric. Construction equipment shall be such that ruts do not exceed 3 inches (75 mm) in depth. Fill all ruts with additional material. The smoothing of ruts without adding additional material will not be permitted.

Cover damaged areas with a patch of fabric using a 3 foot (0.9 m) overlap in all directions.

635-3.9 GEOTEXTILE FABRIC, TYPE ES. Prior to placing the geotextile fabric, bring the embankment to the required elevation and make the surface nominally smooth and level. Place the fabric on the prepared surface to the limits shown on the Plan with the machine

direction of the fabric oriented in the direction or directions shown on the Plan. Roll out the fabric as smoothly as possible and manually pull it taut to remove wrinkles. Restrain the fabric as needed to prevent lifting and displacement due to wind. After placement, expose the fabric no longer than 48 hours prior to covering. If defects or damage to the fabric are observed, remove the section of fabric containing the defect or damage and replace it with a new section of fabric without defects or damage.

Sew all seams between fabric strips with two parallel stitch lines spaced no more than 25 mm apart in accordance with the details shown on the Plan. 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 material in the fabric. Use a 401 stitch conforming to Federal Standard No 751a for all seams. All seams shall 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 any seam as directed by the Engineer. Butt splices between individual roll ends will not be allowed.

The initial fill layer over fabric layers shall not be less than 8 inches (200 mm) or more than 12 inches (300 mm). Carefully end dump and push this lift on to the fabric. Spreading operations and equipment shall not cause displacement and damage to the fabric. Sharp turning movements are not permitted while placing the initial lift over individual fabric layers. Vehicles are not allowed to drive on the fabric. No lift may be started until the preceding lift is completed. Place and compact additional lifts in accordance with Section P-152 of the Standard Specifications.

Unless otherwise specified, all fill material placed in the zone from at least 8 inches (200 mm) below to at least 8 inches (200 mm) above any single or multiple layer geotextile installation shall be a granular material meeting the requirements as presented in the Plans and Special Provisions of the project.

METHOD OF MEASUREMENT

635–4.1 METHOD OF MEASUREMENT. Geotextile Fabric, Type SAS; Geotextile Fabric, Type MS; Geotextile Fabric, Type DF; Geotextile Fabric, Type SR; Geotextile Fabric, Type R; Geotextile Fabric, Type HR; and Geotextile Fabric, Type C; will each be measured by the square yard of surface area upon which the fabric has been placed and accepted in accordance with the Contract.

BASIS OF PAYMENT

635–5.1 BASIS OF PAYMENT. Geotextile Fabric, Type SAS; Geotextile Fabric, Type DF; and Geotextile Fabric, Type SR; and Geotextile Fabric, Type C; measured as provided above, will each be paid for at the Contract unit price per square yard, which price will be full compensation for furnishing, transporting, and installing the fabric; and for furnishing all labor, tools and equipment necessary to complete the Work.

Geotextile Fabric, Type MS; Geotextile Fabric, Type ES: Geotextile Fabric, Type R; and Geotextile Fabric, Type HR, measured as provided above, will each be paid for at the Contract unit price per square yard, which price will be full compensation for preparing the marsh area or foundation; for furnishing, transporting, and placing the fabric; and for furnishing all labor, tools and equipment necessary to complete the Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P63501	Geotextile Fabric, Type SAS, per square yard
Pay Item P63502	Geotextile Fabric, Type MS, per square yard
Pay Item P63503	Geotextile Fabric, Type DF, per square yard
Pay Item P63504	Geotextile Fabric, Type SR, per square yard
Pay Item P63505	Geotextile Fabric, Type R, per square yard
Pay Item P63506	Geotextile Fabric, Type HR, per square yard
Pay Item P63507	Geotextile Fabric, Type C, per square yard
Pay Item P63508	Geotextile Fabric, Type ES, per square yard

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 will be included in the Pay Items contained in the Schedule of Prices.

TESTING REQUIREMENTS

ASTM D 4595	Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D 4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D 4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile
ASTM D 4833	

SPECIFICATION P–638. RIPRAP

DESCRIPTION

638–1 DESCRIPTION. This Work consists of furnishing and placing riprap, (with or without grout), medium random riprap or heavy riprap, as the case may be, in accordance with the requirements of the Plans and Specifications.

MATERIALS

638–2.1 MATERIALS. Stone used for Riprap Materials under this Specification shall meet the requirements for the class of material specified.

Stone for riprap shall be durable field or quarry stone of approved quality. It shall be sound, hard, dense, resistant to the action of air and water, and free from seams, cracks or other structural defects.

Stone pieces for Riprap shall be of a size and shape approved by the Engineer and, except for those used for chinking, shall range in weight from approximately 25 to 150 pounds (11 to 68 Kg), with not less than approximately 50 percent of the pieces weighing more than 60 pounds (27 Kg).

Stone pieces for Medium Random Riprap shall be well graded ranging in weight up to 200 pounds (90 Kg) or more. Not less than approximately 50 percent of the total volume shall consist of pieces weighing 80 pounds (36 Kg) or more with not less than 80 percent weighing 15 pounds (7 Kg) or more.

Stone pieces for Heavy Riprap shall be of a size and shape approved by the Engineer and shall be well graded, ranging in weight up to 400 pounds (181 Kg) or more. Not less than approximately 50 percent of the total volume shall consist of pieces weighing 150 pounds (68 Kg) or more, and not less than approximately 80 percent of the total volume shall consist of pieces weighing 40 pounds (18 Kg) or more.

When provided, waste concrete slabs may be substituted for the above–designated stone. In this case, the concrete shall be sound, and free of reinforcement and the slabs shall meet the size requirements as specified for stone.

638–2.2 MORTAR FOR GROUTED RIPRAP. General. Materials used in the Work shall meet the requirements specified for the class of material named.

Portland cement and water shall meet the requirements of Specification P–610.

Unless otherwise directed, Portland cement may be either Type I or Type IA.

Masonry cement shall conform to the requirements for Masonry Cement, ASTM Designation: C 91, Type S.

Hydrated lime shall conform to the requirements of Type S, Special Hydrated Lime for Masonry Purposes, ASTM Designation: C 207.

Sand for Mortar. Sand furnished for mortar shall conform to the pertinent requirements of ASTM C–144, except as modified herein. It shall consist of sand composed of clean, hard, tough, durable grains of approved inert materials from natural deposits and meet the gradations given below.

Mortar Strength. Sand for mortar, when subjected to the mortar strength test, shall have a tensile or compressive strength at the age of 3 days and 7 days of not less than 85 percent of that developed by mortar of the same proportions and consistency, made of the same cement and standard Ottawa sand.

Size Requirements. Sand shall be uniformly graded from coarse to fine and shall conform to the following gradation requirements:

	Percent
Passing a No. 8 sieve	95–100
Passing a No. 100 sieve	25 max.

Passing a No. 200 sieve.....10 max.

Mortar. Unless otherwise provided, mortar for laying the stone and pointing shall be composed of three parts of sand for mortar and one part of any one of the following materials, by volume: masonry cement, a mixture of 50 percent Portland cement and 50 percent masonry cement or a mixture of 50 percent Portland cement and 50 percent hydrated lime.

Machine mix mortar unless otherwise permitted by the Engineer. Prepare machine mixed mortar in an approved mixer and do not mix for less than 1–1/2 minutes. In the preparation of hand–mixed mortar, thoroughly mix the sand and cement in a clean, tight mortar box until the mixture is of uniform color, after which add clean water to form a stiff paste. Do not use mortar that has been mixed longer than 30 minutes or which has developed its initial set.

CONSTRUCTION METHODS

638–3.1 EXCAVATION. Properly trim and shape the bed for the riprap.

638–3.2 PLACING RIPRAP. Hand place stone placed above the waterline. Lay it with close, broken joints and firmly embed 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 to that the finished surface presents an even, tight surface. Place the larger stone in the lower courses. Chink interstices between stones with spalls firmly rammed into place.

Unless otherwise provided, riprap shall be at least 12 inches (305 mm) thick, measured perpendicular to the slope.

Do not place riprap against or in contact with any concrete masonry surface prior to the expiration of the curing and protection period therefor.

638–3.3 PLACING MEDIUM RANDOM AND HEAVY RIPRAP. Medium random and heavy riprap may be placed by mechanical means that will produce a completed job within reasonable tolerances of the typical section shown on the Plans. Unless otherwise provided on the Plans, heavy riprap cannot be not less than 24 inches (610 mm) thick and medium random riprap cannot be not less than 18 inches thick (460 mm). Limit hand work to the amount necessary to fill large voids or to correct segregated areas. Place riprap from the base of the slope upward. Riprap freefall shall not exceed 6 inches.

638–3.4 GROUTED RIPRAP. When grouted riprap is specified, lay the stone as set forth above for riprap placed above the water line. Fill the spaces between the stones with cement mortar. Use sufficient mortar to completely fill all voids, except leave the face surface of the stone exposed.

Place grout from bottom to top and sweep the surface with a stiff broom. After grouting is completed, cure the surface in accordance with Specification P–501.

METHOD OF MEASUREMENT

638–4 METHOD OF MEASUREMENT. Riprap will be measured by the cubic yard in place in the completed Work, and the quantity to be paid will be the summation of cubic yards of such riprap incorporated in the Work in accordance with the Contract. Only accepted Work will be measured for payment and the computation of the quantity will be based on the volume within the limiting dimensions designated on the Plans, in the Contract or established by the Engineer.

BASIS OF PAYMENT

638–5.1 MEDIUM RANDOM RIPRAP AND HEAVY RIPRAP These Pay Items, measured as provided above, will be paid for at the Contract unit price per cubic yard for Riprap, Medium Random Riprap or Heavy Riprap, as the case may be, and that Contract unit price will be payment in full for excavation and preparation of the bed, including backfilling and disposal of surplus material; for furnishing and placing riprap; for restoring the site of the Work; and for furnishing all equipment, tools, labor and incidentals necessary to complete the Work in accordance with the Contract.

638–5.2 GROUTED RIPRAP. This Pay Item, measured as provided above, will be paid for at the Contract Unit Price per cubic yard for Grouted Riprap, and that Contract unit price will be payment in full for excavation and preparation of the bed, including backfilling and disposal of surplus material; for furnishing and placing riprap; for furnishing, placing and curing mortar; for restoring the site of the Work; and for furnishing all equipment, tools, labor and incidentals necessary to complete the Work in accordance with the Contract.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P63801	Riprap, per cubic yard
Pay Item P63802	Heavy Riprap, per cubic yard

Pay Item P63803	Grouted Riprap, per cubic yard
Pay Item P63804	Medium Random Riprap, per cubic yard

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 will be included in the Pay Items contained in the Schedule of Prices.

MATERIAL REQUIREMENTS

ASTM C 144	Aggregate for Masonry Mortar

SPECIFICATION P–640. MOBILIZATION

DESCRIPTION

640–1.1 DESCRIPTION. This Work consists of operations necessary for the movement of personnel, equipment, supplies and incidentals to the project site and for establishment of all Contractor's offices, buildings, sanitary and other facilities necessary for Work on the Project; and of all other Work and operations that must be performed or for which costs must be incurred before beginning Work on the Project.

METHOD OF MEASUREMENT

640-2.1 METHOD OF MEASUREMENT. Mobilization will be measured for payment as a single complete unit of Work, acceptably performed.

BASIS OF PAYMENT

640-3.1 BASIS OF PAYMENT. This Pay Item, measured as provided above, will be paid for at the Contract lump sum price for Mobilization, which price will be full compensation for supplying and furnishing all materials, facilities and services, and for performing all work necessary for the completion of this Work.

The Contract lump sum will be payable to the Contractor in accordance with the following schedule:

When 5 percent or more of the original Contract amount is earned, 25 percent of the amount bid for Mobilization will be paid.

When 25 percent or more of the original Contract amount is earned, 50 percent of the amount bid for Mobilization will be paid.

When 50 percent or more of the original Contract amount is earned, 75 percent of the amount bid for Mobilization will be paid.

When 75 percent or more of the original Contract amount is earned, 100 percent of the amount bid for Mobilization will be paid.

When the Contract does not include a separate Contract Pay Item for Mobilization, necessary Mobilization will be construed to be subsidiary work and the cost included under other Contract Pay Items contained in the Schedule of Prices and will not be paid for directly.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P64001	Mobilization, per lump sum

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 will be included in the Pay Items contained in the Schedule of Prices.

SPECIFICATION P–642. MAINTENANCE AND REPAIR OF HAUL ROADS

DESCRIPTION

642–1 DESCRIPTION. This Work consists of maintaining, repairing and restoring all public roads not a part of the State Trunk Highway System and streets, and all Airport roads, and other routes utilized to access the Work, including drainage facilities and appurtenances, over which materials are hauled by the Contractor, subcontractors, or suppliers of the Contractor, hereinafter called haul roads, to a condition equivalent to that which would have existed had such hauling not occurred.

The Contractor's obligation under this Pay Item does not authorize the use of haul roads for transporting loads exceeding statutory size and weight limitations.

MATERIALS

642–2 MATERIALS. Materials required and used in the maintenance and repair of haul roads shall be of the quality and serviceability at least equivalent to those existing prior to use as a haul road. Submit for review to the Engineer the amount and quality of all materials to be used prior to being incorporated into the Work

CONSTRUCTION METHODS

642–3.1 GENERAL. The 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. Provide 7 days notice to the Engineer prior to use of the haul road for construction operations and accompany the Engineer during logging of the condition, or accept the Engineer's determination of the prior condition of the haul road. In the event two or more contractors having contracts with the Department engage in transport of materials over the same haul road at the same time or at about the same time, the Engineer will determine the repair and restoration obligations of the respective contractors.

642–3.2 MAINTENANCE. Maintain and repair haul roads, including dust alleviation, as necessary to insure reasonable service to other users of the road.

To prevent or minimize damage to haul roads the Contractor may stabilize, reinforce, or strengthen existing facilities before hauling starts, and condition the surface and perform repairs during hauling operations.

642–3.3 RESTORATION. Upon termination of hauling operations and before final acceptance of the Work under the Contract, restore all haul roads, including drainage facilities, to the condition equivalent to that which would have existed had such hauling of material not occurred.

The final repair of a haul road shall meet the Engineer's approval.

METHOD OF MEASUREMENT

642–4.1 METHOD OF MEASUREMENT. 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.

BASIS OF PAYMENT

642–5.1 BASIS OF PAYMENT. These Pay Items, measured as provided above, will be paid for at the Contract lump sum price for Maintenance and Repair of Haul Roads or for Maintenance and Repair of Airport Haul Roads, which price will be payment in full for furnishing, hauling and placing required materials; for all labor, tools, equipment and all other costs necessary to complete the Work to the satisfaction of the Engineer; and for other costs incurred by the Contractor to prevent or minimize damage to the haul road.

Payment will be made upon completion of all Work under the Contract, except that, as determined by the Engineer, partial payments for these Pay Items may be allowed in amounts that are approximately proportional to the completion of the portions of the Contract for which haul roads are used.

If one or both of these Pay Items are not included in the Schedule of Prices, the corresponding Work shall be considered incidental and the cost included in the other Pay Items contained in the Schedule of Prices.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P64201	Maintenance and Repair of Haul Roads, per lump sum.
Pay Item P64202	Maintenance and Repair of Airport Haul Roads, per lump sum.

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.

SPECIFICATION P–644. AIRCRAFT TIE DOWN

DESCRIPTION

644-1.1 DESCRIPTION. This Work includes construction of tie downs for aircraft at the locations and in accordance with the details shown on the Plans.

CONSTRUCTION METHODS

644-2.1 Materials and installation shall conform to location and details shown on the Plans.

644-2.2 When the Plans show installation of anchors that are required to be augured into place, augur them in a manner that will not loosen or displace the soil in contact with the anchor.

METHOD OF MEASUREMENT

644-3.1 METHOD OF MEASUREMENT. Aircraft Tie Downs will be measured for payment on a unit price basis per set. A set includes three anchors unless shown otherwise on the Plans.

BASIS OF PAYMENT

644-4.1 BASIS OF PAVEMENT. Payment will be made at the Contract unit price per set for the various types of Aircraft Tie Downs constructed in accordance with the Contract Documents. This price will 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 will be measured and paid under the Pay Item for Painting (Specification P–620) 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.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P64401	Aircraft Tie Down, per set.
Pay Item P64402 through P64410	Aircraft Tie Down, Type ___, per set.

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.

SPECIFICATION P–646. BITUMINOUS PAVEMENT JOINTS

DESCRIPTION

646-1.1 DESCRIPTION. This Work includes sawing pavement joints in new bituminous pavement at locations shown on Plans or where directed by the Engineer, routing upper portion of the sawed joint to the size and shape detailed on the Plans, cleaning the joints of dust and debris with compressed air, and filling the joint with sealant.

NOTE TO SPECIFIER:
It is currently the policy of Aeronautics to construct Bituminous Pavement Joints on new runways and taxiways having bituminous pavements. The location of the joints and a joint detail should be shown on the plans for the project. Joint spacing should not exceed 75 feet. If the subgrade is sand, the joint spacing should not exceed 50 feet. The spacing may vary between 50 and 75 feet. Check existing pavements for crack spacing. Spacing on taxiways may be less than 50 feet. The joint detail is posted on the BOA BBS (filename: pavjoint.zip).

MATERIALS

646–2.1 Joint sealant shall meet ASTM D3405 - Joint Sealants, Hot-Poured, for Concrete and Asphalt Pavements as manufactured by Meadows “High Spec” or equal material approved by the Engineer. “High Spec” is manufactured by W.R. Meadows, Inc., Elgin, Illinois.

CONSTRUCTION METHODS

646-3.1 Saw joints in pavement to the dimensions and at the locations shown on the Plans. Do not vary joints more than 1 inch in 30 feet from a straight line and they shall be perpendicular to the pavement centerline unless shown otherwise on Plans.

646-3.2 Clean joints with compressed air. Compressed air equipment shall deliver at least 80 psi to the joint for cleaning. Remove loose material from joints.

646–3.3 Pressure pump sealant into the joint from an oil jacketed double boiler type material heater using nozzles designed for the purpose. Push a V-shaped rubber squeegee over the joint immediately following placement of the material.

646-3.4 Guarantee pavement joints for a period of 2 years following acceptance of the Work. Not more than 5 percent of the footage of joints shall have material pulled away from the side of the joint, shall have cracks within the materials, shall be missing from the joint or shall in any way allow entrance of water into the joint. If more than 5 percent of the footage of joints is judged to have failed, repair these joints to Department satisfaction. If less than 5 percent of the joints have failed, repairs to joints will not be necessary. The Department will be the sole judge as to which joints have failed.

METHOD OF MEASUREMENT

646–4.1 METHOD OF MEASUREMENT. Bituminous Pavement Joints will be measured on a unit basis per linear foot of joint, constructed and accepted in accordance with the requirements of the Contract Documents.

BASIS OF PAYMENT

646–5.1 BASIS OF PAVEMENT. Payment will be made at the Contract unit price per linear foot for Bituminous Pavement Joints. This price will be full compensation for furnishing all materials for preparation, saw cutting, routing, cleaning and sealing joints, including all labor, tools, equipment, and incidentals necessary to complete the Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P64601	Bituminous Pavement Joints, per linear foot.

SPECIFICATION F-160. WOVEN WIRE FENCE

DESCRIPTION

160–1.1 This Work covers the requirements for furnishing materials and constructing new wire fences with wood posts and gates in accordance with these Specifications and as shown on the Plans. Erect the fence with two-stranded barbed wire, as indicated on the Plans.

MATERIALS

160–2.1 WIRE.

a. Woven Wire (Zinc–coated). Use a woven wire fence that is 7–bar, 26–inch (0.66 m) field fence with top and bottom wires No. 10 ASW gauge, and filler and stay wires No. 12-1/2 ASW gauge. Stay wires shall be spaced 6 inches (150 mm) apart. All wires shall be smooth galvanized steel wire, conforming to Fed. Spec. RR–F–221, Type B. All wires shall be two–dip and spaced as shown on the Plans.

b. Barbed Wire (Zinc–coated). Use a zinc–coated barbed wire that is 2–strand twisted No. 12-1/2 ASW gauge galvanized steel wire with 4–point barbs of No. 14 ASW gauge galvanized steel wire. All wire shall conform to Fed. Spec. RR–F–221, Type A. The barbs shall be spaced approximately 4 inches (100 mm) apart.

c. Barbed Wire (Copper–covered). Copper–covered steel barbed wire shall conform to Fed. Spec. RR–F–221, Type A.

d. Barbed Wire (Aluminum–coated). Aluminum–coated steel–barbed wire shall be 2–strand twisted No. 12-1/2 ASW gauge. The 4–point barbs of No. 14 ASW gauge aluminum–coated steel wire shall be spaced approximately 5 inches (125 mm) apart. The steel wire shall have a tensile strength of between 60,000 and 80,000 pounds per square inch (413,700 and 551,600 kPa), and the aluminum coating shall have a minimum weight of 0.30 ounce per square foot (0.10 kg/square meter) of wire surface on the No. 12-1/2 ASW gauge line wires and 0.25 ounce per square foot (0.08 kg/square meter) of wire surface on the No. 14 ASW gauge barbs.

e. Bracing Wire (Zinc–coated). Use No. 9 smooth galvanized soft wire when using cable for bracing.

160–2.2 GATES AND HARDWARE. Construct gates of galvanized steel tubing conforming to Fed. Spec. RR–F–191 and use the size shown on the Plans. Furnish heavily galvanized hinges and latches with each gate. Use either a bolt or lag screw hinge, and furnish either a wing or butterfly latch.

160–2.3 POSTS.

a. Species. Use one of the following species of wood for all posts, unless otherwise shown on the Plans.

Northern White Cedar
Southern Yellow Pine
Tamarack
Red (Norway) Pine
Jack Pine

Posts shall be given a preservative treatment in accordance with the method specified as full length treatment.

b. Quality. Posts should be peeled, sound, straight–grained, free from decay, cracks, and splits; shakes must not be in excess of 1/4 inch (6 mm) wide and 3 feet (0.9 m) long. Checks (lengthwise separations of the wood in a generally radial direction) are permitted, provided they are not injurious.

c. Dimensions. Posts shall be of the length shown on the Plans. Posts shall have the diameter shown on the Plans or minimum top diameters not less than 4–1/2 inches (115 mm) for line posts and not less than 6 inches (150 mm) for corner, bracer, or vertical angle posts. Sawed and split posts are acceptable instead of round posts provided their dimensions are such that round posts of required diameter could be turned therefrom.

d. Manufacture. Outer bark should be completely removed from all posts including depressions. Inner bark should 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 should be held to a minimum.

e. Full Length Treatment. Condition posts by air seasoning, steaming, or heating in oil in a manner that prevents injurious checking, splitting, or warping before treating. The treatment, care, and preservative shall be in accordance with Fed. Spec. TT–W–571.

160–2.4 BRACES. Use cleats, gate stops, and braces in the sizes shown on the Plans. Use the same species and quality specified for the posts or approved by the Engineer that are free from knots larger than one–third the width of the piece. Make gate stops of posts of suitable length. Braces may be made of posts of suitable length or of sawed lumber. Treat all cleats, gate stops, and any braces in contact with the ground and for a distance of at least 6 inches (150 mm) above the ground as specified herein for posts. The wire used in cable for bracing shall conform to Subsection 160–2.1e.

160–2.5 STAPLES. Use staples that are No. 9 galvanized steel wire, 1 inch (25 mm) long for hardwood posts and 1–1/2 inches (37 mm) long for use in softwood posts.

CONSTRUCTION METHODS

160–3.1 GENERAL. Construct the fence in accordance with the details on the Plans and as specified herein using new materials. Prior to the beginning of the Work or upon the request of the Contractor, the Engineer will locate the position of the Work by establishing and marking the property line or fence line. When directed, span the opening below the fence with barbed wire fastened to posts of extra length at locations of small natural or drainage ditches where it is not practical to conform the fence to the general contour of the ground surface. Permanently tie the new fence to the terminals of existing fences whenever required by the Engineer. Plumb the finished fence taut, true to line and ground contour, and complete in every detail. When directed, stake down the woven wire fence at several points between posts.

Arrange construction of the new fence to keep livestock on adjoining property enclosed at all times. Do not exceed 300 feet (90 m) or any length of unfenced section at any time that the stock can be kept in the proper field. At the close of the working day, tie the newly constructed fence to the unremoved existing fence. Guard openings in the fence when livestock is using the adjoining property.

160–3.2 CLEARING FENCE LINE. Clear the site of the fence of obstructions, and grade surface irregularities so that the fence will conform to the general contour of the ground. Clear the fence line to a minimum width of 2 feet (0.60 m) on each side of the centerline of the fence. This clearing consists of the removal of all stumps, brush, rocks, trees, or other obstructions that will interfere with proper construction of the fence. Grub and excavate stumps within the cleared area of the fence line. Place the bottom of the fence a uniform distance above ground as specified in the Plans. When shown on the Plans or as directed by the Engineer, remove as part of the construction Work, the existing fences which coincide with, or are in a position to interfere with, the new fence location unless the removal is listed as a separate item in the Schedule of Prices. After post and stump removal refill remaining holes with suitable soil, gravel, or other material acceptable to the Engineer and compact these areas properly with tampers.

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.

160–3.3 SETTING POSTS. Set posts with large ends down, plumb, and in good line on the side on which the wire is to be fastened. Set posts full depth and do not cut posts off to eliminate rock or other excavation. Remove rock where it is encountered, even if blasting is necessary, to provide full–depth and full–size holes. Cut off square the bottoms of all posts. The diameter of the holes must be at least 6 inches (150 mm) larger than the diameter of the posts. When cleats are used on posts, dig the holes large enough to accommodate them. After posts are placed and lined, backfill the holes with suitable material and properly compacted by the use of tampers. Set and brace with braces and wire the posts adjacent to end, corner, anchor, and gate posts as shown on the Plans. No extra compensation shall be made for rock excavation. Rock excavation may not be grounds for extension of time.

160–3.4 ANCHORING. Anchor corner, end, gate, and adjacent intermediate posts by gaining and spiking cleats to the sides of the posts, as indicated on the Plans. No cleats will be required on other intermediate posts or on anchor posts.

160–3.5 BRACING. Brace end, corner, anchor, and gate posts by using a post of sufficient length or a piece of sawed lumber of the proper size, together with a wire cable. Gain and securely spike the wooden brace into the end, corner, anchor, or gate posts and into the next intermediate posts about 6 inches (150 mm) from the top of the respective posts. Loop a cable made of a double strand of galvanized soft wire around the end, corner, anchor, or gate post near the ground and around the next intermediate post about 12 inches (300 mm) from the top. After the cable has been stapled in this position, twist it until tight. The staples used to hold the cable shall be not less than 1–1/2 inches (37 mm) long. Leave the tool used for twisting the cable in place to permit later adjustment of bracing if found necessary. Set anchor posts at approximately 500–foot (150 m) intervals and braced to the adjacent posts. Brace posts before the wire fencing is placed.

160–3.6 INSTALLING WIRE. Place the wires on the side of the posts away from the Airport or as directed. Place the wire fence on the posts at the height indicated on the Plans. Install longitudinal wires parallel and draw them uniformly taut. The vertical stay wires of the woven wire fencing should be straight and vertical. Wrap the woven wire once around the post and wrap barbed wire at the end and gate posts. Staple each longitudinal wire at least three times and tie these wire ends with a snug, tight twist. Staple each longitudinal wire to each intermediate post with one steel wire staple. At the corner and anchor posts, use two or more staples. Staple the top barbed wire strand of all fences with two staples in each post. Set diagonally with the grain of the wood and drive up tight all staples. After the fence has been erected, saw off the tops of the wood posts with a 1–to–3 pitch. The bottom wire of the wire fencing must clear the ground by not more than 4 inches (100 mm) or less than 1 inch (25 mm) at all locations.

160–3.7 SPLICING WIRE. Wire splices in longitudinal wires will be permitted if made with an approved galvanized bolt–clamp splice or a wire splice made as follows:

a. Carry the end of the wires 3 inches (75 mm) past the splice tool and wrap around the other wire away from the tool for at least six turns in opposite directions.

b. After the tool is removed, close the space occupied by it by pulling the ends together.

c. Cut close the unused ends of the wires.

d. Splice woven wire only at posts.

160–3.8 INSTALLING GATES. Hang the gates on gate fittings, as shown on the Plans. Clamp, screw or bolt fittings on the gate posts to prevent slipping. Erect gates to swing in the direction indicated and provide gate stops, as specified or as shown on the Plans. Erect gates at locations shown on the Plans.

160–3.9 EXISTING FENCE CONNECTIONS. Wherever the new fence joins an existing fence, either at a corner or at the intersection of straight fence lines, set a corner or anchor post at the junction, braced and anchored the same as herein 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 should contain a brace span.

160–3.10 CLEANING UP. Remove all tools, buildings, equipment, debris, and excess material used during construction.

160-3.11 ELECTRICAL GROUNDS. Construct electrical grounds where a power line passes over the fence and at 500–foot (150 m) intervals. Install the ground directly below the point of crossing. Accomplish the ground with a copperclad rod 8 feet (2.4 m) long and a minimum of 5/8 inch (15 mm) in diameter driven vertically until the top is 6 inches (150 mm) below the ground surface. Clamp a No. 6 solid copper conductor to the rod and to the fence so that each element of the fence is grounded. Installation of ground rods shall not constitute a separate Pay Item and shall be considered incidental to fence construction.

NOTE TO SPECIFIER:
Use of this Pay Item will require a detail to be included in the Plans.

METHOD OF MEASUREMENT

160–4.1 Woven Wire Fence will be measured in place from outside to outside of end posts or corner posts and will be the length of fence actually constructed, except for the space occupied by the gates.

Gates will be measured in units for each gate installed and accepted.

BASIS OF PAYMENT

160–5.1 Payment will be made at the Contract unit price per linear foot for Woven Wire Fence. This price will be full compensation for furnishing all materials and for preparation, erection, and installation of these materials, and for all labor, equipment, tools and incidentals necessary to complete the Work.

Payment will be made at the Contract unit price per each for gates. This price will be full compensation for furnishing all materials and for all preparation, erection, and installation of these materials and for all labor, equipment, tools, and incidentals to complete the Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item F16001	Woven Wire Fence, per linear foot
Pay Item F16002	Entrance Gate, 4 foot, per each
Pay Item F16003	Entrance Gate, 6 foot, per each
Pay Item F16004	Entrance Gate, 8 foot, per each
Pay Item F16005	Entrance Gate, 10 foot, per each
Pay Item F16006	Entrance Gate, 12 foot, per each
Pay Item F16007	Entrance Gate, 14 foot, per each
Pay Item F16008	Entrance Gate, 16 foot, per each

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.

MATERIAL REQUIREMENTS

Fed.Spec.RR–F–191/Gen.	Fencing, Wire and Post, Metal (and Gates, Chain–Link Fence Fabric, and Accessories)
Fed.Spec. RR–F–221	Fencing, Wire, Fence Post and Accessories (Barbed Wire, Woven Wire and Netting)
Fed.Spec. TT–W–571	Wood Preservation: Testing Practices

SPECIFICATION F–162. CHAIN LINK FENCES

DESCRIPTION

162–1.1 This Work consists 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 the Engineer. 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 are defined as follows:

NOTE TO SPECIFIER:
The Wisconsin DOT Highways Standard Detail is a Type 2 Chain Link Fence. If other types are included in the Schedule of Prices, additional details need to be included on the Plans.

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.

Anchor corner posts, anchor posts, terminal posts, gate posts, and other brace posts indicated on the Plans in concrete for all types of Chain Link Fence.

MATERIALS

162–2.1 FABRIC. The fabric shall be woven from a 9 gauge aluminum–coated steel wire in a 2–inch (50 mm) mesh and shall conform to the requirements of ASTM A 491.

NOTE TO SPECIFIER:
The following are allowed by FAA.
Galvanized steel fabric shall conform to the requirements of ASTM A 392, Class 2.
Aluminum alloy fabric shall conform to the requirements of ASTM F 1183.
Polyvinyl chloride–coated steel shall conform to the requirements of ASTM F 668, Class 2b.
Zinc – 5% aluminum mischmetal alloy coated steel shall conform to the requirements of ASTM F 1345, Class 2.
Metallic coated fabric shall have a clear acrylic coating applied to the selvage area after weaving.
The fabric specified in the Standard Specification is consistent with DOT Highways. Other fabric in the list may be added by Special Provision upon approval by the WBOA. Zinc coated fabric is not allowed due to potential problems from salt spray.

162–2.2 BARBED WIRE. Barbed wire shall be 2–strand 12–1/2 gauge **zinc–coated or aluminum–coated** wire with 4–point barbs and shall conform to the requirements of ASTM A 121, Class 3, Chain Link Fence Grade, or ASTM A 585, Class II.

162–2.3 POSTS, RAILS AND BRACES. Posts, rails, and braces furnished for use in conjunction with aluminum–coated steel fabric shall be of zinc–coated steel.

Line posts, rails, and braces shall be galvanized steel pipe structural shapes or roll formed conforming to the requirements of the following:

a. Galvanized steel pipe shall conform to the requirements of ASTM F 1083.

b. The steel used in all structural shapes shall conform to the requirements of ASTM A 572, Grade 45, and shall be galvanized in accordance with the requirements of ASTM F 1234, Type A.

c. Roll–formed sections shall be fabricated from material meeting the requirements of ASTM A 570, Grade 45, and shall be galvanized in accordance with the requirements of ASTM F 1234, Type A, or coated with zinc–5 percent aluminum mischmetal alloy in accordance with ASTM F 1234, Type C.

Posts, rails, and braces shall demonstrate the ability to withstand testing in salt spray in accordance with ASTM B 117 as follows:

Exterior: 1,000 hours with a maximum of 5 percent red rust.
Interior: 650 hours with a maximum of 5 percent red rust.

The dimensions of the posts, rails, and braces shall be in accordance with Tables I through VI of Fed. Spec. RR–F–191/3.

162–2.4 GATES. Gate frames shall consist of galvanized steel pipe and conform to the specifications for the same material under Paragraph 162–2.3. The fabric should consist of the same type material as used in the fence.

162–2.5 WIRE TIES AND TENSION WIRES. 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 A 824.

All material shall conform to Fed. Spec. RR–F–191/4.

162–2.6 MISCELLANEOUS FITTINGS AND HARDWARE. Miscellaneous steel fittings and hardware for use with aluminum–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 A 153. Barbed wire support arms shall withstand a load of 250 pounds (113 kg) applied vertically to the outermost end of the arm.

162–2.7 CONCRETE. Use a commercial grade Portland cement concrete with a minimum 28–day compressive strength of 2,500 psi (17,240 kPa).

162–2.8 MARKING. Each roll of fabric must carry a tag showing the kind of base metal, kind of coating, the gage of the wire, the length of fencing in the roll, and the name of the manufacturer. Identify posts, wire, and other fittings as to manufacturer, kind of base metal, and kind of coating.

CONSTRUCTION METHODS

162–3.1 CLEARING FENCE LINE. Clear the site of the fence of obstructions, and grade surface irregularities to allow the fence to conform to the general contour of the ground. Clear the fence line to a minimum width of 2 feet (600 mm) on each side of the centerline of the fence. This clearing consists of the removal of all stumps, brush, rocks, trees, or other obstructions that will interfere with proper construction of the fence. When shown on the Plans or as directed by the Engineer, remove (as part of the Work) existing fences that coincide with, or are in a position to interfere with the new fence location, unless such removal is listed as a separate Pay Item in the Schedule of Prices. Refill holes remaining after post and stump removal with suitable soil, gravel, or other material acceptable to the Engineer and compact it properly with tampers.

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.

162–3.2 INSTALLING POSTS. Set all posts in concrete, (line posts may be driven) when specified, at the required dimension, depth, and spacing shown on the Plans.

NOTE TO SPECIFIER:
Posts should be spaced not more than 10 feet (3 m) apart and should be set a minimum of 36 inches (0.9 m) in concrete footings, unless they are driven, in which case the WisDOT Standard detail shows a depth of 32 inches. If the frost depth is greater than the footing depth or driven depth shown on the Plans, the posts should be set accordingly.

Thoroughly compact the concrete around the posts by tamping or vibrating, leave a smooth finish slightly higher than the ground, and slope it to drain away from the posts. Set all posts plumb and to the required grade and alignment. Do not install materials on the posts or disturb the posts in any manner within 7 days after the individual concrete post footing is completed. Drive line posts plumb to the minimum depth required on the Plans. Drive or set posts with their tops at an elevation to provide a smooth profile at the top wire without abrupt changes and that will conform to the ground contour.

If rock is encountered at a depth less than the planned footing depth, drill to a depth of 12 inches (300 mm) a hole 2 inches (50 mm) larger than the greatest dimension of the posts. After the posts are set, fill the remainder of the drilled hole with grout, composed of one part portland cement and two parts mortar sand. Fill the remaining space above the rock with concrete in the manner described above.

Instead of drilling, the rock may be excavated to the required footing depth. No extra compensation will be made for rock excavation.

162–3.3 INSTALLING TOP RAILS. The top rail must be continuous and shall pass through the post tops. The coupling used to join the top rail lengths shall allow for expansion.

162–3.4 INSTALLING BRACES. Install horizontal brace rails, with diagonal truss rods and turnbuckles, at all terminal posts.

162–3.5 INSTALLING FABRIC. Firmly attach the wire fabric to the posts and brace it in the manner shown on the Plans. Stretch all wire taut and install it to the required elevations. The fence shall follow the contour of the ground, with the bottom of the fence fabric no less than 1 inch (25 mm) or more than 4 inches (100 mm) from the ground surface. Perform grading where necessary to provide a uniform and smooth surface contour.

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, use longer posts and multiple strands of barbed wire stretched thereon to span the opening below the fence. The vertical clearance between strands of barbed wire shall be 6 inches (150 mm) or less.

NOTE TO SPECIFIER:
Openings below the fence may also be spanned with barbed wire fastened to stakes.
The Engineer shall specify if tension wire is to be installed.

162–3.6 ELECTRICAL GROUNDS. Construct electrical grounds where a power line passes over the fence and at 500–foot (150 m) intervals. Install the ground directly below the point of crossing. Accomplish the ground with a copperclad rod 8 feet (2.4 m) long and a minimum of 5/8 inch (15 mm) in diameter driven vertically until the top is 6 inches (150 mm) below the ground surface. Clamp a No. 6 solid copper conductor to the rod and to the fence so that each element of the fence is grounded. Installation of ground rods shall not constitute a separate Pay Item and shall be considered incidental to fence construction.

NOTE TO SPECIFIER:
The Engineer shall indicate the location of all electrical grounds on the plans.

METHOD OF MEASUREMENT

162–4.1 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.

Gates will be measured as complete units, per each.

BASIS OF PAYMENT

162–5.1 Payment for Chain Link Fence will be made at the Contract unit price per linear foot.

Payment for Gates will be made at the Contract unit price for each gate.

The prices will 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 the Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item F16201	Chain Link Fence, Type 1, 6 foot, per linear foot
Pay Item F16202	Chain Link Fence, Type 1, 7 foot, per linear foot
Pay Item F16203	Chain Link Fence, Type 1, 8 foot, per linear foot
Pay Item F16204	Chain Link Fence, Type 1, 10 foot, per linear foot

Pay Item F16205	Chain Link Fence, Type 1, 12 foot, per linear foot
Pay Item F16206	Chain Link Fence, Type 2, 6 foot, per linear foot
Pay Item F16207	Chain Link Fence, Type 2, 7 foot, per linear foot
Pay Item F16208	Chain Link Fence, Type 2, 8 foot, per linear foot
Pay Item F16209	Chain Link Fence, Type 2, 10 foot, per linear foot
Pay Item F16210	Chain Link Fence, Type 2, 12 foot, per linear foot
Pay Item F16211	Chain Link Fence, Type 3, 6 foot, per linear foot
Pay Item F16212	Chain Link Fence, Type 3, 7 foot, per linear foot
Pay Item F16213	Chain Link Fence, Type 3, 8 foot, per linear foot
Pay Item F16214	Chain Link Fence, Type 3, 10 foot, per linear foot
Pay Item F16215	Chain Link Fence, Type 3, 12 foot, per linear foot
Pay Item F16216	Chain Link Fence, Type 4, 6 foot, per linear foot
Pay Item F16217	Chain Link Fence, Type 4, 7 foot, per linear foot
Pay Item F16218	Chain Link Fence, Type 4, 8 foot, per linear foot
Pay Item F16219	Chain Link Fence, Type 4, 10 foot, per linear foot
Pay Item F16220	Chain Link Fence, Type 4, 12 foot, per linear foot
Pay Item F16221	Chain Link Fence, Type 5, 6 foot, per linear foot
Pay Item F16222	Chain Link Fence, Type 5, 7 foot, per linear foot
Pay Item F16223	Chain Link Fence, Type 5, 8 foot, per linear foot
Pay Item F16224	Chain Link Fence, Type 5, 10 foot, per linear foot
Pay Item F16225	Chain Link Fence, Type 5, 12 foot, per linear foot
Pay Item F16226	Chain Link Fence, Type 6, 4 foot, per linear foot
Pay Item F16227	Chain Link Fence, Type 6, 5 foot, per linear foot
Pay Item F16228	Chain Link Fence, Type 6, 6 foot, per linear foot
Pay Item F16229	Chain Link Fence, Type 6, 7 foot, per linear foot
Pay Item F16230	Chain Link Fence, Type 6, 8 foot, per linear foot
Pay Item F16231	Chain Link Fence, Type 6, 10 foot, per linear foot
Pay Item F16232	Chain Link Fence, Type 6, 12 foot, per linear foot
Pay Item F16240 through F16260	Chain Link Fence Gate, ___ foot height, ___ foot width, per each
Pay Item F16261 through F16280	Chain Link Fence Gate, Location ___, per lump sum

Measurement and Payment will only be made for Pay Items contained 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.

MATERIAL REQUIREMENTS

ASTM A 121	Zinc–Coated (Galvanized) Steel Barbed Wire
ASTM A 123	Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip
ASTM A 153	Zinc Coating (Hot–Dip) on Iron and Steel Hardware
ASTM A 446	Specification for Steel Sheet, Zinc–Coated (Galvanized) by the Hot–Dip Process, Structural (Physical) Quality
ASTM A 491	Aluminum–Coated Steel Chain–Link Fence Fabric
ASTM A 569	Steel, Carbon (0.15 Maximum, Percent), Hot Rolled Sheet and Strip Commercial Quality
ASTM A 570	Hot–Rolled Carbon Steel Sheet and Strip Structural Quality
ASTM A 572	High–Strength Low–Alloy Columbium–Vanadium Steels of Structural Quality
ASTM A 585	Aluminum–Coated Steel Barbed Wire
ASTM A 824	Metallic–Coated Steel Marcelled Tension Wire for Use With Chain Link Fence
ASTM B 117	Standard Test Method of Salt Spray (Fog) Testing
ASTM B 221	Aluminum–Alloy Extruded Bars, Rods, Wire Shapes and Tubes
ASTM F 1083	Pipe, Steel, Hot–dipped Zinc–coated (galvanized) Welded, for Fence Structures
ASTM F 1234	Protective Coatings on Steel Framework for Fences
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)

SPECIFICATION D-701. PIPE FOR STORM DRAINS AND CULVERTS

DESCRIPTION

701–1.1 This Work consists of the construction of pipe culverts and storm drains in accordance with these Specifications and in conformity with the lines and grades shown on the Plans.

MATERIALS

701–2.1 Materials shall meet the requirements shown on the Plans and specified below.

701–2.2 PIPE. Provide the type of pipe specified in the Special Provisions or shown on the Plans in accordance with the following specifications.

Metallic Coated Corrugated Steel Pipe (Type I, IR or II)	ASTM A 760
Galvanized Steel Corrugated Structural Plates and Fasteners for Pipe, Pipe–Arches, and Arches	ASTM A 761
Reinforced Concrete Pipe	ASTM C 76
Reinforced Concrete D–Load Pipe	ASTM C 665
Reinforced Concrete Arch Pipe	ASTM C 506
Reinforced Concrete Elliptical Pipe	ASTM C 507
Precast Reinforced Concrete Box Sections	ASTM C 789 and C 850
Bituminous–Coated Corrugated Metal Pipe and Pipe Arches	AASHTO M 190
Bituminous–Coated Structural Plate Pipe, Pipe Arch, and Arches	AASHTO M 167 and M 243

701–2.3 CONCRETE. Concrete for pipe cradles shall have a minimum compressive strength of 2,000 psi (13,790 kPa) at 28 days and conform to the requirements of ASTM C 94.

701–2.4 GASKETS. Rubber gaskets for rigid pipe shall conform to the requirements of ASTM C 443. Rubber gaskets for zinc–coated steel pipe and precoated galvanized pipe shall conform to the requirements of ASTM D 1056, for the "RE" closed cell grades.

701–2.5 JOINT MORTAR. Pipe joint mortar consists of one part Portland cement and two parts sand. The Portland cement shall conform to the requirements of ASTM C 150, Type I. The sand shall conform to the requirements of ASTM C 144.

701–2.6 PLASTIC GASKETS. Plastic gaskets shall conform to the requirements of AASHTO M 198 (Type B).

701–2.7 APRON ENDWALLS.

Reinforced Concrete Apron Endwalls. 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, dimensions, and details shown on the Plans.

Corrugated Steel Apron Endwalls. Steel apron endwalls for corrugated steel culvert pipe shall be manufactured in accordance with the pertinent requirements specified for corrugated steel pipe under Subsection 701–2.2 and shall conform to the dimensions, thickness, design and details shown on the Plans.

CONSTRUCTION METHODS

701–3.1 EXCAVATION. Make the width of the pipe trench sufficient (but not less than the external horizontal dimension of the pipe plus 6 inches (150 mm) on each side) to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe.

Where rock, hardpan, or other unyielding material is encountered, remove it from below the foundation grade for a depth of at least 12 inches (300 mm) or ½ inch (12 mm) for each foot of fill over the top of the pipe (whichever is greater) but for no more than 3/4 of the nominal diameter of the pipe. The width of the excavation shall be at least 1 foot (300 mm) greater than the horizontal outside dimension of the pipe. Backfill the excavation below grade with selected fine compressible material, such as silty clay or loam, and lightly compact it in layers not over 6 inches (150 mm) in uncompacted depth to form a uniform but yielding foundation.

Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, remove the unstable soil and replace it with approved granular material for the full trench width. The Engineer will determine the depth of removal necessary. Compact the granular material to provide adequate support for the pipe.

Do not excavate for pipes that are to be placed in embankment fill until the embankment has been completed to a height above the top of the pipe.

701–3.2 BEDDING. Provide pipe bedding in conformance with the Contract Documents.

a. Rigid Pipe. When no bedding class is specified or detailed on the Plans, the requirements for Class B bedding shall apply.

Class A bedding consists of a continuous concrete cradle conforming to the Plan details.

Class B bedding consists of a bed of granular material having a thickness of at least 6 inches (150 mm) 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. Shape the layer of bedding material to fit the pipe for at least 10 percent of the pipe's vertical diameter and have recesses shaped to receive the bell of bell and spigot pipe. Use crushed stone chips or crushed gravel for the bedding material, all of which passes a 3/8 inch (9 mm) sieve and not more than 10 percent of which passes a No. 200 (0.075 mm) sieve.

Class C bedding consists of bedding the pipe in its natural foundation to a depth of not less than 10 percent of the pipe's vertical outside diameter. Shape the bed to fit the pipe and have recesses shaped to receive the bell of bell and spigot pipe.

b. Flexible Pipe. For flexible pipe, roughly shape the bed to fit the pipe, and provide a bedding blanket of sand or fine granular material as follows:

TABLE 1. FLEXIBLE PIPE

Pipe Corrugation Depth		*Minimum Bedding Depth*	
in.	(mm)	in.	(mm)
1/2	(12.5)	1	(25.0)
1	(25.0)	2	(50.0)
2	(50.0)	3	(75.0)
2–1/2	(62.5)	3–1/2	(87.5)

701–3.3 LAYING PIPE. Begin laying the pipe at the lowest point of the trench and proceed upgrade. The lower segment of the pipe must be in contact with the bedding throughout its full length. Place bell or groove ends of rigid pipes and outside circumferential laps of flexible pipes facing upgrade.

Place paved or partially lined pipe so that the longitudinal center line of the paved segment coincides with the flow line.

Place elliptical and elliptically reinforced pipes with the manufacturer's top of pipe mark within 5 degrees of a vertical plane through the longitudinal axis of the pipe.

Plug laying holes (lift holes) with non–shrink grout. Allow the grout to set and reach strength capable of supporting backfill prior to placing the backfill. Plugs supplied by pipe manufacturers may be used, provided they are mortared in place with non-shrink grout, in a manner to provide a watertight seal.

701–3.4 JOINING PIPE.

a. Concrete Pipe. Concrete pipe may be either bell and spigot or tongue and groove. Use a method of joining pipe sections so that the ends are fully entered and the inner surfaces are reasonably flush and even. Provide rubber gaskets for pipe joints in accordance with 701–2.4.

b. Metal Pipe. Firmly join metal pipe by form fitting bands conforming to the requirements of ASTM A 760 for steel pipe.

701–3.5 BACKFILLING. Have pipes inspected before backfill is placed. Remove pipes found to be out of alignment, unduly settled, or damaged and lay it again or replace at the Contractor's expense.

Material for backfill should be fine, readily compactible soil, or granular material selected from the excavation or a source of the Contractor's choosing. It cannot contain frozen lumps, stones that would be retained on a 2–inch (50.0 mm) sieve, chunks of highly plastic clay, or other objectionable material. No less than 95 percent of a granular backfill material shall pass through a 1/2 inch (12 mm) sieve, and no less than 95 percent of it shall be retained on a No. 4 (4.75 mm) sieve.

When the top of the pipe is even with or below the top of the trench, compact the backfill in layers not exceeding 6 inches (150 mm) on both sides of the pipe and bring up 1 foot (300 mm) above the top of the pipe or to natural ground level, whichever is greater. Be careful to thoroughly compact the backfill material under the haunches of the pipe. Bring material up evenly on both sides of the pipe.

When the top of the pipe is above the top of the trench, compact the backfill in layers not exceeding 6 inches (150 mm) and bring it up evenly on both sides of the pipe to 1 foot (300 mm) 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 must be equal to twice the pipe's diameter, or 12 feet (3.5 m), whichever is less.

Compact all backfill to the density required under Specification P–152.

701–3.6 APRON ENDWALLS. 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 pipe, backfill and firmly compact this trench.

Place reinforced concrete apron endwalls with its tongue (or groove) fully entered in the groove (or tongue) of the pipe.

Backfill for the apron is the same as required for the pipe, unless otherwise directed.

701-3.7 JOINT TIES. When shown on the Plans, furnish and install joint ties for concrete pipe in accordance with the details and at locations indicated.

METHOD OF MEASUREMENT

701–4.1 Pipe Culverts will be measured in linear feet of pipe in place, completed, and approved. It will be measured along the centerline of the pipe between the points of connection to the apron endwalls, or if there are no apron endwalls, to the ends of the pipe. If a length of culvert pipe ends at a drainage structure, measurement will extend to the centerline of the structure. All fittings will be included in the footage as typical pipe sections in the pipe being measured. Apron endwalls will not be included in the measurement for pipe.

701-4.2 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 The volume of concrete for pipe cradles will not be measured separately, and the cost shall included in the contract prices for storm sewer or culvert.

701–4.4 The volume of rock to be paid for will be the number of cubic yards of rock excavated. No payment will be made for the cushion material placed for the bed of the pipe.

701–4.5 Apron endwalls will be measured by the unit per each for the various diameters and materials required on the Plans and Specifications. Materials will be reinforced concrete (RC) or Corrugated Steel (CS) per Subsection 701–2.7.

BASIS OF PAYMENT

701–5.1 Payment will be made at the Contract unit price per linear foot for each size and type or each line number or location indicated for Storm Sewer or Culvert Pipe. Payment will be made at the Contract unit price per each for each size and kind of Apron Endwall designated.

These prices will fully compensate the Contractor for furnishing all materials and for all preparation, dewatering, excavation, installation and bedding and backfill of these materials, joint ties (when required), surface restoration; and for all labor, equipment, tools, and incidentals necessary to complete the Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item D70101	Storm Sewer, 12 inch, per linear foot
Pay Item D70102	Storm Sewer, 15 inch, per linear foot
Pay Item D70103	Storm Sewer, 18 inch, per linear foot
Pay Item D70104	Storm Sewer, 21 inch, per linear foot
Pay Item D70105	Storm Sewer, 24 inch, per linear foot
Pay Item D70106	Storm Sewer, 27 inch, per linear foot
Pay Item D70107	Storm Sewer, 30 inch, per linear foot
Pay Item D70108	Storm Sewer, 33 inch, per linear foot
Pay Item D70109	Storm Sewer, 36 inch, per linear foot
Pay Item D70110	Storm Sewer, 42 inch, per linear foot
Pay Item D70111	Storm Sewer, 48 inch, per linear foot
Pay Item D70112	Storm Sewer, 54 inch, per linear foot
Pay Item D70113	Storm Sewer, 60 inch, per linear foot
Pay Item D70114	Storm Sewer, 72 inch, per linear foot
Pay Item D70115	Storm Sewer, ___ inch, per linear foot
Pay Item D70116	Storm Sewer, ___ inch, per linear foot
Pay Item D70117 through D70124	Storm Sewer, line No. ___, per linear foot
Pay Item D70125 through D70130	Storm Sewer, ___ inch by___ inch, ___, per linear foot
Pay Item D70131	Culvert Pipe, 18 inch, RC, per linear foot
Pay Item D70132	Culvert Pipe, 18 inch, CS, per linear foot
Pay Item D70133	Culvert Pipe, 24 inch, RC, per linear foot
Pay Item D70134	Culvert Pipe, 24 inch, CS, per linear foot
Pay Item D70135	Culvert Pipe, 27 inch, RC, per linear foot
Pay Item D70137	Culvert Pipe, 30 inch, RC, per linear foot
Pay Item D70138	Culvert Pipe, 30 inch, CS, per linear foot
Pay Item D70139	Culvert Pipe, 33 inch, RC, per linear foot
Pay Item D70141	Culvert Pipe, 36 inch, RC, per linear foot
Pay Item D70142	Culvert Pipe, 36 inch, CS, per linear foot
Pay Item D70143	Culvert Pipe, 42 inch, RC, per linear foot
Pay Item D70144	Culvert Pipe, 42 inch, CS, per linear foot
Pay Item D70145	Culvert Pipe, 48 inch, RC, per linear foot
Pay Item D70146	Culvert Pipe, 48 inch, CS, per linear foot
Pay Item D70147 through D70152	Culvert Pipe, ___ inch, ___ per linear foot
Pay Item D70153 through D70160	Culvert Pipe, Location No. ___, per linear foot
Pay Item D70161	Apron Endwalls, 12 inch, RC, per each
Pay Item D70162	Apron Endwalls, 12 inch, CS, per each
Pay Item D70163	Apron Endwalls, 15 inch, RC, per each
Pay Item D70164	Apron Endwalls, 15 inch, CS, per each
Pay Item D70165	Apron Endwalls, 18 inch, RC, per each
Pay Item D70166	Apron Endwalls, 18 inch, CS, per each
Pay Item D70167	Apron Endwalls, 21 inch, RC, per each
Pay Item D70168	Apron Endwalls, 21 inch, CS, per each
Pay Item D70169	Apron Endwalls, 24 inch, RC, per each
Pay Item D70170	Apron Endwalls, 24 inch, CS, per each
Pay Item D70171	Apron Endwalls, 27 inch, RC, per each
Pay Item D70173	Apron Endwalls, 30 inch, RC, per each
Pay Item D70174	Apron Endwalls, 30 inch, CS, per each
Pay Item D70175	Apron Endwalls, 33 inch, RC, per each
Pay Item D70177	Apron Endwalls, 36 inch, RC, per each
Pay Item D70178	Apron Endwalls, 36 inch, CS, per each
Pay Item D70179	Apron Endwalls, 42 inch, RC, per each
Pay Item D70180	Apron Endwalls, 42 inch, CS, per each

Pay Item D70181	Apron Endwalls, 48 inch, RC, per each
Pay Item D70182	Apron Endwalls, 48 inch, CS, per each
Pay Item D70183	Apron Endwalls, 54 inch, RC, per each
Pay Item D70184	Apron Endwalls, 54 inch, CS, per each
Pay Item D70185	Apron Endwalls, 60 inch, RC, per each
Pay Item D70186	Apron Endwalls, 60 inch, CS, per each
Pay Item D70187	Apron Endwalls, 72 inch, RC, per each
Pay Item D70188	Apron Endwalls, 72 inch, CS, per each
Pay Item D70189	Apron Endwalls, 84 inch, RC, per each
Pay Item D70190	Apron Endwalls, 84 inch, CS, per each
Pay Item D70191 through D70198	Apron Endwalls, _____ inch by _____ inch, _____, per each
Pay Item D70199	Rock Excavation for Pipe Trench, per cubic yard

Measurement and payment will only be made for Pay Items contained 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.

MATERIAL REQUIREMENTS

ASTM A 760	Corrugated Steel Pipe, Metallic–Coated for Sewers and Drains
ASTM A 761	Steel Galvanized, Corrugated Structural Plates and Fasteners for Pipe, Pipe–Arches, and Arches
ASTM C 76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 94	Ready Mixed Concrete
ASTM C 144	Aggregate for Masonry Mortar
ASTM C 150	Portland Cement
ASTM C 443	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 506	Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C 507	Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe
ASTM C 655	Reinforced Concrete D–Load Culvert, Storm Drain and Sewer Pipe
ASTM C 789	Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
ASTM C 850	Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less than 2 feet of Cover
ASTM D 1056	Flexible Cellular Materials—Sponge or Expanded Rubber
AASHTO M 198	Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
AASHTO M 243	Field Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe–Arches, and Arches

SPECIFICATION D–705. PIPE UNDERDRAINS FOR AIRPORTS

DESCRIPTION

705–1.1 This Work consists of the construction of pipe underdrains in accordance with these Specifications and in conformity with the lines and grades and details shown on the Plans.

MATERIALS

705–2.1 GENERAL. The pipe shall be of the type called for on the Plans and shall be in accordance with the following appropriate requirements. Whenever a type of pipe is not indicated on the Plans or in the Special Provisions, provide pipe in accordance with one of the following standards.

Polymer Precoated Perforated Corrugated Steel Pipe	ASTM A 762
Smooth–Wall Perforated PVC Pipe	ASTM F 758
Poly (Vinyl Chloride)(PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings	ASTM F 949
Corrugated Polyethylene Drainage Tubing	AASHTO M 252
Corrugated Polyethylene Pipe	AASHTO M 294

705–2.2 ELASTOMERIC SEALS. Elastomeric seals shall conform to the requirements of ASTM F 477.

705–2.3 POROUS BACKFILL. Porous backfill shall be free of clay, humus, or other objectionable matter, and shall conform to the gradation in Table 1 when tested in accordance with ASTM C 136.

TABLE 1. GRADATION OF POROUS BACKFILL

Sieve Designations (square openings)	*Percentage by Weight Passing Sieves*	
	Porous Material No. 1	*Porous Material No. 2*
1–1/2 inch		100
1 inch (225.0 mm)		90–100
3/8 (9.5 mm)	100	25–60
No. 4 (4.75 mm)	95–100	5–40
No. 8 (2.36 mm)		0–20
No. 16 (1.18 mm)	45–80	
No. 50 (0.30 mm)	10–30	
No. 100 (0.15 mm)	0–10	

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.

705–2.4 GEOTEXTILE FABRIC. Provide Type DF, Geotextile Fabric in accordance with Specification P-635.

705-2.5 CONCRETE. Portland cement concrete for end sections, concrete collars, and other uses shall conform to Specification P-610.

CONSTRUCTION METHODS

705–3.1 EQUIPMENT. Before construction is permitted to start, provide equipment necessary and required for the proper construction of pipe underdrains on the project, in first–class working condition, and approved by the Engineer.

705–3.2 EXCAVATION. The width of the pipe trench shall be sufficient (but not less than the external diameter of the pipe plus 6 inches (150 mm) on each side) to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe.

Remove rock, hardpan, or other unyielding material that is encountered, below the foundation grade for a depth of at least 4 inches (100 mm). Backfill the excavation grade with selected fine compressible material, such as silty clay or loam, and lightly compact it in layers not over 6 inches (150 mm) in uncompacted depth to form a uniform but yielding foundation.

Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, remove the unstable soil and replace it with approved granular material for the full trench width. The Engineer will determine the depth of removal necessary. Compact the granular material to provide adequate support for the pipe.

Dispose of excavated material that is not required or acceptable for backfill as directed by the Engineer. Do not carry the excavation below the required depth. If this is done, backfill the trench at the Contractor's expense with material approved by the Engineer and compacted to the density of the surrounding earth material.

Shape the bed for the pipe so that at least the lower quarter of the pipe is in continuous contact with the bottom of the trench. Excavate spaces for the pipe bell accurately to size to clear the bell so that the barrel supports the entire weight of the pipe.

Trench brace, sheath, or shore as necessary to perform and protect the excavation as required for safety and conformance to governing laws. Unless otherwise provided, remove the bracing, sheathing, or shoring after the completion of the backfill to at least 12 inches (300 mm) over the top of the pipe. Pull the sheathing or shoring as the granular backfill is placed and compacted to avoid any unfilled spaces between the trench wall and the backfill material. Include the cost of bracing, sheathing, or shoring, and the removal of it in the unit price bid for the pipe.

705–3.3 LAYING AND INSTALLING PIPE. Start laying the pipe in the finished trench at the lowest point and lay it upgrade. When bell and spigot pipe is used, lay the bells upgrade. If tongue and groove pipe is used, lay the groove end upgrade. Place holes in perforated pipe down, unless otherwise shown on the Plans. Firmly and accurately set the pipe to line and grade shown on the Plans so that the invert will be smooth and uniform. Do not lay pipe on frozen ground.

Take up and relay pipe which is not true in alignment, or which shows settlement after laying without extra compensation.

Install PVC pipe in accordance with the requirements of ASTM D 2321.

Plug or cap the upgrade end of pipelines, not terminating in a structure, as approved by the Engineer.

Unless otherwise shown on the Plans, spread a 4–inch (100 mm) bed of granular backfill material in the bottom of the trench throughout the entire length under all perforated pipe underdrains.

Construct pipe outlets for the underdrains when required or shown on the Plans. Lay the pipe with tight–fitting joints. When shown on Plans, porous backfill is not required around or over pipe outlets for underdrains. Make all connections to other drainage pipes or structures with manufactured fittings and connections, or as shown on the Plans. If connections are not made to other pipes or structures, protect the pipe outlets and construct them as shown on the Plans.

705–3.4 POROUS BACKFILL BEDDING. Install bedding and geotextile fabric as shown on Plans.

Wrap the geotextile fabric securely around porous backfill material as shown on Plans along its entire length so that no water can enter the porous material without first passing through the fabric.

Furnish geotextile fabric in a cover that protects the fabric from exposure to sunlight and abrasion due to shipping and hauling. Do not expose the fabric to the direct rays of the sun for more than 48 hours prior to covering.

Cover torn or punctured fabric with a suitable geotextile fabric extending at least 12 inches (305 mm) in any direction from the edge of the damaged fabric.

Overlap all joints or splices a minimum of 18 inches (460 mm).

705–3.5 BACKFILLING.

Earth. Backfill trenches and excavations within a reasonable time after the pipes are installed, unless other protection of the pipe is directed. The backfill material shall be as shown on the Plan, or if not shown, shall be selected material from excavation or borrow. Material which is placed within a nominal pipe diameter distance of the sides of the pipe and 1 foot (305 mm) over the top shall be material which can be readily

compacted. It cannot contain stones retained on a 3–inch (75 mm) sieve, frozen lumps, chunks of highly plastic clay, or other material that is objectionable to the Engineer. Moisten or dry the material, if necessary to be compacted by the method in use. Backfill material must be approved by the Engineer. Take special care in placing the backfill. Use great care to obtain thorough compaction under the haunches and along the sides to the top of the pipe.

Place the backfill in loose layers not exceeding 6 inches (150 mm) in depth under and around the pipe, and not exceeding 8 inches (200 mm) over the pipe. Add successive layers and thoroughly compact them by hand and pneumatic tampers, approved by the Engineer, until the trench is completely filled and brought to the proper elevation. Backfill in a manner to avoid injurious top or side pressures on the pipe.

In embankments and for other areas outside of pavements, compact the backfill to the density required for embankments in unpaved areas under Specification P–152. Under paved areas, compact the subgrade and any backfill to the density required for embankments for paved areas under Specification P–152.

Granular Material. When granular backfill is required, place it in the trench and about the pipe as shown on the Plans. Take special care in placing the backfill. The granular backfill cannot contain a damaging amount of foreign matter, nor can earth from the sides of the trench or from the windrow be allowed to filter into the backfill. When required by the Engineer, use a template to properly place and keep separate the two sizes of backfill. Place the backfill in loose layers not exceeding 6 inches (150 mm) in depth and compact it by hand and pneumatic tampers to the requirements as given for earth backfill. Backfill in a manner to avoid injurious top or side pressure on the pipe. Make the granular backfill to the elevation of the trench, as shown on the Plans.

When perforated pipe is specified, place granular backfill material along the full length of the pipe. Position the granular material as shown on the Plans.

When placing porous backfill in paved or adjacent areas prior to the completion of grading or subgrade operations, place the backfill material immediately after laying the pipe. The depth of this granular backfill cannot be less than 12 inches (305 mm), measured from the top of the underdrain. During subsequent construction operations, do not disturb this minimum backfill of 12 inches (305 mm) of depth until completion of the underdrains.. When completing the underdrains, remove the unsuitable material until the porous backfill is exposed. Remove and replace that part of the porous backfill that contains objectionable material with suitable material. The cost of removing and replacing unsuitable material shall be borne by the Contractor.

Whenever using a granular subbase blanket course under pavements that extend several feet beyond the edge of paving to the outside edge of the underdrain trench, place the granular backfill material over the underdrains in the trench up to an elevation of 2 inches (50 mm) above the bottom surface of the granular subbase blanket course. Immediately prior to placing the granular subbase blanket course, 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. Remove and replace unsuitable material that remains over the underdrain trench. Place the subbase material 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 END SECTIONS. Construct underdrain end sections in accordance with the details and at the location shown on the Plans.

705–3.7 RISERS. Construct underdrain risers in accordance with the details and at the locations shown on the Plans.

705–3.8 CONNECTIONS. When the Plans call for connections to existing or proposed pipe or structures, these connections must be watertight and made so that a smooth uniform flow line will be obtained throughout the drainage system.

705–3.9 CLEANING AND RESTORATION OF SITE. After the backfill is completed, 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. Except for paved areas of the airport, restore all disturbed areas to their original condition unless indicated otherwise on the Plans or in the Special Provisions.

METHOD OF MEASUREMENT

705–4.1 The length of pipe to be paid for will be the number of linear feet of pipe underdrains in place, completed, and approved; measured along the centerline of the pipe from end or inside face of structure to the end or inside face of structure, whichever is applicable. Fittings will be included in the footage as typical pipe sections in the pipeline being measured.

705–4.2 The quantity of porous backfill to be paid for will be the number of cubic yards of porous backfill No. 1 and No. 2, complete in place and accepted, and will be determined from the dimensions given on the Plans on typical trench sections indicating the placement of porous backfill. Quantities outside the typical trench sections shown will not be measured for payment.

705–4.3 Airport Underdrain Risers and End Sections will be measured on the basis of the amount per each installed and accepted.

BASIS OF PAYMENT

705–5.1 Payment will be made at the Contract unit price per linear foot for Airport Underdrain of the size designated; at the Contract unit price per cubic yard for Porous Backfill No. 1; and at the Contract unit price per cubic yard for Porous Backfill No. 2; and at the Contract unit price per each for Airport Underdrain Riser and Airport Underdrain End Sections. These prices will be full compensation for furnishing all materials and for all preparation, excavation, and installation of these materials, bedding, backfill, site restoration, and for all labor, equipment, tools, and incidentals necessary to complete the Work. The cost of geotextile fabric shall be included in a separate item for geotextile fabric.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item D70501	Airport Underdrain, 6 inch, per linear foot
Pay Item D70502	Airport Underdrain, 8 inch, per linear foot
Pay Item D70503	Airport Underdrain, 10 inch, per linear foot
Pay Item D70504	Airport Underdrain, 12 inch, per linear foot
Pay Item D70510	Porous Backfill No. 1, per cubic yard
Pay Item D70511	Porous Backfill No. 2, per cubic yard
Pay Item D70512	Airport Underdrain Riser, per each
Pay Item D70513	Airport Underdrain End Section, per each.
Pay Item D70514	Airport Underdrain Unperforated, 6 inch, per linear foot
Pay Item D70515	Airport Underdrain, Unperforated, 8 inch, per linear foot
Pay Item D70516	Airport Underdrain, Unperforated, 10 inch, per linear foot
Pay Item D70517	Airport Underdrain, Unperforated, 12 inch, per linear foot

Measurement and payment will only be made for Pay Items contained 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.

MATERIAL REQUIREMENTS

ASTM A 762	Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C 144	Aggregate for Masonry Mortar
ASTM C 150	Portland Cement
ASTM D 2321	Underground Installation of Flexible Thermoplastic Sewer Pipe
ASTM D 3034	Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM F 477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 758	Smooth–Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
ASTM F 949	Poly (Vinyl Chloride)(PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
AASHTO M 252	Corrugated Polyethylene Drainage Tubing
AASHTO M 294	Corrugated Polyethylene Pipe, 12 to 24 in. diameter

TESTING REQUIREMENTS

SPECIFICATION D–751. MANHOLES, CATCH BASINS, AND INLETS

DESCRIPTION

751–1.1 This Work consists of construction of manholes, catch basins and inlets, 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.

MATERIALS

751–2.1 BRICK. Brick shall conform to the requirements of ASTM C 32, Grade SM.

751–2.2 MORTAR. Mortar consists of one part Portland cement and two parts sand. The Portland cement shall conform to the requirements of ASTM C 150, Type I. The sand shall conform to the requirements of ASTM C 144.

751–2.3 CONCRETE. 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 P–610.

751–2.4 PRECAST REINFORCED CONCRETE MANHOLE SECTIONS. Precast reinforced concrete manhole sections shall conform to the requirements of ASTM C 478. Unless otherwise specified or shown on the Plans, the risers and offset cone sections shall have an inside diameter of not less than 36 inches (0.90 m).

751–2.5 CORRUGATED METAL. Corrugated metal shall conform to the requirements of AASHTO M 36.

751–2.6 FRAMES, COVERS, AND GRATES. The castings shall conform to one of the following requirements:

a. Gray iron castings shall meet the requirements of ASTM A 48.

b. Malleable iron castings shall meet the requirements of ASTM A 47.

c. Structural steel for grates and frames shall conform to the requirements of ASTM A 283, Grade D.

d. Ductile iron castings shall conform to the requirements of ASTM A 536.

All castings or structural steel units shall conform to the dimensions shown on the Plans and shall be designed to support the loadings specified.

Provide frame and cover or grate units (castings) with fastening members to prevent dislodging due to traffic but which will allow easy removal for access to the structure.

Castings shall be thoroughly cleaned and given two coats of approved bituminous paint. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A 123.

751–2.7 STEPS. Steps or ladder bars shall be gray or malleable cast iron steps or steps constructed utilizing steel reinforcing rod encapsulated in copolymer polypropylene. Steps shall conform to ASTM C 478. Steps shall be the size, length, and shape shown on the Plans and given a coat of bituminous paint.

751-2.8 PREFORMED FLEXIBLE JOINT SEALANT. Provide preformed flexible joint sealant in accordance with ASTM C 990.

CONSTRUCTION METHODS

751–3.1 UNCLASSIFIED EXCAVATION.

a. Excavate for structures and structure footings to the lines and grades or elevations shown on the Plans, or as staked by the Engineer. Excavate to sufficient size to permit the placing of the full width and length of the structure or structure footings shown.

b. Remove boulders, logs, or other objectionable material encountered in excavation. Clean rock or other hard foundation material of loose material and cut to a firm surface either level, stepped, or serrated, as directed by the Engineer. Clean or grout seams or crevices. Remove loose and disintegrated rock and thin strata. When concrete is to rest on a surface other than rock, take special care not to disturb the bottom of the excavation. Excavation to final grade shall not be made until just before placing the concrete or reinforcing.

c. 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.

d. Unless otherwise provided, remove bracing, sheathing, or shoring involved in the construction of structures after the completion of the structure. The removal should not disturb or mar finished masonry. Include the cost of removal in the unit price bid for the structure.

e. Notify the Engineer after each excavation is completed, and place concrete or reinforcing steel after the Engineer has approved the depth of the excavation and the character of the foundation material.

751–3.2 BRICK STRUCTURES.

a. Foundations. Place a prepared foundation 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 P–610.

b. Laying Brick. Brick must be clean and thoroughly wet before laying so that it will not absorb any appreciable amount of additional water at the time it is laid. Lay brick in freshly made mortar. Discard mortar that is not used within 45 minutes after water has been added. Retempering of mortar is not permitted. Spread an ample layer of mortar on the beds and make a shallow furrow in it which can be readily closed by the laying of the brick. Fill bed and head joints solid with mortar. Fully butter end joints of stretchers and side or cross joints of headers with mortar and a shoved joint made to squeeze out mortar at the top of the joint. Remove, clean, and relay bricks with fresh mortar that may be loosened after the mortar has taken its set. Do not use broken or chipped brick in the face, and do not use spalls or bats except where necessary to shape around irregular openings or edges; in which case, place full bricks at ends or corners where possible, and place the bats used in the interior of the course. In making closures, do not use a piece of brick shorter than the width of a whole brick; and wherever practicable, use and lay whole brick as headers.

c. Joints. Slush joints with mortar at every course, but slushing alone will not be considered adequate for making an acceptable joint. Lay up exterior faces in advance of backing. Back plaster or parget exterior faces with a coat of mortar not less than 3/8–inch (9 mm) thick before the backing is laid up. Prior to pargeting, cut all joints flush on the back of face courses. Unless otherwise noted, joints shall be not less than 1/4–inch (6 mm) nor more than 1/2–inch (12 mm) wide and whatever width is adopted shall be maintained uniform throughout the Work.

d. Pointing. Neatly strike face joints, using the weather joint. Finish joints properly as the laying of the brick progresses. When nails or line pins are used immediately plug holes with mortar and point when the nail or pin is removed.

e. Cleaning. Upon completion of the Work, thoroughly clean exterior surfaces by scrubbing and washing down with water and, if necessary to produce satisfactory results, clean with a 5 percent solution of muriatic acid which is then rinsed off with liberal quantities of clean fresh water.

f. Curing and Cold Weather Protection. In hot or dry weather, or when directed by the Engineer, protect the brick masonry and keep moist for at least 48 hours after laying the brick. Brick masonry work or pointing should not be done when there is frost in the brick or when the air temperature is below 50°F (10°C) 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 (15°C) for the duration of the curing period.

751–3.3 CONCRETE STRUCTURES. Build concrete structures on prepared foundations, conforming to the dimensions and form indicated on the Plans. The construction shall conform to the requirements specified in Specification P–610. Required reinforcement shall be placed as indicated on the Plans and will be approved by the Engineer before concrete is poured.

Construct and shape invert channels accurately so as to be smooth, uniform, and cause minimum resistance to flowing water. Slope the interior bottom downward toward the outlet.

751–3.4 PRECAST REINFORCED CONCRETE STRUCTURES. Construct precast reinforced concrete structures with an integral base or on prepared or previously placed slab foundations and that conform to the dimensions and locations shown on the Plans. Furnish precast reinforced concrete sections necessary to build a completed structure. The different sections should fit together readily, and all jointing and connections must be watertight. Form and dimension the top of the uppermost precast concrete section to receive the metal frame and cover or grate, or other cap, as required. Seal joints between concrete sections with preformed flexible joint sealant installed in accordance with applicable requirements of ASTM C 990 and manufacturer's instructions. Provide provisions for connections for lateral pipe, including drops

and leads that may be installed in the structure. Connections should be made with mortar joints. Form flow lines with concrete that will be smooth, uniform, and cause minimum resistance to flow. Install steps or ladders as shown on the Plans.

751–3.5 CORRUGATED METAL STRUCTURES. Construct corrugated metal structures on prepared foundations, conforming to the dimensions and locations as shown on the Plans. Use prefabricated structures. Furnish standard or special fittings to provide pipe connections or branches of correct dimensions. The connections or branches should be long enough to accommodate connecting bands. Weld the fittings in place to the metal structures. When indicated, place the structures on a reinforced concrete base. Design the top of the metal structure so that either a concrete slab or metal collar may be attached to which then can be fastened a standard metal frame and grate or cover. Furnish steps or ladders as shown on the Plans.

751–3.6 INLET AND OUTLET PIPES. Extend inlet and outlet pipes through the walls of the structures for a sufficient distance beyond the outside surface to allow for connections but cut off flush with the wall on the inside surface. For concrete or brick structures, place the mortar around these pipes so as to form a tight, neat connection.

751–3.7 PLACEMENT AND TREATMENT OF CASTINGS, FRAMES, AND FITTINGS. Place castings, frames, and fittings for manhole and inlet covers in the positions indicated on the Plans or as directed by the Engineer, and set true to line and to correct elevation. If frames or fittings are to be set in concrete or cement mortar, place and position all anchors or bolts before the concrete or mortar is placed. Do not disturb the unit until the mortar or concrete has set.

When frames or fittings are to be placed upon previously constructed masonry, bring the bearing surface or masonry true to line and grade and present an even bearing surface in order that the entire face or back of the unit will come in contact with the masonry. Set the unit in mortar beds and anchor to the masonry as indicated on the Plans or as directed and approved by the Engineer. Set firm and secure all units.

After the frames or fittings have been set in final position and the concrete or mortar has been allowed to harden for 7 days, place and fasten down the grates or covers.

751–3.8 INSTALLATION OF STEPS. Install the steps as indicated on the Plans or as directed by the Engineer. When setting the steps in concrete, place and secure them in position before the concrete is poured. When the steps are installed in brick masonry, place them as the masonry is being built. Do not disturb or use the steps until the concrete or mortar has hardened for at least 7 days. After this period has elapsed, clean and paint the steps, unless they have been galvanized.

When steps are required with precast reinforced concrete structures, cast them into the sides of the pipe at the time the pipe sections are manufactured or set in place after the structure is erected. This is done by drilling holes in the concrete and cementing the steps in place or installing in accordance with the manufacturer's instructions.

When steps are required with corrugated metal structures, weld them into aligned position at a vertical spacing of 12 inches (300 mm).

Instead of steps, prefabricated ladders may be installed. In the case of brick or concrete structures, hold the ladder in place by grouting the supports in drilled holes. In the case of metal structures, secure the ladder by welding the top support and grouting the bottom support into drilled holes in the foundation or as directed.

751–3.9 BACKFILLING.

a. After a structure has been completed, fill the area around it with approved material, in horizontal layers not to exceed 8 inches (200 mm) in loose depth, and compacted to the density required in Specification P–152 for the location where the structure is located or as shown on the Plans. Deposit each layer all around the structure to approximately the same elevation. The top of the fill must meet the elevation shown on the Plans or as directed by the Engineer.

b. Do not place backfill against structures until the structure can support the loads imposed by the backfill. In the case of concrete structures, the concrete shall be in place 7 days, or until tests made by a laboratory establish that the concrete has attained sufficient strength to provide a factor of safety against damage or strain in withstanding pressure created by the backfill or the placement methods.

c. Backfill shall not be measured for direct payment. Performance of this Work shall be considered as a subsidiary obligation of the Contractor covered under the Contract unit price for the structure involved.

751–3.10 CLEANING AND RESTORATION OF SITE. After the backfill is completed, 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. Restore all disturbed areas to their original condition.

After all Work is completed, remove all tools and equipment, leaving the entire site free, clear, and in good condition.

METHOD OF MEASUREMENT

751–4.1 Manholes, catch basins, inlets, manhole covers, inlet covers, and adjusting covers will be measured by the unit per each complete in-place.

BASIS OF PAYMENT

751–5.1 MANHOLES, CATCH BASINS, AND INLETS. The accepted quantities of manholes, catch basins, and inlets will be paid for at the Contract unit price per each, complete and in place. This price will be full compensation for furnishing all materials (including steps but not covers) and for all preparation, excavation, dewatering, site restoration, backfilling and placing of the materials; for furnishing and installation of such specials and connections to pipes and other structures as may be required to complete the Work as shown on the Plans; and for all materials, labor, equipment, steps, tools and incidentals necessary to complete the structure.

Manhole Covers and Inlet Covers. Work under the Pay Items of Manhole Covers (Type) and Inlet Covers (Type), measured as provided above, will be paid for at the Contract unit price each, which price will be full compensation for removing and salvaging the existing covers; for furnishing new covers, including frames, grates or lids, and all other required materials; and for all labor, tools, equipment and incidentals necessary for adjusting and installing each cover complete. Old covers removed shall remain the property of the Airport.

Adjusting Covers. Work under the Pay Item of Adjusting Covers, measured as provided above, will be paid for a the Contract unit price each, which price will be full compensation for furnishing all required materials, exclusive of frames, grates or lids available and designated for adjusting; for removing, reinstalling and adjusting the covers on manholes, inlets, or catch basins; and for all labor, tools, equipment and incidentals necessary for adjusting each cover. Covers to be adjusted and which are rendered unfit for use by the Contractor through the Contractor's operations shall be replaced by the Contractor at the Contractor's own cost and expense.

The adjusting of covers, when designated on the Plan or in the Contract and when not covered by a Contract Pay Item, will be considered as Work incidental to other Contract Pay Items and no separate or extra compensation will be allowed.

Required adjusting of covers, when not designated on the Plans or when the Contract does not contain a Pay Item for adjusting covers, will be considered and paid for as Extra Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item D75101	Storm Water Manholes, Type 1, per each
Pay Item D75102	Storm Water Manhole, Type 2, per each
Pay Item D75103	Storm Water Manhole, Type 3, per each
Pay Item D75104	Storm Water Manhole, Type 5, per each
Pay Item D75105	Storm Water Manhole, Type 6, per each
Pay Item D75110	Storm Water Catch Basin, Type 1, per each
Pay Item D75111	Storm Water Catch Basin, Type 2, per each
Pay Item D75112	Storm Water Catch Basin, Type 3, per each
Pay Item D75113	Storm Water Catch Basin, Type 5, per each
Pay Item D75120	Storm Water Inlet, Type 1, per each
Pay Item D75121	Storm Water Inlet, Type 2, per each
Pay Item D75122	Storm Water Inlet, Type 3, per each
Pay Item D75123	Storm Water Inlet, Type 4, per each
Pay Item D75124	Storm Water Inlet, Type 8, per each
Pay Item D75125	Storm Water Inlet, Type 9, per each
Pay Item D75126	Storm Water Inlet, Type 10, per each
Pay Item D75127	Storm Water Inlet, Type 11, per each
Pay Item D75140	Manhole Cover, Type J, per each
Pay Item D75141	Manhole Cover, Type K, per each
Pay Item D75142	Manhole Cover, Type L, per each
Pay Item D75143	Manhole Cover, Type M, per each
Pay Item D75150	Inlet Cover, Type H-S, per each
Pay Item D75151	Inlet Cover, Type A-S, per each
Pay Item D75152	Inlet Cover, Type B-A, per each

Pay Item D75153	Inlet Cover, Type MS-A, per each
Pay Item D75154	Inlet Cover, Type HM-S, per each
Pay Item D75155	Inlet Cover, Type A, per each
Pay Item D75156	Inlet Cover, Type B, per each
Pay Item D75157	Inlet Cover, Type C, per each
Pay Item D75158	Inlet Cover, Type F, per each
Pay Item D75159	Inlet Cover, Type H, per each
Pay Item D75160	Inlet Cover, Type Z, per each
Pay Item D75161	Inlet Cover, Type GM-A, per each
Pay Item D75162	Inlet Cover, Type MS, per each
Pay Item D75163	Inlet Cover, Type WM, per each
Pay Item D75164	Inlet Cover, Type W, per each
Pay Item D75165	Inlet Cover, Type X, per each
Pay Item D75166	Inlet Cover, Type V, per each
Pay Item D75167	Inlet Cover, Type R, per each
Pay Item D75168	Inlet Cover, Type GM, per each
Pay Item D75169	Inlet Cover, Type S, per each
Pay Item D75170	Inlet Cover, Type HM, per each
Pay Item D75180	Adjusting Cover, per each

Measurement and payment will only be made for Pay Items contained 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.

MATERIAL REQUIREMENT

ASTM A 27	Mild to Medium–Strength Carbon–Steel Castings for General Application
ASTM A 47	Malleable Iron Castings
ASTM A 48	
ASTM A 123	Zinc (Hot–Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip
ASTM A 283	Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes, and Bars
ASTM A 536	
ASTM C 32	Sewer and Manhole Brick
ASTM C 94	Ready Mixed Concrete
ASTM C 144	Aggregate for Masonry Mortar
ASTM C 150	Portland Cement
ASTM C 478	Precast Reinforced Concrete Manhole Sections
ASTM C 443	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 822	Standard Definitions and Terms Relating to Concrete Pipe and Related Products
ASTM C 990	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
AASHTO M 36	Zinc Coated (Galvanized) Corrugated Iron or Steel Culverts and Underdrains

SPECIFICATION D–752. CONCRETE CULVERTS, HEADWALLS, AND MISCELLANEOUS DRAINAGE STRUCTURES

DESCRIPTION

752–1.1 This Work consists of 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 or required by the Engineer.

MATERIALS

752–2.1 CONCRETE. Reinforced concrete shall meet the requirements of Specification P–610.

CONSTRUCTION METHODS

752–3.1 UNCLASSIFIED EXCAVATION.

a. Excavate trenches and foundation pits for structures or structure footings to the lines and grades or 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.

b. Remove boulders, logs, or other objectionable material encountered in excavation. Clean rock or other hard foundation material of loose material and cut to a firm surface either level, stepped, or serrated, as directed by the Engineer. Clean out and grout seams or crevices. Remove loose and disintegrated rock and thin strata. When concrete is to rest on a surface other than rock, take special care not to disturb the bottom of the excavation, and do not excavate to final grade until just before the concrete or reinforcing steel is to be placed.

c. 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. Include the cost of bracing, sheathing, or shoring in the unit price bid for excavation.

d. Unless otherwise provided, remove any involved bracing, sheathing, or shoring after the completion of the structure. Remove in a manner which will not disturb or mar finished concrete. Include the cost of removal in the unit price bid for Unclassified Excavation for Drainage Structures.

e. Notify the Engineer after each excavation is completed, and place concrete or reinforcing steel after the Engineer has approved the depth of the excavation and the character of the foundation material.

752–3.2 BACKFILLING.

a. After a structure has been completed, accomplish backfilling with approved material by applying the fill in horizontal layers not to exceed 8 inches (200 mm) in loose depth, and compacted. The field density of the compacted material must be at least 90 percent of the maximum density for cohesive soils and 95 percent of the maximum density for noncohesive soils. Determine the maximum density in accordance with ASTM D 698. Determine the field density in accordance with ASTM D 1556 or ASTM D 2167.

b. Do not place backfill against any structure until the concrete has been in place 7 days, or until tests made by an approved 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.

c. Deposit fill (placed around concrete culverts) on both sides at the same time and to approximately the same elevation. Take care to prevent any wedging action against the structure. Step or serrate all slopes bounding or within the areas to be backfilled to prevent wedge action.

d. Backfill will not be measured for direct payment. Performance of this Work under the Contract is not payable directly but shall be considered as a subsidiary obligation of the Contractor, covered under the Contract unit price for Unclassified Excavation for Structures.

752–3.3 WEEP HOLES. Construct weep holes as shown on the Plans.

752–3.4 RESTORATION OF SITE. After the backfill is completed, dispose of surplus material, dirt, and rubbish from the site. Deposit surplus dirt in embankment, shoulders, or as ordered by the Engineer. Restore all disturbed areas to their original condition.

After all Work is completed, remove all tools and equipment, leaving the entire site free, clear, and in good condition.

METHOD OF MEASUREMENT

752–4.1 The quantity of Unclassified Excavation for Drainage Structures to be paid for will be the number of cubic yards, measured in original position, of material excavated in accordance with the Plans, or as directed by the Engineer; 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 (450 mm) outside of and parallel to the neat lines of the footings. The quantity of Unclassified Excavation for Drainage Structures will only be measured for payment for structures constructed under this Specification.

752–4.2 Structural Concrete for Drainage Structures will be measured by the number of cubic yards of concrete, complete in place and accepted. In computing the yardage of concrete for payment, the dimensions used will be those shown on the Plans or ordered by the Engineer. No measurements or other allowances will be made for forms, false work, cofferdams, pumping, bracing, expansion joints, or finishing of the concrete. No deductions in yardage will be made for the volumes of reinforcing steel or embedded items.

752–4.3 The quantity of Reinforcing Steel for Drainage Structures to be paid for will be the calculated theoretical number of pounds 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.

BASIS OF PAYMENT

752–5.1 Payment will be made at the Contract unit price per cubic yard for Unclassified Excavation for Structures; at the Contract unit price per cubic yard for Structural Concrete for Drainage Structures; and at the Contract unit price per pound for Reinforcing Steel for Drainage Structures. These prices will be full compensation for furnishing and placing all materials, and for all preparation, excavation, dewatering, backfill, restoration, temporary sheathing and shoring, and for all labor, materials, equipment, tools, and incidentals necessary to complete the structure as specified and shown on the Plans.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item D75201	Unclassified Excavation for Drainage Structures, per cubic yard
Pay Item D75202	Structural Concrete for Drainage Structures, per cubic yard
Pay Item D75203	Reinforcing Steel for Drainage Structures, per pound

Measurement and payment will only be made for Pay Items contained 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.

TESTING REQUIREMENTS

ASTM D 698	Moisture–Density Relations of Soils and Soil–Aggregate Mixtures Using 5.5 lb (2.49 kg) Rammer and 12–in (305 mm) Drop
ASTM D 1556	Density of Soil in Place by the Sand–Cone Method
ASTM D 2167	Density of Soil in Place by the Rubber–Balloon Method

SPECIFICATION D–754. CONCRETE GUTTERS, DITCHES, AND FLUMES

DESCRIPTION

754–1.1 This Work consists 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.

MATERIALS

754–2.1 CONCRETE. Plain and reinforced concrete shall meet the requirements of Specification P–610.

754–2.2 JOINTS. Joint filler materials and premolded joint material shall conform to Specification P–610.

CONSTRUCTION METHODS

754–3.1 PREPARING SUBGRADE. Excavate to the required width and depth, and compact the subgrade upon which the item is to be built to a firm uniform grade. Remove soft and unsuitable material and replace it with suitable approved material. When required, place a layer of approved granular material, compacted to the thickness indicated on the Plans, to form a subbase. The underlying course will be checked and accepted by the Engineer before placing and spreading operations are started.

754–3.2 PLACING. The forms for and the mixing, placing, finishing, and curing of concrete shall conform to the requirements of Specification P–610 and shall be in accordance with the following requirements.

Tamp and spade the concrete until it is consolidated and mortar entirely covers and forms the top surface. The surface of the concrete should be floated smooth and the edges rounded to the radii shown on the Plans. Before the concrete is given the final finishing, test the surface with a 10–foot (3–m) straightedge, and eliminate irregularities of more than 1/4 inch (6 mm) in 10 feet (3 m).

Place the concrete with dummy–grooved joints not to exceed 25 feet (7.5 m) apart, except where shorter lengths are necessary for closures. No section should be less than 4 feet (1.20 m) long.

Construct expansion joints of the type called for in the Plans to replace a dummy groove at spacings of approximately 100 feet (30 m). When the gutter is placed next to concrete pavement, locate expansion joints in the gutter opposite expansion joints in the pavement. When a gutter abuts a pavement or other structure, place an expansion joint between the gutter and the other structure.

Do not remove forms within 24 hours after the concrete has been placed. Repair minor defects with mortar containing 1 part cement and 2 parts fine aggregate.

Conduct the operations of depositing, compacting, and finishing to build a satisfactory structure. Sections of concrete found to be porous (other than minor defects which may be plastered) shall be removed and replaced by the Contractor without additional compensation.

754–3.3 BACKFILLING. After the concrete has set sufficiently, refill the spaces adjacent to the structure 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 D 698. Determine the in–place density in accordance with ASTM D 1556 or ASTM D 2167.

754–3.4 CLEANING AND RESTORATION OF SITE. After the backfill is completed, 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. Restore all disturbed areas to their original condition.

After all Work is completed, remove all tools and equipment, leaving the entire site free, clear and in good condition.

Performance of the Work described in this section is not payable directly but shall be considered as a subsidiary obligation of the Contractor, covered under the Contract unit price for the structure.

METHOD OF MEASUREMENT

754–4.1 Concrete gutters, ditches, and flumes will be measured by the cubic yard, the square yard, or linear foot in accordance with the dimensions shown on the Plans or ordered by the Engineer. No deductions will be made for the volume occupied by reinforcing steel, anchors, conduits, weep holes, or piling.

BASIS OF PAYMENT

754–5.1 Payment will be made at the Contract unit price, which will be full compensation for furnishing all materials, preparation, excavation, construction, joints, finishing, backfilling, and all labor, materials, equipment, tools, and incidentals necessary to complete the Work in accordance with this specification.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item D75401	Concrete Gutter, per cubic yard
Pay Item D75402	Concrete Gutter, per square yard
Pay Item D75403	Concrete Flume, per cubic yard
Pay Item D75404	Concrete Flume, per square yard
Pay Item D75405	Concrete Curb and Gutter, per linear foot

Measurement and Payment will only be made for Pay Items contained 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.

TESTING REQUIREMENTS

ASTM D 698	Moisture–Density Relations of Soils and Soil–Aggregate Mixtures Using 5.5 lb (2.49 kg) Rammer and 12–inch (300 mm) Drop
ASTM D 1556	Density of Soil in Place by the Sand–Cone Method
ASTM D 2167	Density of Soil in Place by the Rubber–Balloon Method

SPECIFICATION T-901. SEEDING

DESCRIPTION

901–1.1 This Work consists of soil preparation and seeding the areas shown on the Plans or as directed by the Engineer in accordance with these Specifications.

NOTE TO SPECIFIER:
Item T–902, Fertilizing, shall be included when fertilizing or liming are required for a specific project.

Wetlands Seeding shall consist of the furnishing and sowing of Seed Mixture No. 60 on areas of the right–of–way and easements which may be wet for extended periods of time.

Uplands Seeding shall consist of the furnishing and sowing of Seed Mixture No. 70 on slopes, appurtenances and other upland areas of the right–of–way having well–drained soils where dry, droughty conditions are likely to exist.

Temporary Seeding shall consist of the furnishing and sowing of a temporary seed mixture on the slopes and appurtenances of temporary embankments and other temporary sites.

Seeding for borrow pits and material disposal site should be measured and paid under this item. Seed mixture for borrow and disposal sites on the Airport will generally be the same mixture as specified for other areas. A special borrow pit mixture is available in the Highway Specifications, if appropriate.

MATERIALS

901–2.1 SEED. The species and application rates of grass, legume, and cover–crop seed furnished shall be those stipulated herein. Seed shall conform to the requirements of Fed. Spec. JJJ–S–181 and these Specifications.

Provide seed conforming to the requirements of the Wisconsin Statutes and of the Wisconsin Administrative Code Chapter ATCP 20 regarding noxious weed seed content and labeling.

Do not use seed later than one year after the test date which appears on the label.

Seed shall be tested in accordance with the methods and procedures used for sampling and analyzing seed for purity, germination, and noxious weed seed content as prescribed by the current edition of Rules for Testing Seed, published by the Association of Official Seed Analysts.

Inoculate White Clover, Red Clover, Ladino Clover, Alsike Clover, Alfalfa, Empire Birdsfoot Trefoil and Crownvetch species. During inoculation, follow the instructions that ordinarily accompany such culture purchases. When the seed is applied according to Method B, treat seeds requiring inoculation with five times the amount of inoculant recommended in the instructions.

Avoid exposure of the culture or inoculated seed to the sunlight for more than ½ hour.

Store seed delivered prior to use to protect it from damage by heat, moisture, rodents or other causes. Discard and replace previously tested and accepted seed that is damaged.

Furnish seed separately or in mixtures in standard containers with the seed name, lot number, net weight, percentages of purity and of germination and hard seed, and percentage of maximum weed seed content clearly marked for each kind of seed. Furnish the Engineer duplicate signed copies of a statement by the vendor certifying that each lot of seed has been tested by a recognized laboratory for seed testing within 6 months of date of delivery. Include in this statement:

- name and address of laboratory,
- date of test,
- lot number for each kind of seed,
- the results of tests as to name, percentages of purity and of germination,
- and percentage of weed content for each kind of seed furnished, and, in case of a mixture, the proportions of each kind of seed.

Provide seed mixtures composed of seeds of the purity, germination, and proportions by weight given in the following Table 2, Table of Seed Mixtures. Provide seed species and varieties listed in Table 1.

Species and Acceptable Varieties. Where no variety is listed, there is no restriction on the variety furnished, provided the species is composed of pure live seed (PLS). PLS shall be grown in Wisconsin, northern Illinois, northeastern Iowa, or eastern Minnesota. PLS shall be packaged separately by species and clearly labeled.

TABLE 1. SPECIES AND ACCEPTABLE VARIETIES

Species Common Name	Species Botanical Name	Acceptable Varieties
Kentucky Bluegrass	Poa pratensis	
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
Redtop	Agrostis alba	
Timothy	Phleum pratense	
Little Bluestem*	Andropogon scoparius	
Sideoats Grama*	Bouteloua curtipendula	
Canada Wild Rye*	Elymus canadensis	
Perennial Rygrass	Lolium perenne	
Perennial Ryegrass	Lolium perenne	Improved Fine
Annual Ryegrass	Lolium multiflorum	
Alsike Clover	Trifolium hydridum	
Red Clover	Trifolium pratense	
White Clover	Trifolium repens	
Birdsfoot Trefoil	Lotus corniculatus	Empire
Japanese Millet	Echinochola crusgalli var. frumentacea	
Annual Oats	Avena sativa	
Alfalfa	Medicago sativa	
Bromegrass	Bromus inermis	
Orchardgrass	Dactylis glomerata	
Ladina Clover	Trifolium repens var. latum	Ladino
Agricultural Rye	Secale cereale	
Winter Wheat	Triticum aestivum	

***Pure Live Seed**

TABLE 2. SEED MIXTURES

Species	*Purity Min. %*	*Germination Min %*	*Mixture Proportions, Percent*						
			No. 10	*No. 20*	*No. 30*	*No. 40*	*No. 50*	*No. 60*	*No.. 70*
Kentucky Bluegrass	85	80	40	6	10	35			
Red Fescue	97	85	25		30	20			
Hard Fescue	97	85		24	25	20			10
Tall Fescue	98	85		40					25
Salt Grass	98	85			10				
Redtop	92	85	5						
Timothy	98	90						12	
Little Bluestem	PLS*								15
Sideoats Grama	PLS*								15
Canada Wild Rye	PLS*							12	5
Perennial Ryegrass	97	90	20	30					30
Improved Fine Perennial Ryegrass	96	85			15	25			
Annual Ryegrass	97	90						35	
Alsike Clover	97	90						4	
Red Clover	98	90						4	
White Clover	95	90	10						
Birdsfoot Trefoil	95	80			10		100		
Japanese Millet	97	85						8	
Annual Oats	98	90						25	

*Substitute winter wheat for annual oats in fall plantings started after September 1.]

NOTE TO SPECIFIER:
If more than one type of seed mixture is bid, indicate the locations where the various mixtures are required.

Select the seed mixture or mixtures for use on the project in accordance with the following:

Seed Mixture No. 10 is intended for use on projects where average loam, heavy clay or moist soils predominate.

Seed Mixture No. 20 is intended for use on projects where light, dry, well–drained, sandy or gravelly soils predominate and shall be used for all high cut and fill slopes (generally exceeding six to eight feet), except where No. 70 is used.

Seed Mixture No. 10 or No. 20 shall be used on all ditches, inslopes, median areas and low fills, except where Seed Mixture No. 30 or No. 70 is used.

Seed Mixture No. 30 is intended for use on medians and on slopes or ditches generally within 15 feet of the shoulder where a salt–tolerant turf is desired.

Seed Mixture No. 40 shall be used in urban or other areas where a lawn type turf is desired.

Seed Mixture No. 50 is designed to produce in conjunction with Seed Mixture No. 20 a suitable ground cover on very steep slopes where sterile soil and erosive conditions preclude the establishment of normal turf. Seed Mixture No. 50 shall be used only on areas where ground cover is desired.

Seed Mixture No. 60 shall be used as a cover seeding for newly graded wet areas or as a nurse crop for specified wetland seed mixtures. Do not apply to inundated areas for the item of Seeding, Wetlands and shall be used only on areas designated in the contract or by the engineer.

Seed Mixture No. 70 shall be used for seeding slopes and upland areas having well drained soils the item of Seeding, Uplands and shall be used only on areas designated in the contract or by the engineer.

Due consideration must be given to longevity of plants, resistance to traffic and erosion, and attraction of birds or large animals. More than one seeding season may be specified, if appropriate. Local offices of the USDA Soil Conservation Service and the State University Agricultural Extension Service (County Agent or equivalent) shall be consulted for assistance and recommendations. These agencies shall also be consulted for liming and fertilizer recommendations.

901–2.2 TEMPORARY. Temporary seed mixture for use with the item of Temporary Seeding shall conform to the requirements for oats for spring and summer plantings and rye for fall plantings (after September 1).

TABLE 2. TEMPORARY SEED MIXTURE

Species	*Min. % Purity*	*Min. % Germination*
Annual Oats	98	90
Agricultural Rye	97	85
Winter Wheat	95	90

901–2.3 SOIL FOR REPAIRS. The soil for fill and topsoiling of areas to be repaired must be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil should be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting, and establishing turf, and must be approved by the Engineer before being placed.

CONSTRUCTION METHODS

901–3.1 ADVANCE PREPARATION AND CLEANUP. After grading of areas has been completed and before applying fertilizer and ground limestone, rake or otherwise clear areas to be of stones (larger than 2 inches (50 mm) in any diameter), sticks, stumps, and other debris which might interfere with sowing of seed, growth of grasses, or subsequent maintenance of grass–covered areas. If damage by erosion or other causes has occurred after the completion of grading and before beginning the application of fertilizer and ground limestone, repair the damage. This Work includes filling gullies, smoothing irregularities, and repairing other incidental damage.

An area to be seeded is considered a satisfactory seedbed without additional treatment if it has recently been thoroughly loosened and worked to a depth of at least 5 inches (125 mm) as a result of grading operations and, if immediately prior to seeding, the top 3 inches (75 mm) of soil is loose, friable, reasonably free from large clods, rocks, large roots, or other undesirable matter, and if shaped to the required grade.

However, when the area to be seeded is sparsely sodded, weedy, barren, and unworked, or packed and hard, cut or satisfactorily dispose of grass and weeds, scarify the soil or otherwise loosen it to a depth of at least 5 inches (125 mm). Break clods and work the top 3 inches (75 mm) of soil into a satisfactory seedbed by discing, or by use of cultipackers, rollers, drags, harrows, or other appropriate means.

901–3.2 SCHEDULING. Seeding, except Nos. 60 and 70 Mixtures, when not protected with a mulch cover, shall be done at a time of the year, except during midsummer, when temperature and moisture conditions are suitable for germination.

Seeding, except Nos. 60 and 70 Mixtures, when performed in conjunction with Mulching as specified in Specification T–908, may be done at any time when conditions are suitable for germination.

Seeding of Nos. 60 and 70 Mixtures may be done at any time during the growing season when soil conditions are suitable except between July 15 and October 15, unless otherwise permitted by the Engineer.

Seed Mixture No. 50 may be applied together with Seed Mixture No. 20, or be used to overseed mixture No. 20 when necessary.

Seeding shall be done with the selected seed mixture sown at the specified rate.

901–3.3 SOWING. Unless otherwise specified, seeds may be sown at the option of the Contractor, by either Method A or Method B described below.

Method A. Sow the selected seed mixture by means of equipment adapted to the purpose, or it may be scattered uniformly over the areas to be seeded, and lightly raked or dragged to cover the seed with approximately 1/4 inch of soil. After seeding, lightly roll the areas or compact it by means of suitable equipment, preferably of the cultipacker type when in the judgment of the Engineer the seedbed is either too loose or contains clods which would reduce the germination of the seed. Slopes steeper than three to one need not be rolled.

Scatter seed by hand with satisfactory hand seeders only, and only at such times when the air is sufficiently quiet to prevent seeds from blowing away.

Method B. Sow or spread the seed on the prepared seed bed by means of a stream or spray of water under pressure operated from an approved type of machine designed for that purpose. Place the selected seed mixture and water into a tank, provided within the machine, in sufficient quantities so that when the contents of the tank are sprayed on a given area the seed will be uniformly spread at the required rate of application. During the process, keep the contents of the tank stirred or agitated to provide uniform distribution of the seed. Empty the contents of the tank within 2 hours after the seed is added to the tank. Discard seed that is allowed to remain mixed with the water for longer than 2 hours. Dragging or rolling will not be required.

901–3.4 SEEDING RATES. The sowing rate for seeds, in pounds per 1,000 square feet of area, shall be as follows:

Seed Mixture No. 10 at 1–1/2 pounds
Seed Mixture No. 20 at 3 pounds
Seed Mixture No. 30 at 2 pounds
Seed Mixture No. 40 at 2 pounds
Seed Mixture No. 50 at 1/2 pound
Seed Mixture No. 60 at 1–1/2 pounds (equivalent)
Seed Mixture No. 70 at 3 pounds (equivalent)
Temporary Seeding at 3 pounds

Determine the actual seeding rate for Seed Mixture No. 60 and Seed Mixture No. 70 by multiplying the equivalent rate of seeding for each of these mixtures by the sum of the unadjusted and adjusted percentages of the various species in the seed mixtures as sown.

The unadjusted percentage is the minimum percent of purity and germination specified in the Table of Seed Mixtures for the applicable species.

Obtain the adjusted percentage for each of the PLS species by dividing the specified percentage of such species by the product of the percent of purity and the percent of germination for each of the PLS species as delivered.

901–3.5 MAINTENANCE OF SEEDED AREAS. Protect seeded areas against traffic or other use by warning signs or barricades, as approved by the Engineer. Repair surfaces gullied or otherwise damaged following seeding by regrading and reseeding as directed. Mow, water as directed, and otherwise maintain seeded areas in a satisfactory condition until final inspection and acceptance of the Work.

When either application method outlined above is used for Work done out of season, it will be required that the Contractor establish a good stand of grass of uniform color and density to the satisfaction of the Engineer. If, at the time when the Contract has been otherwise completed, it is not possible to make an adequate determination of the color, density, and uniformity of such stand of grass, payment for the unaccepted portions of the areas seeded out of season will be withheld until such time as these requirements have been met.

METHOD OF MEASUREMENT

901–4.1 Seeding and Temporary Seeding will be measured by the pound. The quantity to be measured for payment will be the actual number of pounds of seed furnished and sown in accordance with the Contract, within the limits of such Work designated on the Plans or as ordered by the Engineer. Measurement will be based on net weights of seed shipments or on quantities weighed on approved scales furnished by the Contractor.

Deductions will be made for quantities which are wasted or are not actually incorporated in the Work in accordance with the Contract.

BASIS OF PAYMENT

901–5.1 SEEDING. This Pay Item, measured as provided above, will be paid for at the Contract unit price per pound for Seeding for the mixture specified, which will be full compensation for furnishing, handling and storing all seed; for furnishing the required culture and inoculating seed as specified; for preparing the seed bed, sowing, covering and firming the seed; and for all labor, tools, equipment and incidentals necessary to complete the Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item T90101	Seeding, Mixture No. 10, per pound
Pay Item T90102	Seeding, Mixture No. 20, per pound
Pay Item T90103	Seeding, Mixture No. 30, per pound
Pay Item T90104	Seeding, Mixture No. 40, per pound
Pay Item T90105	Seeding, Mixture No. 50, per pound
Pay Item T90106	Seeding, Mixture No. 60, per pound
Pay Item T90107	Seeding, Mixture No. 70, per pound

Measurement and Payment will be made only for 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.

MATERIAL REQUIREMENTS

Fed. Spec. JJJ–S–181B	Agricultural Seeds

SPECIFICATION T–902. FERTILIZING

DESCRIPTION

902–1.1 DESCRIPTION. Fertilizing, Type A or Type B, consists of furnishing and incorporating fertilizing material in the soil on areas to be seeded or in the surface of areas to be sodded, in accordance with the requirements of the Specifications.

Agricultural Limestone Treatment consists of furnishing and incorporating agricultural limestone in the soil on areas shown on the Plans or designated in the Contract, or as ordered by the Engineer, in accordance with the requirements of the Specifications.

MATERIALS

902–2.1 FERTILIZERS. Fertilizers intended for use in connection with seeding, sodding, or other planting shall be standard, commercial, packaged or bulk products in granular or liquid form conforming to the requirements of the Wisconsin Statutes and of the Wisconsin Administrative Code Chapter Agriculture 17. Each container of packaged fertilizer shall be plainly marked with the analysis of the contents showing minimum percentages of total nitrogen, available phosphoric acid and soluble potash. When the fertilizer is furnished in bulk, each shipment shall be accompanied by an invoice indicating the minimum percentages of total nitrogen, available phosphoric acid and soluble potash in the contents.

When fertilizer having a sum of nitrogen, phosphoric acid and potash greater than 32 percent for Type A or 50 percent for Type B is used, apply it at a rate which will provide an equivalent amount of nitrogen, phosphoric acid and potash.

Type A. Type A fertilizer shall meet the following minimum requirements:

Nitrogen, not less than 16%
Phosphoric Acid, not less than 6%
Potash, not less than 6%

The sum of nitrogen, phosphoric acid and potash shall be not less than 32 percent.

Total nitrogen shall be not less than the sum of the phosphoric acid and soluble potash.

Type B. Type B fertilizer shall meet the following minimum requirements:

Nitrogen, not less than ..... 16 percent
Phosphoric Acid, not less than ..... 6 percent
Potash, not less than ..... 24 percent

Sum of nitrogen, phosphoric acid and potash shall be not less than 50 percent.

902–2.2 AGRICULTURAL LIMESTONE. Agricultural limestone shall be limestone conforming to the requirements of Chapter 94.66 of the Wisconsin Statutes and of the Wisconsin Administrative Code Chapter Agriculture 28. Furnished limestone shall have a neutralizing index of not less than 40 or more than 109.

Furnish a statement indicating the index zone or grade of the limestone for each deposit prior to use.

CONSTRUCTION METHODS

902–3.1 FERTILIZER. Uniformly apply the fertilizer selected for the seeding areas and incorporate it in the soil by light discing or harrowing. Granular fertilizer should be well pulverized and free from lumps when applied.

When fertilizer is incorporated with topsoiled areas, the fertilizer may be applied just prior to and in conjunction with the final discing or harrowing operations of the topsoil, or in the event the topsoil is manipulated by hand, just prior to the final raking and leveling.

In the event fertilizer is to be placed on surfaces on which no topsoil is placed, prepare the soil by discing or harrowing to a depth of 5 inches and then incorporate the fertilizer as specified.

In the event fertilizer is to be placed on seeding areas where the seed is to be sown by means of a spray or stream of water under pressure, the required amount of fertilizer may be placed in the tank, mixed together with the water and the seed, and constantly agitated and applied in the seeding operation. Fertilizer applied by this method will not require discing and harrowing after being placed.

When the fertilizing of areas to be sodded is required, uniformly spread the fertilizer over the soil prior to sodding at the rate specified below. Work the fertilizer into the soil as the soil is loosened and prepared.

Apply Type A Fertilizer containing a 32 percent sum total of nitrogen, phosphoric acid and potash at 7 pounds per 1,000 square feet of area, unless otherwise specified in the Contract. Determine the application rate for Type A fertilizer containing a greater percentage of these components by dividing 224 by the greater percentage.

Apply Type B Fertilizer containing a 50 percent sum total of nitrogen, phosphoric acid and potash at 7 pounds per 1,000 square feet of area, unless otherwise specified in the Contract. Determine the application rate for Type B fertilizer containing a greater percentage of these components by dividing 350 by the greater percentage.

902–3.2 AGRICULTURAL LIMESTONE TREATMENT. Uniformly spread agricultural limestone over the designated areas at the rate specified in the following table for the index zone of the limestone proposed for use, unless otherwise specified in the Contract.

TABLE 1. AGRICULTURAL LIMESTONE TREATMENT

	Application Rates per 1000 Square Feet						
Index Zones	40–49	50–59	60–69	70–79	80–89	90–99	100–109
Pounds	140	120	100	90	80	70	60

For convenience in checking the required rate of application, the materials used may be measured on a volumetric basis, providing the conversion from weight to volume is determined from representative samples of the materials used.

Incorporate agricultural limestone in the soils in the designated areas in conjunction with the required fertilizers. Apply the limestone in accordance with the pertinent construction requirements applicable to fertilizers.

METHOD OF MEASUREMENT

902–4.1 METHOD OF MEASUREMENT. Fertilizer will be measured by the hundred pounds (cwt.) based on an application rate of 7 pounds per 1,000 square feet and 32 percent required fertilizer components for Type A and 50 percent of such components for Type B. The quantity to be measured for payment will be the amount of such material furnished and incorporated in the Work in accordance with the Contract. The quantity to be measured for payment shall be 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.

Agricultural Limestone Treatment will be measured by the ton (2,000 pounds), based on an application rate of 100 pounds per 1,000 square feet and an index zone of 60–69. The quantity to be measured for payment shall be 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.

BASIS OF PAYMENT

902–5.1 BASIS OF PAYMENT. Fertilizer, measured as provided above, will be paid for at the Contract unit price per hundred–weight (cwt.) for Fertilizer, Type A, or Fertilizer, Type B, which price will be full compensation for furnishing, hauling, placing and incorporating in the Work; and for all labor, materials, equipment, tools and incidentals necessary to complete the Work.

Agricultural Limestone Treatment, measured as provided above, will be paid for at the Contract unit price per ton for said Pay Item, which price will be full compensation for furnishing, hauling, placing and incorporating the required materials in the soil; and for all labor, equipment, tools and incidentals necessary to complete the Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item T90201	Fertilizing, Type A, per cwt.
Pay Item T90202	Fertilizing, Type B, per cwt.
Pay Item T90203	Agricultural Limestone Treatment, per ton

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.

SPECIFICATION T–904. SODDING

DESCRIPTION

904–1.1 This Work consists of furnishing and laying live sod on prepared areas shown on the Plans, including construction of sod ditch checks or similar applications as shown on the Plans, or as directed by the Engineer.

Watering Sodded Areas consists of furnishing and applying water to sodded areas.

MATERIALS

904–2.1 SOD. The sod shall consist of a dense, well–rooted growth of permanent and desirable grasses, indigenous to the general locality where it is to be used, and shall be practically free from weeds or undesirable grasses. At the time the sod is cut, the grass on the sod shall have a length of approximately 2 inches (if longer, the grass shall be cut to approximately this length) and the sod shall have been raked free from debris.

Cut the sod in uniform commercial sized strips.

Sod thickness shall be as uniform as possible, 3/4 inch minimum, depending on the nature of the sod. The entire dense root system of the grasses shall be retained, but shall be exposed in the sod strip. The sod shall remain intact throughout installation without tearing or breaking.

Do not cut sod unless the moisture content is at a value that will eliminate crumbling or breaking during cutting operations. Water sod, if necessary, at least 12 hours prior to cutting, to achieve optimum moisture content for cutting.

904–2.2 LIME. Lime, when included, shall be in accordance with the requirements of Specification T–902.

904–2.3 FERTILIZER. Fertilizer, when included, shall be in accordance with the requirements of Specification T–902.

904–2.4 WATER. Water shall be sufficiently free from oil, acid, alkali, salt, or other harmful materials that would inhibit the growth of grass. It shall be subject to the approval of the Engineer prior to use.

904–2.5 SOIL FOR REPAIRS. The soil for fill and topsoiling of areas to be repaired shall be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil shall be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting, and establishing turf, and shall be approved by the Engineer before being placed.

CONSTRUCTION METHODS

904–3.1 GENERAL. Areas to be solid, strip, or spot sodded shall be indicated on the Plans. Have on hand suitable equipment necessary for proper preparation of the ground surface and for the handling and placing of required materials.

NOTE TO SPECIFIER:
The location of all areas to be sodded, including ditch check and strips, should be indicated on the Plans or on a sodding schedule on the Plans.

904–3.2 PREPARING THE GROUND SURFACE. After grading has been completed and before applying fertilizer and limestone, areas to be sodded must be raked or otherwise cleared of stones larger than 2 inches (50 mm) in any diameter, sticks, stumps, and other debris which might interfere with sodding, growth of grasses, or subsequent maintenance of grass–covered areas. If damage by erosion or other causes occurs after grading of areas and before beginning the application of fertilizer and ground limestone, repair the damage. This may include filling gullies, smoothing irregularities, and repairing other incidental damage.

904–3.3 APPLYING FERTILIZER AND AGRICULTURAL LIMESTONE. Following ground surface preparation, uniformly spread fertilizer and agricultural limestone at a rate which will provide at least the minimum quantity of each fertilizer ingredient.

904–3.4 OBTAINING AND DELIVERING SOD. Transplant the sod within 24 hours from the time it is stripped, unless circumstances beyond the Contractor's control make storing necessary. In these cases, stack sod, keep it moist, and protect it from exposure to the air and sun and from freezing. Cut and move sod only when the soil moisture conditions are such that favorable results can be expected. Where the soil is too dry, permission to cut sod may be granted only after it has been watered sufficiently to moisten the soil to the depth the sod is to be cut.

904–3.5 LAYING SOD. Sod only during the seasons when satisfactory results can be expected. Do not use frozen sod and do not place sod upon frozen soil. Sod may be transplanted during periods of drought with the approval of the Engineer, provided the sod bed is watered to moisten the soil to a depth of at least 4 inches (100 mm) immediately prior to laying the sod.

The sod should be moist and placed on a moist earth bed. Do not use pitch forks to handle sod, and dumping from vehicles is not be permitted. Carefully place the sod by hand, edge to edge and with staggered joints, in rows at right angles to the slopes, commencing at the base of the area to be sodded and working upward. Immediately press the sod into contact with the sod bed by tamping or rolling with approved equipment to provide a true and even surface, and insure knitting without displacement of the sod or deformation of the surfaces of sodded areas. Where the sod may be displaced during sodding operations, work from ladders or treaded planks when replacing it, to prevent further displacement. Use good quality screened soil to fill all cracks between sods. The quantity of the fill soil should not cause smothering of the grass. Where the grades are such that the flow of water will be from paved surfaces across sodded areas, set the surface of the soil in the sod after compaction approximately 1 inch (25 mm) below the pavement edge. Where the flow will be over the sodded areas and onto the paved surfaces around manholes and inlets, place the surface of the sod after compaction flush with pavement edges.

904–3.6 STAKING AND CLEANUP. On all slopes steeper than one foot vertical to 4 feet horizontal stake or peg the sod with pieces of plasterers' lath or stakes, 12 inches (305 mm) in length, spaced as required by the nature of the soil and steepness of slope, from 18 to 36 inches (460 mm to 0.91 m) apart along the longitudinal axis of the sod strip. Place stakes near the top edge of the sod strip and driven approximately plumb through the sod leaving about 1/2 inch (13 mm) of the peg above the sod.

Stake sod placed in ditches, flumes or other appurtenances, where a concentrated flow of water may be expected, regardless of the slope.

After the staking has been completed clear the surface of loose sod, excess soil or other foreign material.

904–3.7 WATERING. Adequate water and watering equipment must be on hand before sodding begins. Keep the sod moist until it has become established and its continued growth is assured. Water sodded areas for a minimum of 10 days. In all cases, water in a manner that will avoid erosion from the application of excessive quantities and that will avoid damage to the finished surface.

904–3.8 ESTABLISHING TURF.

a. General. Provide and continue general care for the sodded areas as soon as the sod has been laid and until final inspection and acceptance of the Work.

b. Protection. Protect sodded areas against traffic or other use by warning signs or barricades.

c. Mowing. Mow the sodded areas with approved mowing equipment, depending upon climatic and growth conditions and the needs for mowing specific areas. In the event that weeds or other undesirable vegetation are permitted to grow to such an extent that, either cut or uncut, they threaten to smother the sodded species, they shall be mowed and the clippings raked and removed from the area.

904–3.9 REPAIRING. When the surface has become disturbed or damaged during the period covered by this Contract, repair the affected areas to re–establish the grade and the condition of the soil to the originally specified condition and resod the affected area.

METHOD OF MEASUREMENT

904–4.1 Sodding will be measured by the square yard and the quantity to be measured for payment under this Pay Item will be the actual number of square yards of area on which sod or reinforced sod has been placed in accordance with the Contract, within the limits of such construction designated on the Plans or as directed by the Engineer.

Watering Sodded Areas will be measured by volume in gallons, and the quantity to be measured for payment shall be the amount of water furnished and applied in accordance with the Contract or as directed by the Engineer. The volume will be determined by approved meters or from tanks of known capacity.

BASIS OF PAYMENT

904–5.1 Sodding, measured as provided above, will be paid for at the Contract unit price per square yard for Sodding, which price shall be full compensation for preparing the earth bed; for furnishing, placing, staking, rolling and watering the sod; and for all labor, equipment, tools and incidentals necessary to complete the work in accordance with the Contract.

Watering sodded areas, measured as provided above, will be paid for at the Contract unit price per gallon, which price shall be full compensation for furnishing, hauling and applying the water; and for all labor, materials, equipment, tools and incidentals necessary to complete the Work.

When the Contract does not contain a Pay Item for Watering Sodded Areas, then the furnishing and application of water over sodded areas will be considered incidental to Sodding, and measurement or separate payment will not be made.

Standard Pay Items for Work covered by the Specification are as follows:

Pay Item T90401	Sodding, per square yard
Pay Item T90402	Watering Sodded Areas, per gallon

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.

SPECIFICATION T–905. TOPSOIL AND SALVAGED TOPSOIL

DESCRIPTION

905–1.1 TOPSOIL. This Work consists of furnishing humus–bearing soil, adapted to the sustenance of plant life and commonly known as topsoil, from locations off–site furnished by the Contractor, and placing, spreading, and finishing of topsoil, as shown on the Plans, or directed by the Engineer.

905–1.2 SALVAGED TOPSOIL. This Work consists of removal of topsoil from the sites of proposed excavations and embankments in quantities necessary to cover the Work, including reclamation, placing, spreading, and finishing of topsoil, as shown on the Plans, or directed by the Engineer.

MATERIALS

905–2.1 TOPSOIL. 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), clay lumps or similar objects. Brush shall be cut, removed, and disposed of at locations provided by Contractor. Do not remove ordinary sods and herbaceous growth such as grass and weeds but thoroughly break up and intermix it with the soil during handling operations. 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 Advertisement for Bids. The organic content shall be not less than 3 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 (0.075 mm) sieve as determined by the wash test in accordance with ASTM C 117.

Natural topsoil may be amended by the Contractor with approved materials and methods to meet the above specifications.

Thirty days prior to placing topsoil, notify the Engineer of the source of topsoil to be furnished by the Contractor. Inspect topsoil 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.

905–2.2 SALVAGED TOPSOIL. Salvaged topsoil should consist of the natural loam, sandy loam, silt loam, silty clay loam or clay loam humus–bearing soils available from the original surface of the areas to be excavated for construction of proposed improvements.

CONSTRUCTION METHODS

905–3.1 GENERAL. Areas to be topsoiled shall be shown on the Plans. If topsoil is available on the site beyond the normal construction limits, the location of the stockpiles or areas to be stripped of topsoil and the stripping depths shall be shown on the Plans.

Have on hand suitable equipment necessary for proper preparation and treatment of the ground surface, for stripping of topsoil, and for the handling and placing of all required materials, in good condition before the various operations are started.

905–3.2 PREPARING THE GROUND SURFACE. Immediately prior to dumping and spreading the topsoil, loosen the surface by discs or spike–tooth harrows, or by other means approved by the Engineer, to a minimum depth of 2 inches (50 mm) to facilitate bonding of the topsoil to the covered subgrade soil. Clear the surface of the area to be topsoiled of all stones larger than 2 inches (50 mm) 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. Areas that are too compact to respond to these operations shall receive special scarification.

Undercut or underfill areas designated to be covered with topsoil to a degree that when covered to the required depth with topsoil, the finished Work will be in accordance with the required lines, grades, slopes, and cross–sections. Grade areas to drain. Do not leave low places or pockets where water will not immediately drain away.

This Work shall be considered subsidiary to the Pay Items of Topsoil or Salvaged Topsoil and no additional compensation will be made, nor will allowance be made for undercut or underfill for placement of topsoil in the final measurement for quantities of the classes of Excavation.

905–3.3 OBTAINING TOPSOIL. Prior to the stripping of topsoil from designated areas, remove vegetation, briars, stumps and large roots, rubbish or stones found on these areas, which interfere with subsequent operations. Remove heavy sod or other cover, which cannot be incorporated into the topsoil by discing or other means.

When suitable topsoil is available on the site, remove this material from the designated areas and to the depth shown on the Plans or as necessary to provide sufficient volumes to cover the areas designated on the Plans to the depths specified. Spread the topsoil on areas already tilled and smooth–graded, or stockpiled in areas approved by the Engineer. Topsoil salvaged and stockpiled by the Contractor shall be rehandled and placed without additional compensation. Remove and replace topsoil that has been stockpiled on the site by others, and is required for topsoiling purposes. Grade, if required, the sites of all stockpiles and adjacent areas that have been disturbed and put into a condition acceptable for seeding.

Dispose of volumes of Salvaged Topsoil excavated in excess of the quantities required to complete the Work according to the Plans with no additional compensation. In the case of Salvaged Topsoil, deductions from Excavation Pay Items shall be made at the applicable Contract unit prices for the volume of fill required to backfill the voids resulting from excess topsoil removed.

When suitable topsoil is secured off the Airport site, locate and obtain the supply, subject to the approval of the Engineer. Notify the Engineer sufficiently in advance of operations in order that necessary measurements and tests can be made. Haul topsoil to the site of the Work and place it for spreading, or spread as required. Rehandle and place topsoil hauled to the site of the Work and stockpiled without additional compensation.

905–3.4 PLACING TOPSOIL. Spread the topsoil on the prepared areas to a uniform depth of 4 inches (100 mm) after compaction, unless otherwise shown on the Plans or stated in the Special Provisions. Do not spread when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the Work. Spread topsoil so that turfing operations can proceed with a minimum of soil preparation or tilling.

After spreading, break all large, stiff clods and hard lumps with a pulverizer or by other effective means, and rake up and dispose of stones or rocks (2 inches (50 mm) or more in diameter), roots, litter, or any foreign matter. After spreading is completed, compact the topsoil by rolling with a cultipacker or by other means approved by the Engineer. The compacted topsoil surface must conform to the required lines, grades, and cross sections. Promptly remove topsoil or other dirt falling upon pavements.

METHOD OF MEASUREMENT

905–4.1 Topsoil will be measured by the square yard or cubic yard as provided in the Contract. Topsoil paid by the cubic yard will be measured in its original position. Topsoil volume will be computed by the method of end areas. When approved by the Engineer, topsoil may be measured by cubic yards in the vehicle.

When measured by the square yard, the quantity to be measured for payment is 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 or as direct by the Engineer.

905–4.2 SALVAGED TOPSOIL. Salvaged Topsoil will be measured by the square yard, and the quantity measured for payment under this Pay Item will be 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 or as directed by the Engineer.

BASIS OF PAYMENT

905–5.1 TOPSOIL. Topsoil, measured as provided above, will be paid for at the Contract unit price per square yard or per cubic yard for Topsoil, which price will be full compensation for furnishing, excavating, loading, hauling, and placing of this material; for undercutting of excavations or underfilling of embankments necessary to receive this material; and for furnishing all labor, material, equipment, tools and incidentals necessary to complete the Work.

905–5.2 SALVAGED TOPSOIL. Salvaged Topsoil, measured as provided above, will be paid for at the Contract unit price per square yard for Salvaged Topsoil, which price will be full compensation for removing, stockpiling, reclaiming, hauling and placing this material; and for furnishing all labor, equipment, tools, and incidentals necessary to complete the Work. However, no deductions will be made from Pay Items of Excavation for the quantities of Salvaged Topsoil material that may be obtained from areas in cut sections, nor will the volumes of Salvaged Topsoil removed from sites of proposed embankments be measured for payment or paid for under Excavation Pay Items. There will be no allowance, adjustment, or measurement for payment under the pertinent Excavation Pay Items for undercutting of cut sections or underfilling of embankments as hereinbefore prescribed under preparation for topsoiling.

Payment will be made at the Contract unit price per cubic yard for Topsoil (obtained off the site). This price will be full compensation for furnishing all materials and for all preparation, placing, and spreading of the materials, and for all labor, equipment, tools, and incidentals necessary to complete the Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item T90501	Topsoil, per cubic yard
Pay Item T90502	Topsoil, per square yard
Pay Item T90503	Salvaged Topsoil, per square yard

Measurement and payment will only be made for 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.

MATERIAL REQUIREMENTS

ASTM C 117	Test Method for Materials Finer than 75–mm (No. 200) Sieve in Mineral Aggregates by Washing

SPECIFICATION T–908. MULCHING

DESCRIPTION

908–1.1 This Work consists of furnishing, hauling, placing, and securing mulch on surfaces indicated on the Plans or designated by the Engineer.

MATERIALS

908–2.1 MULCH MATERIAL. Mulching material shall consist of straw or hay in an air dry condition or wood excelsior fiber, wood chips or other suitable material of a similar nature, which is free of noxious weed seeds and objectionable foreign matter. Mulch materials, which contain matured seed of species which would volunteer and be detrimental to proposed overseeding, or to surrounding farm land, will not be acceptable. Straw or other mulch material which is fresh, excessively brittle, or which is in such an advanced stage of decomposition as to smother or retard the planted grass, will not be acceptable.

a. Hay. Hay shall be native hay, sudan grass hay, broomsedge hay, legume hay, or similar hay or grass clippings.

b. Straw. Straw shall be the threshed plant residue of oats, wheat, barley, rye, or rice from which grain has been removed.

c. Manufactured Mulch. Cellulose–fiber or wood–pulp mulch shall be products commercially available for use in spray applications.

908–2.2 INSPECTION. Thirty days prior to application, notify the Engineer of sources and quantities of mulch materials available and furnish representative samples of the materials to be used. These samples may be used as standards with the approval of the Engineer and all materials brought on the site which do not meet these standards will be rejected.

CONSTRUCTION METHODS

908–3.1 MULCHING. Place mulch on a given area within 3 days after the seeding has been completed.

Do not place mulch during periods of high winds that would blow mulch from its original position.

Place mulch loosely or openly enough to allow sunlight to penetrate and air to circulate, but thickly enough to shade the ground, conserve soil moisture and prevent or reduce erosion.

Maintain mulched areas and repair areas damaged by wind, erosion, traffic, fire or other causes prior to final or partial acceptance of Work under the Contract.

Before spreading mulch, remove large clods, stumps, stones, brush, roots, and other foreign material from the area to be mulched. Apply mulch immediately after seeding. Spread mulch by hand methods, blower, or other mechanical methods, to provide a uniform covering.

Furnish mulch material and haul it, and evenly apply it on the area shown on the plans or designated by the Engineer. Spread straw or hay over the surface to a uniform thickness at the rate of 1–1/2 to 3 tons per acre (1350–2700 kg per acre) to provide a loose depth of not less than 1/2 inches (13 mm) nor more than 2 inches (50 mm). Mulch may be blown on the slopes and the use of cutters in the equipment for this purpose is permitted to the extent that at least 95 percent of the mulch in place on the slope is 6 inches (150 mm) or more in length. When mulches applied by the blowing method are cut, the loose depth in place shall be not less than 1 inch (25 mm) nor more than 2 inches (50 mm).

908–3.2 SECURING MULCH. Immediately after spreading, anchor mulch in the soil by the use of a mulch tiller consisting of a series of dull, flat discs with notched edges. The discs should be approximately 20 inches in diameter and spaced at about 8–inch centers. Equip the tiller with a ballast compartment to permit adjustment of the weight for depth control.

Press mulch into the soil to a depth of approximately 1–1/2 to 2–1/2 inches (40–60 mm) in one pass of the tiller traveling longitudinally. Do not operate mulch tillers on slopes so steep that damage to the mulch, seedbed, or soil occurs. Anchor the mulch on these areas by the use of an

approved netting securely pegged or stapled in place. In lieu of this anchorage, the "peg and string" method may be used. Approved erosion control blankets or mats may be used in lieu of separate applications of mulch and netting. Equip and operate tractors to minimize the disturbance or displacement of the soil. More than one pass of the tiller may be required to assure adequate anchoring of the mulch.

If the "peg and string" method is used, secure the mulch by the use of wooden stakes driven into the ground on 5–foot (1.5 m) centers (both ways) or less. String binder twine between adjacent stakes in straight lines and crisscrossed diagonally over the mulch. Next, firmly drive the stakes nearly flush to the ground to draw the twine down tight onto the mulch.

908–3.3 CARE AND REPAIR.

a. Care for the mulched areas until final acceptance of the project. Care should consist of providing protection against traffic or other use by placing warning signs, and erecting barricades that may be shown on the Plans before or immediately after mulching has been completed on the designated areas.

b. Repair or replace mulching that is defective or becomes damaged until the project is finally accepted. When, in the judgment of the Engineer, such defects or damages are the result of poor workmanship or failure to meet the requirements of the Specifications, the cost of the necessary repairs or replacement shall be borne by the Contractor. However, once mulching has been completed in accordance with the provisions of the Contract, no additional Work at Contractor's expense will be required, but subsequent repairs and replacements deemed necessary by the Engineer shall be made by the Contractor and will be paid for as Extra Work.

METHOD OF MEASUREMENT

908–4.1 Mulching will be measured by the square yard or by the ton as provided in the Contract.

When measured by the square yard, the quantity to be measured for payment will be the number of square yards of surface area on which the mulch has been placed and accepted in accordance with the Contract.

When measured by the ton, the quantity to be measured for payment will be the number of tons of mulch furnished, placed, and accepted in accordance with the Contract.

BASIS OF PAYMENT

908–5.1 The quantity, measured as provided above, will be paid for at the Contract unit price per square yard or per ton for Mulching, which price will be full compensation for furnishing all materials; for all hauling, treating, placing, spreading, and anchoring of the mulch material; for maintenance of the Work and repair of damaged areas; and for furnishing all labor, tools, equipment, and incidentals necessary to complete the Work.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item T90801	Mulching, per square yard
Pay Item T90802	Mulching, per ton

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.

SPECIFICATION L-100. AIRPORT LIGHTING GENERAL PROVISIONS

DESCRIPTION

100–1.1 These Specifications cover requirements for all Airport lighting installations in Part XI.

NOTE TO SPECIFIER:

The following "General Requirements" section was developed to provide standard electrical construction instructions for all electrical Contract Documents, including WisDOT Standard Specifications, details and special engineered drawings. This information is communicated to the Contractor in 100–2.1.

The following Wiring "Methods and Materials" were developed to provide electrical products to build WisDOT WBOA standard specifications L–101 through L–125 and WisDOT standard details only. This section is not intended for engineered drawings, unless the special provisions explicitly mentions that this section is included. This information is communicated to the Contractor in paragraphs 100–3.1.

All Standard Specifications in L–100 were developed to provide information consistent with typical electrical trade construction. This information is in greater volume than before, so it is now located in its own section, rather than repeated in each specification section.

All standard L–100 specifications now incorporate the material design requirements typically found in the AC 150/5340 series, which were typically communicated to the Contractor through Drawings and Special Provisions.

All Standard L–100 Specifications now incorporate the material design requirements typically found in the FAA Regional Supplement and other FAA directives, which were typically communicated to the Contractor through Drawings and Special Provisions.

The Standard L–100 Specifications were not developed to replace or conflict with pre–manufactured products built under the AC 150/5345 series, or products listed under the jurisdiction of testing laboratories mentioned in ILHR 16.11.

Standard L–100 specifications were not developed to duplicate or replace wiring methods and materials mentioned in Chapter ILHR 16. L–100 either establishes a grade of construction that exceeds the requirements of ILHR 16, or defines and selects methods and materials where ILHR 16 offers a choice.

A hierarchical document precedence for WisDOT airport electrical construction should proceed as follows:

1) The Construction Contract Proposal has first precedence. By reference, it establishes that the WisDOT Standard Specifications for Airport Construction are included.

2) By association, Part I Section 5–03 establishes that the Special Provisions have precedence over all other Drawings and Specifications. If the Special Provisions do not alter the WisDOT Electrical Standard Specifications, then these Standard Specifications have the next precedence.

3) By reference, Part XI establishes the standard electrical specifications that are to be used. The standard electrical specifications for FAA products are governed by the AC 150/5345 series, and take precedence over all other product specifications. FAA electrical products are only accepted through ETL testing and FAA certification, and cannot be modified. The standard electrical equipment specifications for all other products required to install FAA products, or to build airside facilities for FAA installations, in accordance with WisDOT Standard Pay Items, are governed by Specification L–100–3.1. Specification L–100–3.1 has precedence over all other specifications for the Standard Pay Items and details, and cannot be modified unless approved by the Department.

L–100–3.1 specification has a reference section for each product that lists testing laboratories, agencies and societies that govern the product specifications. These laboratories, agencies and societies have precedence over the manufacture of these products, and these specifications cannot be modified. L–100–2.2 also references ILHR 16. This Wisconsin State.

GENERAL REQUIREMENTS

100–2.1 The following General Requirements specifications govern all Contract Documents. Perform all Work in strict accordance with these Specifications. Conform with the latest edition of the applicable FAA advisory circulars and revisions for installation details and material and equipment specifications. Provide airport lighting equipment from the FAA approved equipment list in the latest edition of AC 150/5345–53 Appendix 3. The list is also available through the FAA web page, http://www.faa.gov/.

Furnish all other basic wiring materials and products as listed by Underwriters Laboratories and as suitable for the purpose specified.

All installation shall be in accordance with National Electrical Contractors Association (NECA) "Standard of Installations".

Contractor's workers shall be trained and experienced in installing, testing and repairing Airport lighting systems. Keep a copy of FAA Advisory Circular (AC) 150/5340–26, and be familiar with its contents. Maintain a copy of the AC on site and follow all pertinent aspects as it relates to the Work. The AC is available through the FAA web page, http://www.faa.gov/.

100–2.2 CODES AND REGULATORY REQUIREMENTS. Comply with all ordinances, laws, regulations and codes applicable, in particular, the Wisconsin Administrative Code Chapter ILHR 16 Volumes 1 and 2, and the Life Safety Code. 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.

NFPA 70 is included by reference in ILHR 16.12. Coincidentally, Chapter ILHR 16 is also inclusive even where NFPA 70 is the only reference mentioned.

Obtain inspections, approvals, and plan and specification reviews required by State Statutes, codes, rules, laws or ordinances. Pay all costs and fees for inspections, approvals, and plan and specification reviews.

Have, as a minimum, one electrician certified by the State of Wisconsin on the project. If there are local regulations relating to licensing or certification, the more stringent requirements will governed.

NOTE TO SPECIFIER:
Whereas the Contractor is responsible for compliance with all State Statutes, the requirement for certification is included. Certification also places the responsibility for Wisconsin Code compliance onto the installer. The Engineers are encouraged to include this statement in these specifications; however, if specifiers determine a certified electrician is not advantageous, they may delete this requirement by Special Provision, upon approval by the WBOA.

100–2.3 ELECTRICAL UTILITY SERVICE POINT. Electrical utility power services required by the Contract Documents shall include all Work from the utility point of service to the service main disconnect switch.

"Construction limits" designations that are indicated on Contract Documents shall not apply to Electric Utility Service work necessary to serve the project and occurring outside of the "construction limits" designations. Pay for the cost for all Work by the Utility company.

Definitions:

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, disconnect 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.

"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". Under most circumstances, 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.

100–2.4 EXCAVATION. Provide excavation for underground Work in accordance with the construction methods and requirements of Part II Earthwork. Compact backfill for trenches to densities required for adjacent embankment and cut areas.

100–2.5 CONCRETE. Concrete shall be in accordance with Specification P–610.

100–2.6 CUTTING AND PATCHING. Perform all cutting and patching necessary in order to do the Work. Obtain special permission from the Engineer before cutting structural members of finished material. Perform all patching to return the part affected to the condition equal to or exceeding the undisturbed Work.

100–2.7 CLOSING OF OPENINGS.
Firestopping. Close and seal all unused slots, sleeves and other penetrations in fire rated floors, walls or other general construction with an approved firestopping material.

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°F shall expand to not less than five times its original volume to form a fireproof envelope. Firestopping material shall be UL listed for 3–hour protection, applied in accordance with the manufacturer's recommendation.

Close openings in floor slabs 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. Locate the sheet steel so that the top surface of the silicone elastomer is approximately 1 inch below the finished floor slab.

Close openings in walls 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.

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.

Perform patching Work with experienced workers, skilled for the particular type of Work involved. Repair all cut surfaces and match adjacent surfaces. Drill all holes in masonry with rotary drills.

100–2.8 PAINTING AND FINISHING DAMAGE AND TOUCH–UP. Repair all marred or damaged painted finishes with materials and procedures to match original finishes.

100–2.9 ACCEPTANCE OF MATERIALS AND EQUIPMENT. Acceptance of equipment, where applicable, will be based on Section 100–2.10. Be prepared to submit samples of equipment or material for review when requested by the Engineer.

Contractor installed equipment (including FAA approved) shall not generate any electromagnetic interference in the existing and/or new communications, weather, air navigation, and air traffic control equipment. Replace equipment generating interference at no additional cost, with equipment not generating interference and meeting the applicable specifications.

Ascertain that all furnished lighting system components (including FAA approved equipment) are compatible in all respects with each other, and the remainder of new or existing systems. Replace contractor furnished non–compatible components at no additional cost to the Department. 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.

Follow the manufacture's installation instructions. Accept 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.

Where installation procedures are required to be in accordance with manufacturers' recommendations, have printed copies of the recommendations prior to installation. Do not proceed with installation of the item until recommendations are received. Failure to use recommendations shall be cause for rejection of the equipment or material.

Replace damaged or broken materials or products. 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. Submit six sets of shop drawings for all electrical equipment. Reference the Specification's article to which each shop drawing is applicable. Include complete catalog information such as product illustrations, ratings, and dimensions as applicable. Submit shop drawings in complete groups of materials (i.e. cables, all lighting fixtures, etc.), and sign each item of material submitted 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. 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, highlight the data pertinent to the specified material.

Include with each submitted shop drawing the following paragraph:

"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. Failure to add the preceding statement or any departure from the enclosed procedure will result in delay of review of submittal. Electrical equipment subject to shop drawing review will 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. Replace non–conforming equipment at the Contractor's expense.

NOTE TO SPECIFIER:
The engineer should note in the special provisions which materials required shop drawing review to meet the intent of Section 100–2.10.
The quantity of six shop drawings is designated for distribution as follows:
1 – office copy for the design Engineer
1 – field copy for the resident Engineer
1 – office copy for the Contractor
1 – field copy for the Contractor
1 – office copy for the Owner
1 – copy for return to the Vendor
The Engineers should adjust the number of copies at their discretion.

100–2.11 OPERATING AND MAINTENANCE MANUAL. Prepare Operation and Maintenance (O&M) Manuals for all electrical equipment furnished under the Contract. Provide three copies to the Engineer.

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, neatly and clearly identify the installed equipment on the sheets. Give full ordering information assigned by the original parts manufacturer for listed parts. Relabeled and/or renumbered parts information as reassigned by equipment supplier is not acceptable.

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".

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 are not acceptable.

Group the information contained in the manuals in an orderly arrangement by specification Table of Contents. Include a typewritten index and divider sheets between categories with identifying tabs in the manuals. Bound the completed manuals with hard board 3–ring binders. Imprint the name of the job, Sponsor, Contractor, and year of completion on the covers. Imprint the name of the job, Sponsor, Contractor, and year of completion on the back edge.

Submit a preliminary copy to the Engineer prior to completion of the project for review. Deliver the three corrected copies to the Sponsor before final payment is approved.

NOTE TO SPECIFIER:
The three O & M manuals required are intended for distribution as follows:
1. Sponsor – 1 copy;
2. Design Engineer – 1 copy;
3. Airport Maintenance – 1 copy.
If additional copies are required, a Special Provision should be added.

100–2.12 TESTS. Conduct the acceptance test for equipment in the presence of the 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.

NOTE TO SPECIFIER:
The Engineer should add Special Provisions and possible Pay Items to define tests, as deemed necessary to exceed testing outlined in the requested equipment and system specifications.

a. Make available at the site the following test equipment:

(1) Voltmeter/OHM with proper scales.

(2) Clamp–on ammeter with proper scales.

(3) Meggar to measure conductor insulation resistance with 100V, 500V and 1000VDC outputs.

(4) Grounding system resistance tester.

(5) High voltage probe for measuring up to 5000 VAC.

Test equipment shall remain the property of the Contractor.

b. Have available a licensed electrician with necessary tools and materials to perform the following:

(1) To open and close equipment enclosures, covers to junction boxes, terminal panels and wireways when directed.

(2) To open and reconnect splices other than the cast type when directed.

(3) To make tests and demonstrate system performance.

100–2.13 FACILITY STARTING AND COMMISSIONING. Do not energize illuminated navigational aid equipment included in the Contract Documents for Sponsor use until the Engineer has inspected and the Department 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. Do not operate unattended equipment, illuminated navigational or otherwise, until it has been fully prepared, connected, tested, and made ready for normal operation. Correct damage to equipment occasioned by improper or ill–timed operation or testing at the Contractor's expense.

Provide a written statement saying 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 Department.

All equipment requiring operation during construction shall require operating instructions for systems and equipment indicated in the Contract Documents. Include in the operating instructions 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, 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.

NOTE TO SPECIFIER:
The engineer will need to provide a special provision for the extent of instruction should they deem this effort necessary.

100–2.14 CONTRACT DRAWING. Before roughing–in facilities or installation of equipment, consult all Drawings for obstructions that affect the installation. Verify that field measurements and circuiting arrangements are as shown on Drawings, and that abandoned wiring and equipment serve only abandoned facilities.

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.

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. Refer to Symbols and Abbreviations illustrated on Drawings. Other symbols are in common usage, but if uncertainty exists regarding Plan symbols or abbreviation, bring it to the attention of the Engineer for clarification.

NOTE TO SPECIFIER:
A list of Symbols and Abbreviations should be added to the Plans.

100–2.16 CONTRACT DRAWING RECORDS. The Engineer will furnish a newly printed set of Contract Drawings for the Contractor to mark where construction differed from the original Drawings. Keep the set on site at all times and complete this Work and give the Drawings to the Engineer before final payment is approved.

100–2.17 DEMOLITION. 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.

Demolition drawings are schematic and are based on existing record documents. Report discrepancies to the Engineer before disturbing existing installations. Beginning of demolition signifies that the Contractor has investigated existing conditions and accepts the demolition requirement under these specifications.

NOTE TO SPECIFIER:
If demolition is extensive, a Drawing, Special Provision, and special Pay Item may be necessary to separate a major cost for demolition.

WIRING METHODS AND MATERIALS

100–3.1 GENERAL. 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 L–101 through L–125 only.

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.

Definitions:

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.

Landside equipment is electrical equipment installed as part of public and passenger handling areas, unrestricted.

NOTE TO SPECIFIER:
If engineers intend to use Sections 100–3.2 through 100–3.13 for engineered airside installations, special pay items, they must explicitly mention the inclusion in their special provisions.

100–3.2 RACEWAYS. Provide raceways at locations indicated on the Drawings and in accordance with the following specifications. Refer to Specification L-110 for underground electrical duct bank installations.

a. Section Includes.

(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.

b. References.

(1) American National Standards Institute (ANSI). Comply with requirements of the following.

ANSI	C80.2	Rigid and Steel Conduit.
ANSI	C80.3	Electrical Metallic Tubing (EMT), Zinc Coated.
ANSI	870	Wireways, Auxiliary Gutters and Associated Fittings.

(2) National Electrical Manufacturers Association (NEMA). Comply with the requirements of the following.

NEMA	TC2	Electrical Plastic Tubing (EPT) and Conduit (EPC–40 and EPC–80).
NEMA	TC3	Fittings for PVC Conduit.
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.

UL	1	Flexible Metal Conduit.
UL	360	Liquid–Tight Flexible.
UL	514B	Fittings for Conduit and Outlet Boxes.
UL	886	Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.
UL	1242	Intermediate Metal Conduit. Steel Conduit.

UL 543 Bituminous Fiber Duct.

c. Products.

(1) Rigid Steel Conduit and Intermediate Metal Conduit (IMC).

(a) Use for stub–ups from direct burial and wherever susceptible to severe physical damage.

(b) Use in hazardous (classified) location and Class I, Division 2.

(c) Use for burial in concrete slabs or concrete encasement.

(d) Use for direct contact with earth.

(2) Rigid Nonmetallic Conduit.

(a) Schedule 40–Use for direct burial under driveways and parking lots only. Use under runways, taxiways, and aprons only when encased in concrete.

(b) 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.

(3) Electrical Metallic Tubing (EMT).

(a) Use for branch circuits in dry locations.

(b) Do not bury in ground or in slabs.

(c) Do not use in concrete.

(d) Do not use for circuits operating over 600–volts.

(4) Flexible Metal Conduit.

(a) Use in dry locations.

(b) Do not use in corrosive atmosphere or concealed work exterior locations.

(c) Use wherever equipment must be isolated for vibration or shifted to its final position.

(5) Flexible Polyethylene Duct, Couplings, and Connectors.

(a) 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.

(b) Do not use above grade.

(6) Liquid–Tight Flexible Metal Conduit.

(a) Use for exterior and damp locations.

(b) Sizes 1–1/4–inch and smaller, provide with a continuous copper bonding conductor wound spirally between convolutions.

(c) Sizes 1–1/2–inch and larger, provide with an internal grounding conductor and grounding bushings.

(7) Wireways, Auxiliary Gutters.

(a) 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.

(b) Provide NEMA 4 stainless enclosure where outdoors or subject to moisture and similar elements.

(c) 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.

(8) Raceway Fittings, Couplings and Connectors.

(a) 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.

(b) Bushing and connectors shall be insulated type which maintain continuity of conduit grounding system. Mold or lock insulating material into the metallic body of the fitting. Bushing made entirely of nonmetallic material will not be allowed.

(c) Connectors and couplings body shall have wall thickness at least equal to wall thickness of conduit used.

(d) Provide flexible metal conduit fittings made of steel of malleable iron and one of the following types:

Screw type having an angular wedge fitting between the convolutions of the conduit.

Squeeze or clamp type having a bearing surface contoured to wrap around the conduit and clamped by one or more screws.

Steel, multiple point type, for threading into internal wall of the conduit convolutions.

(e) Liquid–tight flexible metal conduit shall incorporate a steel, nylon or equal plastic compression ring and a gland for tightening. The fitting shall be steel, or malleable iron with insulated throat, with male thread and locknut or male bushing with or without "O" ring seal.

(f) 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.

(g) Do not use material such as "pot metal" for any type of fitting.

d. Installation.

Complete installation of electrical raceways before starting installation of cables/wires within raceways.

Prevent foreign matter from entering raceways; use temporary closure protection.

During construction, protect stub–ups from damage. Arrange so curved portion of bends is not visible above the finished slab or grade.

Make bends and offsets so the inside diameter is not effectively reduced.

Unless otherwise indicated keep the legs of a bend in the same plane and the straight legs of offset parallel.

Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location.

Run concealed raceways with a minimum of bends. All bends shall have the longest possible radii.

Install exposed raceways parallel and perpendicular to nearby surfaces or exposed structural members, and follow the surface contours.

Run exposed, parallel or banked raceways together.

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.

Where the installation is such that joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system.

Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the protection shoulder.

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.

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.

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.

Tie raceway to reinforcing rods or support to prevent sagging or disturbing when concrete is placed.

At expansion joints, provide expansion fittings and cross at right angles to joint.

Provide conduits stubbed up through or from concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside.

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. Allow all PVC conduits directly buried 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:

(1) Exterior locations (ultra violet light rated)

(2) Moisture or humidity laden atmospheres where it is possible for condensation to accumulate. Corrosive atmospheres.

(3) Wherever there is a possibility of seepage or dripping of oil, grease, or water.

(4) Raceway Sealing Fittings shall be zinc coated, cast or malleable iron type. Use continuous drain type fittings that are used to prevent passage of water vapor..

(a) Upon completion of installation of raceways, inspect interiors of raceways at all outlet, junction and pull boxes, and remove burrs and obstructions.

(b) Run a swab or mandrel to remove dirt and blockages. Replace new raceways that are deformed and prevent the passage of a mandrel. Replace used raceways that are deformed and prevent the passage of a mandrel at the Engineer's discretion with payment in accordance with Extra Work Section 40–04.

(c) Remove dirt and construction debris from outlet, junction and pull boxes.

100–3.3 FEEDER AND BRANCH CIRCUIT WIRE AND CABLE.

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.

a. Section Includes.

(1) Copper conductors.

(2) Tap type connectors.

(3) Split–bolt connectors.

(4) Wire nut connectors.

b. References.

(1) American Society for Testing and Materials (ASTM). Comply with requirements of the following:

ASTM	B 1	Standard Specification for Hard Drawn Copper Wire
ASTM	B 2	Standard Specification for Medium–Hard–Drawn Copper Wire
ASTM	B 3	Standard Specification for Soft or Annealed Copper Wire
ASTM	B 8	Standard Specification for Concentric–Lay–Stranded Copper Conductors, Hard, medium–Hard, or Soft
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:

IEEE	82	Test Procedure for Impulse Voltage Tests on Insulated Conductors
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:

NEMA	WC 3S–19–81	Rubber–Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
NEMA	WC 5S–61–402	Thermoplastic–Insulated Wire and Cable for the transmission and Distribution of electrical Energy
NEMA	WC 7/S–66–524	Cross–Linked–Thermosetting–Polyethylene–Insulated Wire and Cable for the transmission and Distribution of Electrical Energy.
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

UL	44	Rubber–insulated Wires and Cables
UL	83	Thermoplastic–Insulated Wires and Cables
UL	486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL	854	Service–Entrance Cables

c. Products

(1) Conductors.

For all constant voltage circuits 600 volts or less, provide wire rated 600 V minimum of the single conductor annealed copper type.

Conductors No. 10 AWG and smaller may be solid, and No. 8 AWG and larger shall be stranded.

Conductivity shall not be less than 98 percent at 20°C (68°F) or resistivity greater than 1.7 microhms per centimeter.

For dry and wet locations provide Type THHN/THWN, 75° maximum.

(2) Cable.

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.

(3) Connectors and Splices.

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.

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.

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. Retain cable sizes 250 MCM and larger in the connector by twin clamping elements.

(4) Insulating Materials.

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, use a tape with a minimum thickness of 8.5 mils that consists of an oil–resistant vinyl backing with an oil–resistant acrylic adhesive.

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.

(5) Prohibited Products.

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.

d. Installation – General.

Deliver wire and cable packaged in factory–sealed containers.

Store wire and cable in a clean dry space in original containers. Protect products form weather, damaging fumes, construction debris and traffic.

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.

Unless otherwise indicated in Contract Documents, install all wiring in conduit, in conformance with NFPA 70.

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.

Do not use wire and cable manufactured more than 12 months prior to date of delivery to the site.

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.

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. Stamp or print tags or labels to correspond with markings on drawings or marked so that feeder or cable may be readily identified. If suspended type tags are provided, attach them by approximately 55–pound test monofilament line or slip free plastic cable lacing units.

e. Installation – In Conduit.

Refer to L–100–3.2, RACEWAYS, for the preparation of raceways for wire and cables.

Provide suitable installation equipment to prevent cutting and abrasion of conduits during the pulling of wires and cables, according to the following:

(1) Use ropes for pulling of conductors in raceways with existing circuits made of polyethylene or other suitable nonmetallic material.

(2) Pull conductors simultaneously where more than one is being installed in same raceway.

(3) Use pulling compound or lubricant where necessary; compound shall not deteriorate conductor or insulation.

(4) Use lubricants conforming to UL requirement as applicable.

(5) Attach pulling lines to conductor cables by means of either woven basket grips or pulling eyes attached directly to the conductors. Do not use rope hitches.

(6) Where polyethylene insulation is used, a pulling lubricant is required. Use lubricant non–injurious to the insulation.

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.

Install exposed cable parallel and perpendicular to surfaces or exposed structural members and follow surfaces contours, where applicable.

f. Installation – Above Grade.

(1) In making a splice, bring connectors up securely upon the conductors so 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) Follow the number, size, and combinations of conductors permitted as listed on manufacturer's packaging.

(3) Fully insulate connectors by a skirt, or taped to provide an insulation value at least equal to the rating of wires being connected.

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.

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

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:

(1) Solid color compound

(2) Solid color coating

(3) Surface printing every 12 inches, maximum spacing of 18 inches.

(4) All grounding and phase conductors No. 10 AWG and smaller shall be solid color compound or solid color coating.

(5) 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.

(6) Apply color pressure–sensitive plastic tape in half overlapping turns for a distance of 6 inches or all terminal points and in all boxes in which splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding.

(7) Use 3/4–inch wide tape in colors as specified.

(8) Do not be obliterated cable identification markings by taping. Tape locations may be adjusted slightly to prevent obliteration of cable markings.

Seal cables and conductors entering from underground between cable and raceway or sleeve, with a waterproof non–hardening sealing compound.

g. Installation – Manholes.

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.

Cover constant voltage power cables located in manholes and handholes with arcproof and flameproof tape. Apply the tape in a single layer, one–half lapped, or as recommended by the manufacturer.

h. Installation – Below Grade.

Refer to Specification L-108 for underground cable installations.

Conduct tests with a meggar on constant voltage circuits will be performed so as not to harm the conductor insulation. Follow manufacturer's instructions and Subsection 100–2.12.

100–3.4 CONTROL AND SIGNAL WIRE AND CABLE. 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.

a. Section Includes.

(1) Class 2 and Class 3

b. Reference Standards.

(1) American Society for Testing and Materials (ASTM). Comply with requirements of the following:

ASTM	B 3	Standard Specification for Soft or Annealed Copper Wire.
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:

IEEE	82	Test Procedure for Impulse Voltage Tests on Insulated Conductors.
IEEE	241	Recommended Practice for Electric Power Systems in Commercial Buildings.
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:

NEMA	WC 3/S–19–81	Rubber–Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

NEMA	WC 5/S–61–402	Thermoplastic–Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
NEMA	WC 7/S–66–524	Cross–linked–thermosetting–Polyethylene–Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
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:

UL	44	Rubber–Insulated Wires and Cables.
UL	83	Thermoplastic–insulated Wires and Cables.
UL Labeled:		Provide control and signal wire UL listed and labeled.

c. Products.

Provide control and signal wires and cables single conductor and multiple conductors, shielded and unshielded, as indicated in the Contract Documents.

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.

Use control and signal wire that is coated copper solid or stranded Class B.

Stranded conductors shall be constructed of short lay seven strand minimum concentric bare copper wires.

Use the size of conductors that is 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.

Provide conductors with a primary insulation material that is heat, moisture, flame, and chemical, resistant crosslinked polyethylene, or PVC high temperature insulation material.

Cable shall have nonhydroscopic fillers and a high temperature nonhydroscopic tape shall be applied over the cable code.

Multi–conductor cable shall have conductors color coded.

Control cable for above grade dry locations shall have an outer covering, fabricated of thermoplastic with flame, heat and moisture resisting compounds.

d. Installation.

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 that protects wires and cables against moisture and dust. Ensure that dielectric resistance integrity of wires and cables is maintained.

Store wire and cable in a clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.

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.

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.

Do not use wire and cable manufactured more than 12 months prior to date of delivery to the site.

Neatly and securely bundle all conductors in signal cabinets and signal control panels. Bundle and cable with nylon straps made of self–extinguishing nylon having a temperature range of –65°F to +350°F.

Provide pressure sensitive labels, securely fastened to each conductor at each termination of single conductor or multiconductor cables. Stamp or print Tags or labels to correspond with markings on the Contract Documents. Mark conductors so they can be readily identified.

Splices in control wire are not permitted. All control wire shall be continuous from terminal block to terminal block.

Prevent pickup of magnetic and static noise by routing cables and wires away form 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.

Prevent cables and wires from picking up common mode noise by grounding the shield at one point. Locate the ground point at the point where the instrument circuit is grounded and isolated from all other grounds.

Prevent pickup of cross talk noise on multiple pair cable by using cables with individually shielded, isolated pair shields.

100–3.5 ELECTRICAL BOXES AND FITTINGS. Provide electrical box and fittings as shown on the drawings and in accordance with the following specifications.

a. Section Includes.

(1) Outlet boxes

(2) Junction boxes

(3) Pull boxes

(4) Conduit bodies

(5) Bushings

(6) Locknuts

(7) Knockout closures

b. References.

(1) National Electrical Manufacturers Association (NEMA): Comply with applicable requirements of the following.

NEMA	OS 1	Sheet Steel Outlet Boxes, Device Boxes, Covers and Box Supports
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.

UL 50	Cabinets and Boxes
UL 514A	Metallic Outlet Boxes
UL 514B	Fittings for Conduit and Outlet Boxes, Flush–Device Boxes and Covers
UL 886	Outlet Boxes and Fittings for Hazardous (Classified) Location.

c. Products

Provide galvanized or other approved corrosion resistant finish for all boxes, accessories and fittings.

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.

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.

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.

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.

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.

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.

Provide boxes UL listed for the particular type and class for Hazardous Locations.

Provide outlet boxes conforming to UL 886 for hazardous locations and install in conformance with NFPA 70 Articles 500 through 555 for Hazardous Locations.

d. Installation.

Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.

Provide weatherproof outlets for all interior and exterior locations exposed to weather or moisture.

Provide knockout closures to cap unused knockout holes where blanks have been removed.

Provide boxes of sizes adequate to meet NFPA 70 volume requirements, but in no case smaller than sizes indicated in the Contract Documents.

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.

Mount outlet boxes for switches with the long axis vertical. Mount boxes for receptacles either vertically or horizontally but consistently one way. Mount three or more gang boxes 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.

Protect outlet boxes to prevent entrance of debris. Thoroughly clean foreign material from boxes before conductors are installed.

At the following locations use threaded hub type boxes with gasketed weatherproof covers:

(1) Exterior locations.

(2) Where exposed to moisture laden atmosphere

(3) Where indicated in the Contract Documents.

For installation of junction and pull boxes, conform to the following:

(1) For boxes exposed to rain or installed in wet locations use NEMA 4 stainless steel.

(2) 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

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. Provide wiring devices at locations indicated on the Drawings and in accordance with the following Specifications.

a. Section Includes.

(1) Receptacles.

(2) Ground–fault circuit interrupters.

(3) Switches.

(4) Photocells.

b. 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:

NEMA	WD 1	General Requirements for Wiring Devices.
NEMA	WD 2	Semiconductor Dimmers for Incandescent Lamps.
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:

UL	5	Surface Metal Raceways and Fittings
UL	20	General–Use Snap Switches
UL	498	Attachment Plugs and Receptacles.
UL	514A	Metallic Outlet Boxes
UL	514B	Fittings for Conduit and Outlet Boxes.
UL	943	Ground–Fault Circuit Interrupters.

c. Products.

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.

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.

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.

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.

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. The Engineer will select the color.

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.

Provide wall plates for each switch, receptacle, signal special purpose outlet. Do not use sectional gang plates. Provide multi–gang outlet plates for multi–gang boxes. Use wall plates in accordance with UL 514A, UL 514B, and UL 514C.

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.

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. 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 will energize when north sky light decreases to 1.5 foot candles and will remain energized until north sky light increases from 3 to 5 footcandles. Provide photocells of voltage and wattage ratings as indicated in the Contract Documents.

d. Installation.

Handle wiring devices carefully to prevent damage. Do not install damaged wiring devices.

Store wiring devices in a clean and dry place. Protect from dirt, construction debris, and physical damage.

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.

Coordinate with other Work, including painting, electrical boxes and wiring Work, as necessary to integrate installation of wiring devices with other Work.

Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.

Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing 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."

Install switches with centerline located 4 feet above finished floor unless otherwise indicated. Install receptacles in machine with centerline 4 feet above finished floor. Locate all other devices as indicated in the Contract Documents or as direct by the Engineer.

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. Provide covers, cabinets, and individual hinged–door enclosures for all electrical systems as indicated on the Drawings and in accordance with the following Specifications.

a. 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."

b. Products.

Provide cabinets and enclosures as follows:

(1) Surface NEMA 1 Cabinets and Enclosures:

(a) Provide a front consisting of a one– piece sheet steel frame and a hinged door with catch and lock.

(b) Provide each cabinet with a combination catch and flat key lock.

(c) Hinge doors directly to cabinet, with 3/4–inch flange around all edges shaped to cover edge of box.

(2) Surface NEMA 12 Cabinets and Enclosures:

(a) Fabricate of minimum 16 MSG steel with continuous welded seams.

(b) 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.

(c) Provide multiple doors where required. Individual door width shall be no greater than 24 inches.

(d) Provide butt hinges or continuous hinges.

(e) Furnish single door cabinets with padlock and hasp, and double door cabinets with 3–point handle–operated–latch plus hasp.

(3) Surface NEMA 4 Cabinets and Enclosures:

(a) Provide features similar to those for NEMA 12 units except provide NEMA 4 protection against hose directed water. Provide multiple cover clamps instead 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.

Paint all cabinets and enclosures located in dry locations, unless noted otherwise in the Contract Documents.

In addition to a priming coat, give all outside surfaces of trim and doors a factory finish coat of gray paint. All cabinet interiors and panel mounted back plates shall be white.

NEMA 4 stainless cabinets and enclosures shall maintain a natural finish.

Provide cabinets and enclosures with provision for cabinet grounding without penetrating exterior wall of the enclosure.

c. Installation.

Touch up all scrapes and other mars in the enclosure finish equal to the manufacturer's finish.

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.

Support and fasten all cabinets securely in place.

100–3.8 SUPPORTING DEVICES. Provide all electrical supports, anchors, sleeves, seals, fastenings and other components indicated on the drawings and in accordance with the following specifications.

a. Section Includes.

(1) Clevis hangers.

(2) Riser clamps.

(3) C–clamps.

(4) One–hole conduit straps.

(5) Two–hole conduit straps.

(6) Round steel rods.

(7) Expansion anchors.

b. 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.

c. Products.

Provide supporting devices with manufacturer's standard materials, designed and constructed in accordance with published product information.

Provide all supports, support hardware and fasteners hot dipped galvanized for exterior installations and cadmium plated for interior installations.

Provide manufactured standard supports including clevis hangers, risers clamps, conduit straps, threaded C–clamps with retainers, wall brackets and spring steel clamps.

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. Use fittings that are compatible with the U–channel struts.

d. Installation.

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.

Coordinate with other electrical work, including raceway and wiring work.

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.

Provide individual and multiple (trapeze) raceway hangers, and riser clamps to support raceways. Provide U–bolts, clamps, attachments, and other hardware for hanger assembly, and for securing hanger rods and conduits.

Arrange for grouping of parallel runs of horizontal raceways to be supported together on trapeze type hangers where possible.

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 instead 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.

Space supports for metallic raceways in accordance with the requirements or this Section and the requirements of the NFPA 70, except as otherwise indicated.

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.

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, panelboards, disconnects, control enclosures, pull boxes and junction boxes.

Install cable supports in strict compliance with manufacturer's instructions. Spacing should not exceed NFPA 70 tabulation for spacing of conductor supports. Allow adequate slack in conductors to prevent any stress on terminations. Consider conductor thermal expansion and contraction in installation.

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.

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.

Holes cut to a depth of more than–1/2 inches 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.

On loads applied to any fastener do not exceed one–fifth of the proof test load. Use vibration and shock–resistant fasteners, where applicable.

Rawl plugs are not permitted.

100–3.9 ELECTRICAL IDENTIFICATION. Provide electrical identification as indicated on the drawings and in accordance with the following Specifications.

a. Section Includes.

(1) Buried electrical line warnings.

(2) Identification of electrical power, control and communication, cables and conductors.

(3) Operational instruction signs.

(4) Warning and caution signs.

(5) Equipment labels and signs.

b. 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.

c. Products.

Provide manufacturer's standard products of categories and types required for each application, except as otherwise indicated.

Use pre-printed, flexible, self-adhesive marking labels for raceways with a 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.

Use permanent bright-colored continuous-printed plastic Underground Line Marking 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.

Use Vinyl or Vinyl Cloth Wire/Cable Designation Tape Markers that are self adhesive wrap–around cable/conductor markers with pre–printed numbers and letters for designation purposes.

Cut Aluminum Wrap–Around Cable Marker Bands 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.

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.

Use Baked Enamel Warning and Caution Signs that are pre–printed aluminum signs appropriate to the location, punched for fasteners, and sized for good visibility.

Use Fasteners for Plastic Laminate and Metal Signs that are self tapping stainless steel screws or No. 10/32 minimum stainless steel machine screws with nuts and flat and lock washers.

Use Cable Ties that are 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 –50°F to +350°F. Provide ties in specified colors when used for color coding.

d. Installation.

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.

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.

Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

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:

(1) 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.

(2) On wall surfaces directly exterior to conduits run concealed within the wall.

(3) On all accessible surfaces of concrete envelope around conduits in vertical shafts exposed at ceilings or concealed above suspended ceilings.

(4) On entire surface of exposed conduits.

(5) Clean surface of dust, loose material and oil films before painting.

(6) 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.

(7) Provide one intermediate and one finish coat of orange silicone alkyd enamel.

(8) Apply all primer and finish materials in accordance with manufacturer's instructions.

Identify Pull and Connection Boxes 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 the outside of the box cover. Also label box covers to identify the circuits. Use pressure sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes.

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.

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.

Tag or label conductors as follows:

(1) Tag or label all conductors with identification indicating source and circuit numbers.

(2) 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.

(3) Match identification markings with designations used in panelboards, shop drawings, contract documents and similar previously established identification schemes for the facility electrical work.

(4) 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.

(5) 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.

Provide sign or stenciled legend to identify equipment concealed behind bolted covers of housing for disconnecting switches, transformers and switchboards.

Stencil or provide an 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 a unit is specified with its own self–explanatory identification. Except as otherwise indicated, provide a single line of text, and 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:

(1) Panelboards, electrical cabinets and enclosures.

(2) Access doors and panels for concealed electrical items.

(3) Electrical switchgear and switch boards.

(4) Regulators.

(5) Power transfer equipment.

(6) Contactors.

(7) Remote controlled switches.

(8) Control devices.

(9) Transformers.

(10) Power generating units.

For panelboards, provide circuit schedules with explicit description and identification of items controlled by each individual breaker.

Stencil and install labels at locations for best convenience of viewing without interference with operation and maintenance of equipment.

100–3.10 SECONDARY GROUNDING. Provide secondary grounding as indicated on the Drawings and in accordance with the following Specifications.

a. Section Includes.

(1) Materials and methods for grounding constant voltage 600V or less electrical systems only.

(2) Grounding conductors.

(3) Bonding jumpers.

(4) Ground bus.

(5) Ground rods.

(6) Grounding terminations.

b. 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.

c. Products.

Provide insulated equipment grounding conductors that run in the same raceway with circuit wires.

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.

Provide braided copper tape constructed of No. 30 gauge bare copper wires sized to suit the application.

Ground rods 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.

Where welded connections are required, such welds shall be made by the exothermic process utilizing factory provided molds.

d. Installation.

Deliver grounding materials in factory–sealed containers and with conductors wound on National Electrical Manufacturers Association (NEMA) wire and cable reels.

Store grounding materials in a clean dry space in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.

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.

Provide the equipment grounding system so 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.

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.

Drive electrical system ground rods until the top is 6 inches below the final grade.

Interconnect the electrical system ground rods with bare copper grounding electrode conductors buried at least 24 inches below grade.

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.

Provide the proper number and size of pressure connectors required for all equipment grounding bars in panelboards and other electrical equipment for the termination of equipment grounding conductors. Provide pressure connectors for all active and spare circuits.

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 ground bushing with a bare copper bonding jumper to the ground lug or bus in the electrical equipment. Size the conductor as required by NFPA 70.

Make all ground connections with UL listed products.

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. Provide panelboards as indicated on the drawings and in accordance with the following Specifications.

a. Section Includes.

(1) Distribution panelboards.

(2) Lighting and appliance branch circuit panelboards.

b. Section Does Not Include.

(1) Switchboards.

(2) Service entrance equipment.

c. References.

(1) National Electrical Manufacturers Association (NEMA). Provide panelboards and switches constructed and configured in accordance with the following:

NEMA AB 1 Molded Case Circuit Breakers and Molded Case Switches
NEMA KS 1 Encloses Switches
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:

UL	50	Cabinets and Boxes
UL	67	Panelboards
UL	310	Electrical Quick–Correct Terminals
UL	486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL	489	Molded–Case Circuit Breakers and Circuit–Breaker Enclosures
UL	943	Ground–Fault Circuit Interrupters
UL	1053	Ground–Fault Sensing and Relaying Equipment

d. Products.

(1) Distribution Panelboards.

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.

Provide bare, uninsulated copper, factory installed grounding bus with ampacity equal to the main bus. Provide copper pressure connected terminations.

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.

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.

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 produced from 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.

Provide multiple knockouts not fewer than 1.5 times the number of bus circuits.

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. Paint recessed boxes, and surface boxes in vaults, switchgear rooms and electrical equipment enclosures as previously described.

Provide factory printed directories with a clear plastic directory cover and metal frame attached to the panel door.

Provide Wiring Space that conforms to the requirements of UL 67. Feed–through gutters are 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.

Breakers shall have inverse time automatic tripping.

Provide adjustable trip circuit breakers as noted in the Contract Documents.

Use factory assembled bolt-in type circuit breakers, 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.

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.

Provide breakers as indicated in the Contract Documents with current interrupting ratings, in RMS symmetrical amps.

(2) Lighting and appliance Branch Circuit Panelboards.

Provide enclosures, bus systems, spacing and knockouts same as for distribution panelboards.

Provide interrupting ratings, circuit arrangements, and trip settings as noted in the Contract Documents.

Provide common trip mechanisms for multi–pole breakers.

Provide instantaneous automatic trips conforming to NEMA AB 1.

Breakers shall be bolt–on type, factory assembled.

Stab–in circuit breaker types are not acceptable.

Provide quick–make and quick–break mechanism.

e. Installation.

Install panelboards in conformance with NEMA PB 1 and NFPA 70.

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.

Verify gutter size conforms to wire bending space requirements of NFPA 70 and UL 67.

Wire wrap branch circuits in gutters after installation. Use approved wire ties.

Verify maximum gutter fill to conform with NFPA 70 and UL 67.

Verify bolted circuit breaker connection lugs conforming to shop drawings.

Verify breaker size, trip setting, and breaker type in conformance with Contract Documents.

Complete typewritten panelboard circuit directory prior to project acceptance.

Only wires made of the conductor material for which the panelboard terminals have been marked shall be used.

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. Provide overcurrent protective devices as indicated on the drawings and according to these specifications.

a. Section Includes.

(1) Molded case circuit breakers.
(2) Heavy duty safety switches.
(3) Combination molded case circuit breakers and current–limiting fuses.

b. Section Does Not Include.

(1) Main service switches.

c. References.

(1) National Electrical Manufacturers Association (NEMA). Provide and install fuses and circuit breakers conforming to NEMA, including:

NEMA	AB–1	Molded Case Circuit Breakers and Molded Case Switches.
NEMA	AB–2	Field Inspection and Performance Verification of Molded Case Circuit. Breakers Used in Commercial and Industrial Applications, Procedures for.
NEMA	AB–3	Molded Case Circuit Breakers and Their Application.
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:

UL	512	Fuseholders
UL	198B	Class H Fuses
UL	198C	High–Interrupting–Capacity Fuses, Current–Limiting Types
UL	198D	Class K Fuses

UL	198E	Class R Fuses
UL	198G	Fuses for Supplementary Overcurrent Protection
UL	198H	Class T Fuses
UL	489	Molded–Case Circuit Breakers and Circuit–Breaker Enclosures.

d. 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.

Circuit breakers shall conform to NEMA AB 1.

Use circuit breakers that have a trip rating and number of poles as indicated on the Contract Documents.

Use circuit breakers that 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.

Use circuit breakers from the same manufacturer.

Provide circuit breakers with a quick–made and quick–break toggle mechanism with inverse–time trip characteristics.

Automatic release is to be secured by a bimetallic thermal element releasing the mechanism latch.

A magnetic armature shall be provided to trip the breaker instantaneously for short–circuit currents above the overload range.

Automatic tripping shall be indicated by a handle position between the manual OFF and ON position.

Provide adjustable magnetic trip devices adjusted at the factory to "low" trip setting ampere values.

(3) Heavy Duty Safety Switches.

Provide quick make, quick break load interrupter enclosed knife switch assemblies.

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.
Install current–limiting fuses instead of regular fuses where the fault current exceeds 10,000 RMS amperes.

Fuses rated over 600 amperes shall be NEMA Class L.

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 10 seconds at 500 percent of rating.

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.

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.

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.

High–interrupting–capacity circuit breakers adequate for the short circuit current available at the particular location in the system may be provided instead of the combination current limiting fuse units.

d. Installation.

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.

Coordinate with other work, including electrical wiring work, as necessary to interface installation of overcurrent protective devices with other work.

Fasten overcurrent devices without causing mechanical stresses, twisting or misalignment being exerted by clamps, supports, or cabling.

Set field–adjustable circuit breakers for trip settings as indicated, subsequent to installation of units.

Install fuses and package the spare fuses in an orderly fashion.

Inspect circuit–breaker operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.

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. Work specified herein will be measured for payment as part of other Pay Items described in other Specifications. The cost of Work required in this Specification will be included in the prices bid for Pay Items included in the Schedule of Prices.

SPECIFICATION L–101. INSTALLATION OF AIRPORT ROTATING BEACONS L–801A, L–801H, L–801S, L–802A, L–802H, AND L–802S

DESCRIPTION

101–1.1 GENERAL.

a. This Work consists of furnishing and installing Airport Rotating Beacons, including mounting, leveling, conduit wiring, power source, beacon controller, photocell, painting, lightning protection, servicing, and testing of the beacon and all materials and incidentals necessary to place the beacons in operating condition as a completed unit. This Work includes an electric utility service, panelboard, mounting platform and attachment structure if specified in the Contract Documents. This Work does not include a tower structure or tower obstruction lighting.

101-1.2 THIS SPECIFICATION INCLUDES:

a. Regulatory requirements.
b. Beacons.
c. Beacon attachment structure.
d. Lightning rod.
e. Down conductor.
f. Down conductor ground rod.
g. Ground clamp.
h. Paint.

101-1.3 OTHER RELATED SPECIFICATIONS.

a. L-100-2.1 through L-100-2 .17 General Requirements.
b. L-100-3.2 Raceways.
c. L-100-3.3 Feeder and Branch Circuit Wire and Cable.
d. L-100-3.4 Control and Signal Wire and Cable.
e. L-100-3.5 Electrical Boxes and Fittings.
f. L-100-3.6 Wiring Devices.
g. L-100-3.7 Cabinets and Enclosures.
h. L-100-3.8 Supporting Devices.
i. L-100-3.9 Electrical Identification.
j. L-100-3.10 Secondary Grounding.
k. L-100-3.11 Panelboards.
l. L-100-3.12 Overcurrent Protective Devices.

101-1.4 CLASSIFICATIONS.

a. L-801A Medium Intensity Airport Beacon.
b. L-801H Medium Intensity Heliport Beacon.
c. L-801S Medium Intensity Seaplane Beacon.
d. L-802A High Intensity Airport Beacon.
e. L-802H High Intensity Heliport Beacon.
f. L-802S High Intensity Seaplane Beacon.

NOTE TO SPECIFIER:
The Plans need to show a complete installation to further define the scope of Work.

EQUIPMENT AND MATERIALS

101–2.1 REGULATORY REQUIREMENTS.

a. Airport lighting equipment and materials requiring Federal Aviation Administration (FAA) specifications shall have the prior approval of the FAA, and be listed in the latest edition of Advisory Circular (AC) 150/5345–53 Appendix 3.

b. All other electrical equipment and materials shall be subject to acceptance through manufacturer's certification of compliance as required in Specification L–100.

101–2.2 BEACON. The beacon shall meet the requirements of the latest edition of AC 150/5345–12, Specification for Airport and Heliport Beacons.

101–2.3 BEACON ATTACHMENT STRUCTURE. The attachment structure shall be as specified in the Contract Documents. Galvanized steel shall conform to ASTM A242. Wood structure shall be pressure treated conforming to AWPA Treatment C1. All ungalvanized steel shall conform to ASTM A36.

101–2.4 LIGHTNING ROD. The lightning rods shall be 5/8" diameter x 8' long galvanized steel, copper–clad.

101–2.5 DOWN CONDUCTOR. The down conductor cable for lighting protection shall be No. 4 AWG or larger bare stranded copper wire.

101–2.6 DOWN CONDUCTOR GROUND ROD. The ground rod shall be 5/8" x 8' long, copper or copper clad.

101–2.7 GROUND CLAMP. Ground clamp shall be similar and equal to the Type GR as manufactured by the Burndy Engineering Company.

101–2.8 PAINT.

a. Priming paint for ungalvanized metal surfaces and the mixing thereof shall conform to ASTM D 83.

b. Priming paint for galvanized metal surfaces shall be zinc dust–zinc oxide primer paint conforming to Fed. Spec. TT–P–641.

c. 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 Fed. Spec. TT–P–59. The color shall be in accordance with Federal Standard 595, Aviation Gloss Orange Number 12197.

d. White paint for body and finish coats on metal and wood surfaces shall be ready–mixed paint conforming to Fed. Spec. TT–P–102.

e. Priming paint for wood surfaces shall be mixed on the job by thinning the above specified orange or white paint with 1/2 pint (0.06 liter) of raw linseed oil to each gallon (liter).

CONSTRUCTION METHODS

101–3.1 PLACING THE BEACON EQUIPMENT. Mount the beacon equipment on a tower, separate structure, or building as shown in the Contract Documents. Install the power source and the electric service utility at the location indicated in the Contract Documents.

101–3.2 HOISTING AND MOUNTING. Place the beacon on the mounting platform using suitable slings and hoisting methods. Before fastening the beacon in place, check the mounting holes for correct spacing. Do not strain or force the beacon base or mounting legs out of position to fit incorrect spacing of mounting holes. Use stainless steel hardware sized by the manufacture for attachment.

101–3.3 LEVELING. After the beacon has been mounted in place, level it accurately. Check the leveling in the presence of the Engineer in accordance with manufacturer's instructions.

101–3.4 SERVICING. Before placing the beacon in operation, accomplish the following:

a. Clean and polish the reflector and all glassware, both inside and outside, using a type of cleaner which will not scratch the finishes.

b Clean interior of beacon base and check for alignment of parts.

c. Clean and polish commutator slip rings. Apply a very small amount of Vaseline to the slip rings and immediately wipe off any excess. Operate about 1/2 hour, then wipe the surplus off the rings again. Remove the brushes and lubricate the chamber of brush holders.

d. Apply grease to the gears of the rotating mechanism where gears are accessible. Use a stiff brush and do not overgrease. Check to see if gears mesh properly, and turn the motor shaft by hand to ascertain if action of gear train is free. Check and adjust the clutch tension. Set the clutch to release at 12–16 pounds measured at 2 feet. Measure with the scale in a horizontal position tangent to the surface of the housing. Fill grease fittings with grease conforming to the manufacturer's recommendations.

e. Set brushes for free motion on slip rings, and adjust springs to manufacturer's recommendations.

f. Secure lamps properly in the sockets.

101–3.5 BEACON ADJUSTMENT. After the beacon has been mounted and leveled, adjust the elevation of the beams. Make the final beam adjustments at night so that results can be readily observed. Adjust the beams to the elevation as shown in the Contract Documents, except that, in no case shall the elevation of the beams be less than 2 degrees above the horizontal.

101–3.6 BEACON ATTACHMENT STRUCTURE. Where the beacon is to be mounted at a location other than the beacon tower and where a special attachment structure is required, the construction of this structure and hardware shall be in accordance with the details shown in the Contract Documents.

101–3.7 ELECTRICAL. Furnish all necessary labor and materials and make complete above ground electrical connections in accordance with the wiring diagram furnished with the Contract Documents.

Attach all electrical circuits to the beacon controller using the controller terminal blocks. Avoid cable splices.

Furnish and install at the top of the beacon tower or mounting platform a circuit–breaker panel board consisting of breakers to provide separate protection for the circuits to the beacon lamps, motor, obstruction lights, and other equipment. Locate the panel board so that it is accessible from the beacon structure.

Run all exposed wiring in not less than 1/2 inch galvanized rigid steel conduit, or intermediate metal conduit. Do not install conduit across the surface of the beacon platform floor. Install all conduit to provide for drainage. If mounted on a steel beacon tower, fasten the conduit to the tower members with "wraplock" straps, clamps, or approved fasteners. Fasten the conduit to wooden structures with galvanized pipe straps and with galvanized round head wood screws not less than No. 8 nor less than 1–1/4 inches (31 mm) long. Space all conduit straps approximately 5 feet (1.5 m) apart.

101–3.8 LIGHTNING PROTECTION. If down–conductor cables are attached to a tower structure, securely fasten the cables to the surface of the tower leg at 5–foot (1.5–m) intervals with suitable fasteners.

Make all connections of cable to cable, cable to lightning rods, and cable to ground plates or rods, with approved type solderless connectors or noncorrosive metal that are rated the same as the cable.

Firmly attach the down–conductor to the ground plate or rod by means of a ground conductor or clamp.

Accomplish the complete lightning protection installation to the satisfaction of the Engineer. The resistance to ground of any part of the lightning protection system shall not exceed 25 ohms.

101–3.9 PAINTING. If construction of a wooden mounting platform is stipulated in the proposal as part of this Specification, give all wooden parts of the platform one priming coat of white or aviation–orange paint after fabrication but before erection and one body and one finish coat of aviation–orange paint after erection. Give steel mounting platforms one priming coat before erection and one body and one finish coat of aviation–orange paint after erection. Give all equipment installed under this Contract and exposed to the weather one body and one finish coat of aviation–orange or white paint as required. This includes the beacon, beacon base, breaker cabinet, all conduit, and transformer cases. It does not include lightning rods, obstruction light globes, and beacon lenses.

Apply the paint uniformly in the proper consistency by skilled painters. The finished paint shall be free from sags, holidays, and smears. Give each coat of paint ample time to dry and harden before the next coat of paint is applied. Allow a minimum of 3 days for drying on wood surfaces, and allow a minimum of 4 days for drying on metal surfaces. Do not paint in cold, damp, foggy, dusty, or frosty atmospheres, or when air temperature is below 40°F (4°C), nor started when the weather forecast indicates such conditions for the day.

Clean all surfaces before painting. The surfaces should be dry and free from scale, grease, rust, dust, and dirt when paint is applied. Cover all knots in wood surfaces with shellac immediately before applying the priming coat of paint. Fill nail holes and permissible imperfections with putty.

Thin the ready–mixed paint for the priming and body coats in accordance with the manufacturer's recommendations.

101–3.10 TESTING. Test the installation in operation as a completed unit prior to acceptance. These tests shall include operation of the lamp–changer operation and taking meggar and voltage readings. Testing equipment shall be furnished by the Contractor. Conduct tests in the presence of the Engineer.

METHOD OF MEASUREMENT

101–4.1 Beacons will be measured as complete units per lump sum for beacons installed in place, accepted, and ready for operation. Electric Utility Services will be measured as a complete unit per Lump Sum for services provided at location indicated in the Contract Documents.

BASIS OF PAYMENT

101–5.1 Payment will be made at the Contract Price per Lump Sum for the classification of Airport Rotating Beacons, at the locations indicated, complete and accepted.

Payment will be made the Contract Price per Lump Sum for Electric Utility Service, at the locations indicated, complete and accepted.

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 Rotating Beacons will include the beacon equipment, beacon controller, lightning protection, attachment structure, mounting, leveling, conduit, wiring, power source, photoelectric control, ground rods, and servicing and testing of the beacon, 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, L-100-3.3 and L-100-2.3

NOTE TO SPECIFIER:
Electric Utility Services are bid separately. The location and number should be shown on the Plans. Connection to power sources other than electric utilities are incidental and are provided from existing electric facilities on the Airport, except cable from the source to the location is measured under L–108.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item L10101	Airport Rotating Beacon, Location No. ___ L–801A, per Lump Sum
Pay Item L10102	Airport Rotating Beacon, Location No. ___ L–801H, per Lump Sum
Pay Item L10103	Airport Rotating Beacon, Location No. ___ L–801S, per Lump Sum
Pay Item L10104	Airport Rotating Beacon, Location No. ___ L–802A, per Lump Sum
Pay Item L10105	Airport Rotating Beacon, Location No. ___ L–802H, per Lump Sum
Pay Item L10106	Airport Rotating Beacon, Location No. ___ L–802S, per Lump Sum
Pay Item L10107 through L10110	Electric Utility Service, Location No. ___, per Lump Sum

Measurement and Payment will be made only for Pay Items listed in the Schedule of Prices. The cost of all Work required by the Contract Documents will be included in the Pay Items contained in the Schedule of Prices.

MATERIAL REFERENCES

Fed.Spec. TT P-59	Paint, Ready-mixed, International Orange
Fed.Spec. TT P-641	Primer, Paint; Zinc Dust-zinc Oxide
Fed.Spec. TT P-102	Paint, Oil: Exterior, Ready-mixed, White and Light Tints
Fed Std. 595	Colors
AC 150/5345-7	Specification for L-824 Underground Cable for Airport Lighting Circuits
AC 150/5345-12	Specification for Airport and Heliport Beacons

SPECIFICATION L–107. INSTALLATION OF AIRPORT WIND CONES L-806 AND L-807

DESCRIPTION

107–1.1 GENERAL.

a. This Work consists of furnishing and installing an Airport Wind Cone in accordance with these Specifications and in accordance with the dimensions, design, and details shown in the Contract Documents. The Work includes furnishing and installing the wind cone, a support structure for mounting the wind cone, power source, conduit, wiring on the wind cone and wind cone structure, and a concrete foundation. The Work also includes all cable connections, conduit and conduit fittings, furnishing and installation of all lamps, ground rod and ground connection, testing of the installation, and all incidentals necessary to place the wind cone in operation as a completed unit to the satisfaction of the Engineer.

This Work includes an Electric Utility Service and Segmented Circle, if specified in the Contract Documents.

107-1.2 THIS SPECIFICATION INCLUDES:

a. Regulatory Requirements.
b. Wind Cones.
c. Segmented Circle.
d. Paint.

107-1.3 OTHER RELATED SPECIFICATIONS.

a. L-100-1.1 through L-100-2.17 General Requirements.
b. L-100-3.2 Raceways.
c. L-100-3.3 Feeder and Branch Circuit Wire and Cables.
d. L-100-3.4 Control and Signal Wire and Cable.
e. L-100-3.5 Electrical Boxes and Fittings.
f. L-100-3.6 Wiring Devices.
g. L-100-3.7 Cabinets and Enclosures.
h. L-100-3.8 Supporting Devices.
i. L-100-3.9 Electrical Identification.
j. L-100-3.10 Secondary Grounding.
k. L-100-3.12 Overcurrent Devices.

107-1.4 CLASSIFICATIONS.

a. Type L-806 - Low Mass Supporting Structure.
b. Type L-807 - Rigid Mass Supporting Structure.
c. Size 1 - 8-Foot Wind Cone (L-806 and L-807).
d. Size 2 - 12-Foot Wind Cone (L-807).
e. Style 1 - Lighted.
f. Style 2 - Unlighted (Not Used).

NOTE TO SPECIFIER:

Electric utility services are bid as separate Pay Items.
Electric power sources provided from existing airport

EQUIPMENT AND MATERIALS

107–2.1 REGULATORY REQUIREMENTS.

a. Airport lighting equipment and materials requiring Federal Aviation Administration (FAA) specifications shall have the prior approval of the FAA, and be listed in the latest edition of Advisory Circular (AC) 150/5345–53, Appendix 3.

b. All other electrical equipment and materials shall be subject to acceptance through manufacturer's certification of compliance as required in Specification L–100.

107–2.2 WIND CONES. The 8–foot (24 m) and 12–foot (3.5–m) wind cones and assemblies shall conform to the requirements of the latest edition of AC 150/5345–27, Specification for Wind Cone Assemblies.

107-2.3 SEGMENTED CIRCLE. Furnish and install segmented circle markers of the design, type, and at the locations shown in the Contract Documents.

107–2.4 PAINT.

a. Priming paint for ungalvanized metal surfaces, and the mixing thereof, shall conform to ASTM D 83.

b. Use zinc dust-zinc oxide priming paint for galvanized metal surfaces that conforms to Fed. Spec. TT–P–641.

c. Use orange paint for the body and the finish coats on metal and wood surfaces that consists of a ready–mixed nonfading paint meeting the requirements of Fed. Spec. TT–P–59. The color shall be in accordance with Federal Standards 595, Aviation Gloss Orange Number 12197.

d Use ready-mixed white paint for body and finish coats on metal and wood surfaces that conforms to Fed. Spec. TT–P–102.

e. Mix on the job priming paint for wood surfaces by thinning the previously specified aviation–orange or white paint by adding 1/2 pint (0.06 liter) of raw linseed oil to each gallon (liter).

CONSTRUCTION METHODS

107–3.1 INSTALLATION. Mount the Wind Cones on a support role as shown in the Contract Documents. Install the power source and the electric utility service at the locations indicated in the Contract Documents.

107–3.2 ELECTRICAL CONNECTION. Furnish all labor and materials and make complete electrical connections in accordance with the wiring diagram furnished with the Contract Documents.

107–3.3 GROUND CONNECTION AND GROUND ROD. Furnish and install electrical system ground rods, grounding cable, and ground clamps for grounding the unit. The ground rod shall be 5/8_" x 8' long copper or copper clad. The grounding cable shall consist of No. 4 AWG bare stranded copper wire or larger. The resistance to ground shall not exceed 25 ohms.

107–3.4 PAINTING. Apply three coats of paint (one prime, one body, and one finish) to all exposed material installed except the fabric cone, obstruction light globe, and lamp reflectors. Give the wind cone assembly, if painted on receipt, one finish coat of paint instead of the three coats specified herein. The paint shall meet the requirements of Fed. Spec. TT–P–59. The color shall be in accordance with Federal Standard 595, Aviation Gloss Orange Number 12197.

107–3.5 LAMPS. Furnish and install general lighting service lamps as recommended by the manufacturer and necessary to complete the assembly.

107–3.6 CHAIN AND PADLOCK. Furnish and install a suitable operating chain for lowering and raising the hinged top section of Wind Cones. Attach the chain to the pole support in a manner to prevent the light fixture assembly from striking the ground in the lowered position.

When provisions for a padlock are provided by the manufacturer, furnish a padlock for securing the hinged top section to the fixed lower section. Deliver two sets of keys for the padlock to the Sponsor.

METHOD OF MEASUREMENT

107–4.1 Wind Cones, of the type and at the location indicated, and Segmented Circles at locations indicated, will be measured as a complete unit per lump sum. Electric Utility Service will be measured as a complete unit per lump sum for each location required by the Contract Documents.

BASIS OF PAYMENT

107-5.1 Payment will be made at the Contract price per Lump Sum for the classification of Airport Wind Cone, at the locations indicated, complete and accepted.

Payment will be made at the Contract price per Lump Sum for the Electric Utility Service, at the locations indicated, complete and accepted.

Payment will be made at the Contract price per Lump Sum for the Segmented Circle, at the locations indicated, complete and accepted.

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 Wind Cone shall include the wind cone equipment, support structure, foundation, receptacle, disconnect switch, pull box mounting, leveling, conduit, wiring, power source, photoelectric control, ground rods, and servicing and testing of the Wind Cone, all in accordance with the Contract Documents.

b. The Electric Utility Service shall 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 L-100-2.2 and L-100-2.3.

c. The Segmented Circle shall include the segmented circle equipment, foundation excavation, and backfill, all in accordance with the Contract Documents.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item L10701 through L10705	Wind Cone, L-806, Size 1, Style 1, Location No. ___, per lump sum
Pay Item L10706 through L10710	Wind Cone, L-807, Size 1, Style 1, Location No. ___, per lump sum
Pay Item L10711 through L10715	Wind Cone, L-807, Size 2, Style 1, Location No. ___, per lump sum
Pay Item L10716 through L10720	Electric Utility Service, Location No. ____, per lump sum
Pay Item L10721 through L10725	Segmented Circle, Wood Markers, Location No. ____, per lump sum
Pay Item L10726 through L10730	Segmented Circle, Steel Markers, Location No. ____, per lump sum

MATERIAL REFERENCES

Fed.Spec. TT P-59	Paint, Ready-mixed, International Orange
Fed.Spec. TT P-641	Primer, Paint; Zinc Dust-Zinc Oxide
Fed.Spec. TT P-102	Paint, Oil: Titanium Lead Zinc and Oil, Exterior, Ready-mixed, White and Light Tints
Fed Std. 595	Colors
AC 150/5345-27	Specification for Wind Cone Assemblies

SPECIFICATION L–108. INSTALLATION OF UNDERGROUND CABLE AND CONDUCTORS FOR AIRPORTS

DESCRIPTION

108–1.1 GENERAL.

a. This Work consists of furnishing and installing underground cable, conductors, and flexible polyethylene duct in accordance with these Specifications at the locations shown in the Contract Documents. This Work includes excavation and backfill of the trench, installation of cable and counterpoise wire in trench, duct, conduit or by plowing, the location and protection of existing circuits, splicing, cable marking, and testing of the installation, site installation, and all incidentals necessary to place the cable in operating condition as a completed unit.

108-1.2 THIS SPECIFICATION INCLUDES:

a. Regulatory Requirements.
b. Underground Cable.
c Bare Counterpoise Wire.
d. Underground Wire/Cable Connections.

108-1.3 OTHER RELATED SPECIFICATIONS.

a. L-100-1.1 through L-100-2.17 General Requirements.

108-1.5 CLASSIFICATIONS.

a. Type C Cable and Conductors - 600V to 5000V with cross linked polyethylene insulation.

EQUIPMENT AND MATERIALS

108–2.1 REGULATORY REQUIREMENTS.

a. Airport lighting equipment and materials requiring Federal Aviation Administration (FAA) specifications shall have the prior approval of the FAA, and be listed in the latest edition of Advisory Circular (AC) 150/5345–53, Appendix 3.

b. All other electrical equipment and materials shall be subject to acceptance through manufacturer's certification of compliance as required in Specification L–100.

108–2.2 UNDERGROUND CABLE. Underground cable shall conform to the requirements of the latest edition of AC 150/5345–7, Specification for L–824 Underground Electrical Cable for Airport Lighting Circuits.

If telephone control cable is used as control cable, it shall be copper shielded, polyethylene insulated and jacketed, No. 19 AWG telephone cable conforming to the United States Department of Agriculture, Rural Electrification Administration (REA) Bulletin 345–14, REA Specification for Fully Color–Coded, Polyethylene Insulated, Double Polyethylene–Jacketed Telephone Cables for Direct Burial.

Where bare copper counterpoise conductors are to be installed where soil conditions would adversely affect bare copper wire, thermoplastic wire conforming to Fed. Spec. J–C–30, Type TW, 600 volt, may be used.

Cable type shall be Classification Type C. Size, number of conductors, strand and service voltage are specified in the Contract Documents.

108–2.3 BARE COUNTERPOISE WIRE. Bare copper wire for counterpoise installations shall be stranded wire conforming to ASTM Specifications B 3 and B 8.

108–2.4 UNDERGROUND WIRE/CABLE CONNECTIONS. In–line connections of underground cables shall be of the type called for in the Contract Documents, and shall be one of the following types. Series circuit connectors shall conform to the latest edition of AC 150/5345-26.

a. Cast Splice. A cast splice, employing a plastic mold and using epoxy resin equal to that manufactured by Minnesota Mining and Manufacturing (3M) Company, "Scotchcast" Kit No. 82—A, or as manufactured by Hysol Corporation, "Hyseal Epoxy Splice" Kit No. E1135,

for potting the splice is approved. The means of splicing telephone control cable is by using 3M "Scotchcart" kits 89–D through 89–D3 or 8981 through 8985 or equal.

b. Vulcanized Splice. A vulcanized splice employing Joy Manufacturing Company's Vulcanizing Kit No. X–1604–8 or equal is approved for field vulcanized splices. Use the proper molds for various cable sizes.

c. Field–attached Plug–in Connector. Use L–823 Plug and Receptacle, Cable Connectors, Class I Type B, employing connector kits, for field attachment to single conductor cable per the Contract Documents.

d. Factory–Molded Plug–in Connector. Specification for L–823 Connectors, Class I, Type A, Factory–Molded to Individual Conductors, are approved.

e. Taped Connections. Taped connections employing field–applied rubber, or synthetic rubber tape covered with plastic tape are approved. Double tape the secondary connector joint. The first layer of tape shall be 3M, #13 rubber tape or equal. The second layer of tape shall be 3M, #38 plastic tape or equal. Lap the second layer of tape over the first layer of tape. In all the above cases, use crimp connectors to make connections of cable conductors utilizing a crimping tool designed, to make a complete crimp before the tool can be removed. No. 19 AWG telephone control wires may be connected by means of wrapped and soldered splice, 3M Company Moisture Proof UR Type Connector, or equal.

CONSTRUCTION METHODS

108–3.1 GENERAL. Install the specified cable at the approximate locations indicated in the Contract Documents.

Locate and mark all existing circuits near the construction of new circuits with flagging through the turf area prior to the excavating operation by the Contractor.

The Contractor is entirely responsible for locating and identifying existing underground cables. Do not, under any circumstances, deliberately plow or trench across existing conductors for the sole purpose of locating cables. Cable that is cut and is not designated for replacement shall be replaced at Contractor's expense in its entirety from edge light unit to unit. Replace home run circuits in their entirety or install a UL or ETL listed pull box for a cast splice, at the Contractor's expense.

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. The Contractor shall be responsible for providing cable in continuous lengths for home runs or other long cable runs without connections, unless otherwise shown in the Contract Documents.

Acclimate cable to the installed ambient temperature before installation commences (1 hour minimum).

All direct burial splices shall be in a manhole or a hand hole. With the exception of stake mounted lights per Specification L-125, splicing of buried cables directly in the soil is not permitted.

108–3.2 INSTALLATION IN DUCT OR CONDUIT. This Work includes the installation of the cable in duct or conduit as described herein. 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 edition of NFPA 70.

Install the duct or conduit as a separate Pay Item in accordance with Specification L–110, "Installation of Airport Underground Electrical Duct." Make sure that the duct is open, continuous, and clear of debris before installing cable. Install the cable in a manner to prevent harmful stretching of the conductor, injury to the insulation, or damage to the outer protective covering. Seal the ends of all cables with moisture–seal tape before pulling into the conduit and left seal it until connections are made. Where more than one cable is to be installed in a duct under the same Contract, pull all cable in the duct at the same time. Pull cable through ducts or conduits by hand winch or power winch with the use of cable grips or pulling eyes. Pulling tensions should be governed by recommended standard practices for straight pulls or bends. Where pulling lubricant is required use a lubricant recommended for the type of cable being installed. Replace duct or conduit markers temporarily removed for excavations and include the cost in the price for cable installation.

108–3.3 TRENCHING. Where turf is well established and the sod can be removed, carefully strip and properly store it. Trenches for cables may be excavated manually or with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Do not use road graders to excavate the trench with their blades. The bottom surface of trenches shall be

essentially smooth and free from coarse aggregate. Unless otherwise specified, excavate cable trenches to a depth as indicated in the Contract Documents.

Excavate all cable trenches to a width as indicated in the Contract Documents. Widen the trench where more than two cables are to be installed parallel in the same trench as shown in the Contract Documents. Unless otherwise specified in the Contract Documents, install all cables in the same location and running in the same general direction in the same trench.

When rock excavation is encountered, remove the rock to a depth of at least 3 inches (75 mm) below the required cable depth and replace it with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4–inch (6 mm) sieve. Ascertain the type of soil or rock to be excavated before bidding. Excavation shall be incidental to this Pay Item.

108–3.4 INSTALLATION IN TRENCHES. Mechanical cable–laying equipment may be used in conjunction with a trenching machine if indicated in the Contract Documents; and it should provide for physical inspection of cable prior to backfilling. Sharp bends or kinks in the cable are not permitted.

Unreel cables in place alongside or in the trench and carefully place the cable along the bottom of the trench. Do not unreel the cable and pull into the trench from one end.

Whenever cables (including counterpoise) cross, adjust the trench depth to provide 3" vertical clearance between 5KV conductors; 6" vertical clearance between 600V conductors and 5KV conductors; and 4" vertical clearance between any conductor and the counterpoise conductor. Counterpoise shall always maintain an 8" vertical depth at the edge of pavement and 18" vertical depth when the counterpoise is located above home run circuits. All other cables shall meet NFPA section 70 requirements.

Leave cable slack on each side of all connections, insulating transformers, light units, and at all other points where cable is connected to field equipment. Place the slack cable in the trench in a series of S curves. Leave additional slack cable in runway light bases, handholes, manholes, and other locations where it is required to bring the cable above ground level to make connections. The amount of slack cable shall be as shown in the Contract Documents. Slack cable for above ground connections will be paid as defined in Method of Measurement.

108–3.5 BACKFILLING. After the cable or conductors have been installed on a 3" sand bedding, the first layer of backfill shall be loose measurement, and shall be sand containing no mineral aggregate particles that would be retained on a 1/4–inch (6 mm) sieve. Do not compact this sand backfill layer. The second and subsequent layers shall be as shown on the Drawings and shall contain no particles larger than 1 inch (25 mm) maximum diameter. The top layer of the backfill shall be topsoil. Do not place material in a manner that would stress or damage the cable.

Thoroughly tamp and compact the second, and subsequent layers to at least the density of the adjacent undisturbed soil, and to the satisfaction of the Engineer. If necessary to obtain the desired compaction, moisten or aerate the backfill material as required.

Trenches shall not be excessively wet and shall not contain pools of water during backfilling operations. Completely backfill the trench and tamp it level with the adjacent surface, except that when sod is to be placed over the trench, stomp the second backfilling at a depth equal to the thickness of the sod to be used, with proper allowance for settlement. Remove excess excavated material and dispose of it in accordance with the Contract Documents. All backfilling shall be incidental and the cost included in the Pay Items contained in the Schedule of Prices

Trenches for polyethylene duct will not require sand bedding or a first layer of sand backfill. However, the second and subsequent layers and top layer of topsoil shall comply with paragraph 108–3.5.

108–3.6 RESTORATION. Restore pavement and other surface features disturbed by trenching, plowing, cable installation, storage of materials, and other Contractor operations, to a condition equal to or exceeding that which existed prior to construction. Restore turf as follows:

a. When grading limits are shown on the Plans and the Schedule of Prices contains Pay Items for Salvaged Topsoil, Seeding, Fertilizing, and Mulching, restore the area within the grading limits in accordance with requirements shown on the Plans and contained in the turfing Specifications for areas disturbed by grading operations.

b. Complete turf restoration, for turf disturbed by trenching, plowing, and cable installation outside grading limits, or when there are no grading limits shown, by removing and replacing existing sod or by replacing the disturbed turf with topsoil or salvaged topsoil, seeding, and mulching, in accordance with Specification T–901, T–902, T–905, and T–908. The finished surface upon completion of restoration shall be graded smooth and uniform to match existing slope, and shall be free from ruts over 1 inch in depth and stones over 1 inch in diameter. Maintain and water the turf. Replace seeded areas that do not "catch."

NOTE TO SPECIFIER:
Grading limits should be shown on the Plans for Contracts that include earthwork.

108–3.7 CABLE AND SPLICE MARKERS. Define the location of runway light circuits and splices with concrete markers. In general, mark home run circuits from the runway lights approximately every 200 feet (60 m) along the cable run, with an additional marker at each

change of direction of cable run. Mark all other cable buried directly in the earth in the same manner. Do not install markers where cable lies in straight lines between pavement edge lights or obstruction light poles which are spaced 300 feet (90 m) apart, or less. Install markers immediately above the cable or splice. Impress the legend and directional arrows on each marking slab as required by the Contract Documents. The letters shall be approximately 4 inches (100 mm) high and 3 inches (75 mm) wide, with width of stroke 1/2 inch (12 mm) and 1/4 inch (6 mm) deep. Legends inscribed by hand in wet concrete are not acceptable. Edge expose concrete with a 1/4 inch radius tool.

108–3.8 PLOWING. 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 6 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.

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 10 inches deeper than the cable. There shall be a measure of slack at each ground rod to perform the connection process and accommodate movement caused by frost heaving.

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. Continue plowing by lowering the plow, starting it and holding the cable by hand before it is firmly held by the ground.

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.

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.

When an underground obstruction is 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.

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.

108–3.9 CONNECTIONS. In line connections of the type shown in the Contract Documents shall be made by experienced personnel regularly engaged in this type of work and shall be made as follows:

a. Cast Splices. Use crimp connectors for jointing conductors. Assemble molds and mix and pour the compound in accordance with manufacturer's instructions and to the satisfaction of the Engineer.

b. Vulcanized Splices. Use crimp connectors for joining conductors. Make the splice using compounds furnished by the manufacturer, in accordance with the manufacturers instructions and to the satisfaction of the Engineer.

c. Field–attached Plug–in Connectors. Assemble these in accordance with manufacturer's instructions. Make these splices by plugging directly into mating connectors. In all cases seal the joint where the connectors come together with heat shrink tubing as required by the Contract Documents and these Specifications.

d. Factory–Molded Plug–in Connections. Make these by plugging directly into mating connectors. In all cases, wrap the joint where the connectors come together 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 (37 mm) on each side of the joint.

e. Taped Connections. Make a taped splice in the following manner:

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 (6 mm) of bare conductor on each side of the connector. Use a sharp knife to pencil insulation and jacket at approximately the same angle as a pencil point. Care must be taken to avoid nicking or injuring the conductor during removal of insulation or penciling. Do not use emery paper on splicing operations since it contains metallic particles. Thoroughly clean the copper conductors. Join the conductors by inserting them equidistant into the compression connection sleeve. Crimp conductors firmly in place with a crimping tool that requires a complete crimp before the 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 (75 mm) on each end) is clean. After scraping, wipe the entire area with a clean lint–free cloth. Do not use solvents.

Apply specified 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 1 inch (25 mm) over the original jacket. Cover rubber tape with two layers of specified 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.

If shielded cable is to be spliced, prepare cable as for a regular taped splice, except remove the neoprene jacket a distance not less than 5 inches (125 mm) from the beginning of the penciled portion. Carefully unwrap the shielding tape from that portion where jacket has been removed and cut off so that it extends about 1 inch (25 mm) from end of the jacket. Proceed with the taped splice as described above and tape up to 1/4 inch (6 mm) from the shield on both ends. Build up rubber tape to a thickness equal to the insulation thickness or 5/16 inch (9 mm) over connector.

Next wrap one–half lapped layer of semi–conducting tape (Scotch No. 13 Semi–Conducting Tape, or equal) over splicing tape and 1/4 inch (6 mm) onto the shielding tape. Wrap a fine, flat shielding braid one–half lapped over the splice extending 1/2 inch (12 mm) onto the metallic shielding. Solder ends of braid to metallic shielding tape. A bonding wire, (Minimum No. 14 Stranded Copper) equal to the current carrying capacity of the metallic shield, should have the individual strands wrapped around the metallic shield at both ends of the splice. These strands should be tack soldered to the shield in several places. The cable sheath should be replaced by wrapping with two one–half lapped layers of vinyl tape extending 2 inches (50 mm) onto the cable jacket.

The above described splice is for a straight–through splice with continuity of shielding.

f. Heat Shrink Connections. Make these with a heat shrinkable insulating cover, specifically designed for splices and terminations per UL 486D. The head shrink material shall be made of thermally stabilized cross linked polyolefin, rated 90°C, designed with a 3:1 shrink ratio. The material shall have a factory internally applied adhesive sealant, which is applicable to metal, plastic and elastomeric insulating materials.

Heat shrink application and installation procedures, shall conform to the manufacturers instructions.

g. Connection Rating. The dielectric strength and insulation rating of all connection materials, application and installation methods, shall be equal to or exceed the rating of the cables or conductors spliced together.

108–3.10 BARE COUNTERPOISE WIRE INSTALLATION AND GROUNDING FOR LIGHTNING PROTECTION. When shown in the Contract Documents, install a stranded or solid bare copper wire, No. 8 AWG minimum size, for lightning protection of the underground cables. Install the bare counterpoise wire as required in the Contract Documents. Install homerun circuits in the same trench for the entire length of the insulated cables it is designed to protect. Securely attach the counterpoise wire to copper or copper–clad ground rods installed not more than 500 feet (150 m) apart for the entire circuit and at the beginning and end of each counterpoise circuit. The ground rods shall be of the length and diameter specified in the Contract Documents, but never less than 8–feet (2.4 m) long nor less than 5/8 inch (15 mm) in diameter.

Terminate the counterpoise system outside structures that enclose the power source for the circuit protected. Make the connections as shown in the Contract Documents.

108–3.11 TEST, LOCATE AND PROTECT EXISTING CIRCUITS. 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 any FAA installed cables or equipment encountered during construction; and removal/reinstallation of existing cables.

Immediately prior to construction, obtain meggar test readings of all airport circuits that will be encountered during construction, including those crossed by haul routes or access roads, shall be taken 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.

Upon completion of construction, in the presence of the Sponsor and the Engineer, Meggar test all airport circuits encountered during construction. Repair all portions of circuits that have been damaged during construction.

The 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. The 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 TEST. Furnish all necessary equipment and appliances per Specification 100–2.13 for testing the underground cable circuits after installation. Test and demonstrate the following:

a. That all lighting power and control circuits are continuous and free from short circuits.

b. That all circuits are free from unspecified grounds.

c. That the insulation resistance to ground of all ungrounded constant current circuits meets the requirements of Table 1.

d. That the insulation resistance to ground of all ungrounded constant voltage circuits meets the requirements of Specification 100–3.3(h).

TABLE 1. INSULATION RESISTANCE TO GROUND

CIRCUIT LENGTH IN FEET	*MINIMUM MEGOHMS AT 500VDC*	*MINIMUM MEGOHMS AT 1000VDC*
10,000 OR LESS	50	45
10,000 – 20,000	40	36
20,000 OR MORE	30	27

e. That all circuits are properly connected in accordance with applicable wiring diagrams.

f. That all circuits are operable. Tests shall be conducted that include operating each control not less than 10 times and the continuous operation of each lighting and power circuit for not less than 1/2 hour.

g. Test shall be conducted per Subsection 100-2.12.

METHOD OF MEASUREMENT

108–4.1 LOCATE AND PROTECT EXISTING CIRCUITS. Locate and Protect Existing Circuits will be measured for payment as a complete unit per lump sum.

NOTE TO SPECIFIER:
It is intended that when the Pay Item Cable Plow is included in the Schedule of Prices, Cable Trench will also be bid. If the Pay Item Cable Trench or Plow is bid, the Pay Items Cable Plow and Cable Trench should not be used unless a Special Provision or Plan note is included to specify where measurement will be made.

108–4.2 PLOW. Plow will be measured for payment on a unit price basis per linear foot. Measurement will be made in straight horizontal lies between lights, signs, and angle points shown on the Plans.

108–4.3 TRENCH. 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. 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. 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. 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. 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 3 feet of cable length required for each isolation transformers, will be added to the length measured for payment.

108-4.7 FLEXIBLE POLYETHYLENE DUCT. 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. 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. Counterpoise Ground Rods will be measured for payment on a unit price basis for each.

108–4.10 CABLE AND SPLICE MARKERS. 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. Turf Restoration will be measured for payment on a unit price basis per linear foot. Measurement 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.

NOTE TO SPECIFIER:
Grading limits must be shown on drawings for projects with excavation and embankment.

BASIS OF PAYMENT

108–5.1 LOCATE AND PROTECT EXISTING CIRCUITS. 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. 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. 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 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.

108–5.4TRENCH OR PLOW. 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 for the installation of the various sizes and types of cable and flexible polyethylene duct 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, and 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.

108-5.5 COUNTERPOISE TRENCH OR PLOW. 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. 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. 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. 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.

NOTE TO SPECIFIER:
The cost for trenching or plow for cable and <u>counterpoise</u> shall be included in Pay Items separate from the Pay Items for cable and counterpoise.

108–5.9 COUNTERPOISE GROUND RODS. 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, and incidentals necessary to complete the Work.

108–5.10 CABLE AND SPLICE MARKERS. 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 TURF RESTORATION. 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, and appurtenant Work, shall be incidental and the cost included in the prices for Trench or Trench or Plow. Basis of Payment for turf restoration 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 T–901, T–902, T–905, and T–908 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 complete grading, electrical, and turfing 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 conductors are installed 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 T–901, T–902, T–905, and T–908. Measurement will be made as specified herein, and payment will be made at the Contract unit price per linear foot. This price will include furnishing all materials for grading, topsoiling, seeding, mulching, and maintenance, 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.

108-5.12 Standard Pay Items for Work covered by this Specification are as follows:

Pay Item L10801	Locate and Protect Existing Circuits, per lump sum
Pay Item L10802	Plow, per lineal foot
Pay Item L10803	Trench 6", per linear foot
Pay Item L10804	Trench 9", per linear foot
Pay Item L10805	Trench 12", per linear foot
Pay Item L10806	Trench 18", per linear foot
Pay Item L10807	Trench 21", per linear foot
Pay Item L10808	Trench 24", per linear foot
Pay Item L10809	Flexible Polyethylene Duct, per lineal foot
Pay Item L10810	Trench or Plow, per lineal foot
Pay Item L10811	Counterpoise Plow, per lineal foot
Pay Item L10812	5000 Volt Cable No. 8, per lineal foot
Pay Item L10813	600 Volt Cable, No. 4, per lineal foot
Pay Item L10814	600 Volt Cable, No. 6, per lineal foot
Pay Item L10815	600 Volt Cable, No. 8, per lineal foot
Pay Item L10816	600 Volt Cable, No. 10, per lineal foot
Pay Item L10817	Bare Counterpoise Wire, No. 6, per lineal foot
Pay Item L10818	Bare Counterpoise Wire, No. 8, per lineal foot
Pay Item L10819	Counterpoise Ground Rod, per each
Pay Item L10820	Cable Markers, per each
Pay Item L10821	Turf Restoration, per lineal foot

MATERIAL REFERENCES

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 will be included in the Pay Items contained in the Schedule of Prices.

AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuit
AC 150/5345-26	Specification for L-823 Plug and Receptacle Cable Connectors

SPECIFICATION L–109. INSTALLATION OF VAULT ELECTRICAL EQUIPMENT

DESCRIPTION

109–1.1 GENERAL.

a. This Work consists of the furnishing and installation of equipment in a vault or prefabricated metal housing in accordance with these Specifications and with the design and dimensions shown in the Contract Documents. The Work includes enclosure facilities equipment; the painting of equipment; the marking and labeling of equipment and the labeling or tagging of wires; the testing of the installations; and the furnishing of all incidentals necessary to place it in operating condition as a completed unit.

109-1.2 THIS SPECIFICATION INCLUDES:

a. Regulatory Requirements.
b. Regulators.
c. Regulator Monitors.
d. L-847 Circuit Switch Selector.
e. L-841 Relay Cabinets per.
f. L-854 Radio Controller
g. Generators per FAA

109-1.3 OTHER RELATED SPECIFICATIONS.

a. L-100-1.1 through L-100-2.17 General Requirements.
b. L-100-3.2 Raceways.
c. L-100-3.3 Feeder and Branch Circuit Wire and Cable.
d. L-100-3.4 Control and Signal Wire and Cable.
e. L-100-3.5 Electrical Boxes and Fittings.
f. L-100-3.6 Wiring Devices.
g. L-100-3.7 Cabinets and Enclosures.
h. L-100-3.8 Supporting Devices.
i. L-100-3.9 Electrical Identification.
j. L-100-3.10 Secondary Grounding.
k. L-100-3.11 Panelboards.
l. L-100-3.12 Overcurrent Devices.

109-1.4 CLASSIFICATIONS.
Not used.

EQUIPMENT AND MATERIALS

109–2.1 REGULATORY REQUIREMENTS.

a. Airport lighting equipment and materials requiring Federal Aviation Administration (FAA) specifications shall have the prior approval of the FAA, and be listed in the latest edition of Advisory Circular (AC) 150/5345–53, Appendix 3.

b. All other electrical equipment and materials shall be subject to acceptance through manufacturer's certification of compliance as required in Specification L–100.

109-2.2 REGULATOR. The regulator shall meet the requirements of the latest edition of AC 150/5345-10.

109-2.3 REGULATOR MONITOR. The regulator monitor shall meet the requirements of the latest edition of AC 150/5345-10.

109-2.4 L847 CIRCUIT SELECTOR SWITCH. The l847 circuit selector switch shall meet the latest edition of AC 150/5345-5.

109-2.5 L841 RELAY CABINET. The L841 relay cabinet shall meet the latest edition of AC 150/5345-13.

109-2.6 L854 RADIO CONTROLLER. The L854 radio controller shall meet the latest edition of AC 150/5345-49.

109-2.7 GENERATOR. The generator shall meet the latest edition of FAA specification E-2204.

NOTE TO SPECIFIER:
If particular materials are required, they should be specified by Special Provision or Plan notes.

It is suggested that only metal conduit be used without concrete encasement, as a matter of cost. Metal conduit by itself will withstand the compacted strength to withstand subbase preparation for runway pavement.

NOTE TO SPECIFIER:
Pushing of duct under paved areas, and hydraulic boring of holes for pushing conduit, are not part of the standard specifications. Although the practice is well recognized and accepted, it is not without faults, specifically under runways, taxiways, and aprons. As a result, this work will remain at the discretion of the Engineer and will require Special Provisions.

CONSTRUCTION METHODS

109–3.10 GENERAL. Furnish, install, and connect all equipment, electrical facilities equipment, accessories, conduit, cables, wires, buses, grounds, and support necessary to insure a complete and operable electrical distribution center for the airport lighting system as specified herein and shown in the Contract Documents. When specified, provide and install an emergency power supply and transfer switch.

109–3.11 SEPARATELY DERIVED POWER EQUIPMENT. Furnish and install transformers, regulators, booster transformers, and other power supply equipment items at the location shown in the Contract Documents. Set the equipment to provide space for maintenance and code clearance. Place the equipment 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.

If specified, furnish and install the equipment for an emergency power generator. The installation shall include all equipment, accessories, an automatic transfer switch, and all necessary wiring and connections. The emergency power generator set shall be the size and type specified.

109–3.12 DISTRIBUTION EQUIPMENT. Furnish and install switches, cutouts, relays, transfer switches, panels, panel boards, and other similar items at the location shown in the Contract Documents. Attach wall or ceiling–mounted items to the wall or ceiling with galvanized bolts engaging metal expansion shields or anchors in masonry or concrete.

109–3.13 CABLE ENTRANCE. Incoming underground cable from field circuits installed from outside of the vault or premanufactured metal housing will be measured as a separate Pay Item under Specification L–108. Bring the cables from the trench or duct through the entrance conduits into the enclosure and make the necessary electrical connections under Specification L–108. Furnish and install the incoming public utility circuits under this Specification.

109–3.14 WIRING AND CONNECTIONS. Make all necessary electrical connections in accordance with the Contract Documents. In wiring to the terminal blocks, leave sufficient extra length on each control lead to make future changes in connections at the terminal block. Accomplish this by running each control lead the longest way around the box to the proper terminal. Leads shall be neatly laced in place.

METHOD OF MEASUREMENT

109–4.1 Equipment, Installed in vault or enclosure will be measured and paid as a complete unit per lump sum,

109–4.2 The quantity for regulators, monitors, circuit switch selectors, L-841 relay cabinets, L-854 radio controllers, and generators to be measured and paid will consist of the number and type in place as a complete unit per each.

109-4.3 Electric utility service will be measured as complete units per lump sum at location indications in the contract document.

BASIS OF PAYMENT

109–5.1 Payment will be made at the Contract unit price for each completed and accepted 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, and incidentals necessary to complete the Work.

a. Payment for Equipment, Installed in a vault 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 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.

b. Payment for regulators, regulator monitors, L-847 circuit switch selectors, L-841 relay cabinet, and L-854 radio controller and generator will be made at the contract unit price for 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.

c. Electric Utility Service shall include providing an electric service from the electric utility, including coordination, costs, fees, and all appurtenant Work.

NOTE TO SPECIFIER:
Obstruction lighting is bid per lump sum for discrete locations. The plans should show the location and define the lights and appurtenances to be included in each location. Single lights or multiple lights may be included in a location. If Electric Utility service is required, it is also bid per location. Power sources from existing airport facilities are incidental, except for cable paid under L–108. The limits of cable to be measured should be indicated on the Plans.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item L10901 through L10905	Equipment, Installed, Location No. ___, per lump sum
Pay Item L10906 through L10910	Electrical Utility Service, Location No. ___ per lump sum
Pay Item L10901	Regulator, 6.6A, 4KW, per each
Pay Item L10902	Regulator, 6.6A, 7–1/2KW, per each
Pay Item L10903	Regulator, 6.6A, 10KW, per each
Pay Item L10904	Regulator, 6.6A, 15KW, per each
Pay Item L10915	Regulator, 6.6A, 20KW, per each
Pay Item L10916	Regulator, 6.6A, 30KW, per each
Pay Item L10917	Regulator Monitor, per each
Pay Item L10918	L-847 Circuit Switch Selector, per each
Pay Item L10919	L-841 Relay Cabinet, per each
Pay Item L10920	L-854, Radio Controller, per each
Pay Item L10921	Generator, per each

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 will be included in the Pay Items contained in the Schedule of Prices.

MATERIAL REQUIREMENTS

AC 150/5345-5	Specification for Circuit Switch Selector
AC 150/5345-10	Specification for Constant Current Regulators and Regulator Monitors
AC 150/5345-13	Specification for L-841 Relay Cabinet
AC 150/5345-49	Specification for L-854 Radio Controllers
FAA E2204	Specification for Generators

SPECIFICATION L–110. INSTALLATION OF AIRPORT UNDERGROUND ELECTRICAL DUCT

DESCRIPTION

110–1.1 GENERAL.

a. This Work consists of underground electrical ducts and underground conduits installed in accordance with this Specification at the locations and in accordance with the dimensions, designs, and details shown in the Contract Documents. Also include all excavation, trenching, backfilling, removal, and restoration of paved areas, manholes, concrete encasement, mandreling, installation of steel drag wires and duct markers, capping, and the inspection of the installation as a completed duct system ready for installation of cables, unless otherwise shown in the Contract Documents.

110-1.2 THIS SPECIFICATION INCLUDES:

a. Regulatory Requirements.

110-1.3 OTHER RELATED SPECIFICATIONS.

a. L100-1.1 through L-100-2.17 General Requirements.
b. L-100-3.2 Raceways.

110-1.4 CLASSIFICATIONS.

a. Type I - Duct encased in concrete.
b. Type II - Duct without concrete encasement.

EQUIPMENT AND MATERIALS

110–2.1 REGULATORY REQUIREMENTS. All equipment and materials shall be subject to acceptance through manufacturer's certification of compliance with applicable specifications and as required in Specification L-100.

CONSTRUCTION METHODS

110–3.1 GENERAL. Install underground ducts at the approximate locations shown in the Contract Documents. The Engineer will indicate specific locations as the work progresses. Ducts shall be of the size, material, and type indicated in the Contract Documents. Where no size is indicated in the plans or specifications the ducts shall be not less than 3 inches (75 mm) inside diameter. Lay all duct lines to drain toward handholes, manholes and duct ends. Grades shall be at least 3 inches (75 mm) per 100 feet (30 m). On runs where it is not practicable to maintain the grade all one way, grade the duct lines from the center in both directions toward manholes, handholes, or duct ends. Avoid pockets or traps where moisture may accumulate.

Mandrel each duct. Push An iron–shod mandrel, not more than 1/4–inch (6 mm) smaller than the bore of the duct through each duct by means of jointed conduit rods. The mandrel shall have a leather or rubber gasket slightly larger than the duct hole.

All ducts installed shall be provided with a No. 10 gauge galvanized iron or steel drag wire for pulling the permanent wiring. Where steel spare ducts are installed, as indicated on the plans, plug the open ends with removable tapered plugs, designed by the duct manufacturers, or with hardwood plugs conforming accurately to the shape of the duct and having the larger end of the plug at least 1/4–inch (6 mm) greater in diameter than the duct. Use plugs recommended by the manufacturer for plastic and fiber duct. Securely fasten and plug all ducts in place during construction and progress of the work to prevent seepage of grout, water, or dirt. Do not install duct sections having a defective joint.

Install ducts under runways, taxiways, aprons, and other paved areas in accordance with details shown on the Drawings. When required, provide concrete encasement as shown on Drawings.

Excavate the trenches for ducts manually or with mechanical trenching equipment. Walls of trenches shall be vertical so that a minimum of shoulder surface is disturbed. Do not use blades of road graders to excavate the trench. Ascertain the type of soil or rock to be excavated before bidding. All excavation shall be unclassified and incidental to this Item.

110–3.2 DUCTS ENCASED IN CONCRETE (TYPE I). When shown in the Plans, install concrete–encased ducts so that the top of the concrete envelope is not less than 18 inches (450 mm) below the finished subgrade where installed under runways, taxiways, aprons, or other paved areas, and not less than 18 inches (450 mm) below finished grade where installed in unpaved areas. Extend ducts under paved areas at least 5 feet (1.5 m) beyond the edges of the pavement or 5 feet (1.5 m) beyond underdrains that may be installed alongside the paved area. Open trenches for concrete–encased ducts the complete length before concrete is laid so that if any obstructions are encountered, proper provisions can be made to avoid them. Place all ducts for concrete encasements on a layer of concrete not less than 3 inches (75 mm) thick prior to its initial set. Where two or more ducts are encased in concrete, space them not less than 1–1/2 inches (37 mm) apart (measured from outside wall to outside wall) using spacers applicable to the type of duct. As the duct laying progresses, place concrete not less than 3 inches (75 mm) thick around the sides and top of the duct bank. Install end bells or couplings flush with the concrete encasement where required.

When specified, reinforce the bottom side and top of encasements with steel reinforcing mesh or fabric or other approved metal reinforcement. When directed, supply additional supports where the ground is soft and boggy, where ducts cross under roadways, or where otherwise shown on the Plans. Under such conditions, support the complete duct structure on reinforced concrete footings, piers, or piles located at approximately 5 foot (1.5 m) intervals.

Do not backfill the excavation until concrete has reached 2,000 psi compressive strength.

Clay or soapstone duct is prohibited.

110–3.3 DUCTS WITHOUT CONCRETE ENCASEMENT (TYPE II). Trenches for single–duct lines shall be not less than 6 inches (150 mm) nor more than 12 inches (300 mm) wide, and the trench for 2 or more ducts installed at the same level shall be proportionately wider. Make trench bottoms for ducts without concrete encasement to conform accurately to grade so as to provide uniform support for the duct along its entire length. Open trenches the complete length before duct is installed.

Place a layer of sand, at least 4 inches (100 mm) thick (loose measurement) or as shown on the Plans, in the bottom of the trench as bedding for the duct. The bedding material shall consist of, sand and shall contain no particles that would be retained on a 1/4–inch (6 mm) sieve. Tamp the bedding material until firm.

Unless otherwise shown in Plans, install ducts in accordance with NFPA 70, but never less than 18 inches below the finished grade.

When two or more ducts are installed in the same trench without concrete encasement, install them as shown on the Drawings.

110–3.4 DUCT MARKERS. Mark The location of the ends of all ducts by a concrete slab marker as shown in the Contract Documents. Locate the markers above the ends of all ducts or duct banks, except where ducts terminate in a handhold, manhole, or building.

Impress the word "duct" and the number and size of ducts beneath the marker on each marker. Show the letters on the Contract Documents.

110–3.5 BACKFILLING. After ducts have been properly installed, backfill the trench in at least two layers with excavated material less than 4 inches (100 mm) in diameter and thoroughly tamped and compacted to at least the density of the surrounding undisturbed soil. If necessary to obtain the desired compaction, the backfill material shall be moistened or aerated.

Trenches shall not be excessively wet and shall not contain pools of water during backfilling operations.

Completely backfill and tamp the trench level with the adjacent surface, except that, when sod is to be placed over the trench, stop the backfilling at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Remove and dispose of excess excavated material in accordance with instructions issued by the Engineer.

110–3.6 RESTORATION. Restore turf areas disturbed by the trenching, storing of dirt, cable laying, pad construction and other work. The restoration shall include topsoiling, fertilizing, liming, seeding, and mulching. Perform all Work in accordance with Specifications T–901, T–902, T–904, T–905, and T–908. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance.

Restore paved areas disturbed by Contractor operations in accordance with the detail shown on the Contract Documents. Material specification and installation shall be in accordance with Standard Specifications.

METHOD OF MEASUREMENT

110–4.1 ELECTRICAL DUCT. Electrical Duct of the various sizes and number of duct indicated, with or without concrete encasement, will be measured on a unit price basis per linear foot. Measurement for payment will be made in a straight horizontal line along the centerline duct installed and accepted.

110–4.2 PAVEMENT RESTORATION Pavement Restoration for Duct Installation will 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. Duct Markers will be measured on a unit price basis per each for markers constructed and accepted.

BASIS OF PAYMENT

110–5.1 Payment will be made at the Contract unit price per linear foot for each type and size of single–way or multi–way duct, completed and accepted. 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, and incidentals necessary to complete this Item.

a. The Pay Items for Electrical Duct will include excavation, installation, materials, bedding and backfill, compaction, concrete encasement when specified, mandreling, and restoration, except when separate Pay Items are included for pavement restoration.

b. The Pay Item for Duct Markers will include materials and installation.

c. The Pay Item for Pavement Restoration will 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.

The cost of restoration of turf, pavement and other features disturbed by installation of duct will be included in prices for Electrical Duct, except when a Pay Item is included for Pavement Restoration in the Schedule of Prices.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item L11001	Electrical Duct, Type I, 3 inch, 1–way, per lineal foot
Pay Item L11002	Electrical Duct, Type I, 3 inch, 2–way, per lineal foot
Pay Item L11003	Electrical Duct, Type I, 3 inch, 3–way, per lineal foot
Pay Item L11004	Electrical Duct, Type I, 3 inch, 4–way, per lineal foot
Pay Item L11005	Electrical Duct, Type I, 3 inch, 5–way, per lineal foot
Pay Item L11006	Electrical Duct, Type I, 3 inch, 6–way, per lineal foot
Pay Item L11007	Electrical Duct, Type I, 4 inch, 1–way, per lineal foot
Pay Item L11008	Electrical Duct, Type I, 4 inch, 2–way, per lineal foot
Pay Item L11009	Electrical Duct, Type I, 4 inch, 3–way, per lineal foot
Pay Item L11010	Electrical Duct, Type I, 4 inch, 4–way, per lineal foot
Pay Item L11011	Electrical Duct, Type I, 4 inch, 5–way, per lineal foot
Pay Item L11012	Electrical Duct, Type I, 4 inch, 6–way, per lineal foot
Pay Item L11013	Electrical Duct, Type II, 3 inch, 1–way, , per lineal foot
Pay Item L11014	Electrical Duct, Type II, 3 inch, 2–way, , per lineal foot
Pay Item L11015	Electrical Duct, Type II, 3 inch, 3–way, , per lineal foot
Pay Item L11016	Electrical Duct, Type II, 3 inch, 4–way, , per lineal foot
Pay Item L11017	Electrical Duct, Type II, 3 inch, 5–way, per lineal foot
Pay Item L11018	Electrical Duct, Type II, 3 inch, 6–way, , per lineal foot
Pay Item L11019	Electrical Duct, Type II, 4 inch, 1–way, , per lineal foot
Pay Item L11020	Electrical Duct, Type II, 4 inch, 2–way, , per lineal foot
Pay Item L11021	Electrical Duct, Type II, 4 inch, 3–way, , per lineal foot
Pay Item L11022	Electrical Duct, Type II, 4 inch, 4–way, , per lineal foot
Pay Item L11023	Electrical Duct, Type II, 4 inch, 5–way, , per lineal foot
Pay Item L11024	Electrical Duct, Type II, 4 inch, 6–way, , per lineal foot
Pay Item L11025	Duct marker, per each
Pay Item L11026	Pavement Restoration for Duct Installation, per lineal foot

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 will be included in the Pay Items contained in the Schedule of Prices.

SPECIFICATION L–119. INSTALLATION OF AIRPORT OBSTRUCTION LIGHTS AND FLASHING RED BEACON L–810, L–856, L–857, L–864, L–865, L–866, and L-885

DESCRIPTION

119–1.1 GENERAL.

a. This Work consists of furnishing and installing obstruction lights in accordance with the Contract Documents, and shall include furnishing and installing poles, steel or iron pipes, structures, or other supports as required in the Contract Documents, and mounting, leveling, conduit, wiring, and power source. This Work also includes all wire and cable connections, the furnishing and installing of all necessary conduits and fittings, insulators, pole steps, and the painting of poles and pipes. In addition, it includes the furnishing and installing of all lamps and the servicing and testing of the installation and all incidentals necessary to place the lights in operation as completed units. This Work includes an Electric Utility Service and treated wood pole, if specified in the Contract Documents.

119-1.2 THIS SPECIFICATION INCLUDES:

a. Regulatory Requirements.
b. Obstruction Lights.
c. Isolation Transformers.
d. Transformer Housings.
e. Paint.
f. Flasher.

119-1.3 OTHER RELATED SPECIFICATIONS.

a. L-100-1.1 through L-100-2.17 General Requirements.
b. L-100-3.2 Raceways.
c. L-100-3.3 Feeder and Branch Circuit Wire and Cable.
d. L-100-3.4 Control and Signal Wire and Cable.
e. L-100-3.5 Electrical Boxes and Fittings.
f. L-100-3.6 Wiring Devices.
g. L-100-3.7 Cabinets and Enclosures.
h. L-100-3.8 Supporting Devices.
i. L-100-3.9 Electrical Identification.
j. L-100-3.12 Overcurrent Devices.

119-1.4 CLASSIFICATIONS.

a. L-810 Steady Burning Red Obstruction Light.
b. L-856 High Intensity Flashing White Obstruction Light, 40 flashes per minute.
c. L-857 High Intensity Flashing White Obstruction Light, 60 flashes per minute.
d. L-864 Flashing Red Obstruction Light, 20-40 flashes per minute.
e. L-865 Medium Intensity Flashing White Obstruction Light, 40 flashes per minute.
f. L-866 Medium Intensity Flashing White Obstruction Light, 60 flashes per minute.
g. L-885 Flashing Red Obstruction Light, 60 flashes per minute.
h.

NOTE TO SPECIFIER:
Refer to AC 70/746- for obstruction lighting specifications.

EQUIPMENT AND MATERIALS

119–2.1 REGULATORY REQUIREMENTS..

a. Airport lighting equipment and materials requiring Federal Aviation Administration (FAA) specifications shall have the prior approval of the FAA, and be listed in the latest edition of Advisory Circular (AC) 150/5345–53 Appendix 3.

b. All other electrical equipment and materials shall be subject to acceptance through manufacturer's certification of compliance as required by Specification L–100.

119–2.2 OBSTRUCTION LIGHTS. The obstruction lights shall conform to the requirements of AC 150/5345–43, Specification for Obstruction Lighting Equipment.

119–2.3 ISOLATION TRANSFORMERS. Where required for series circuits, the isolation transformers shall conform to the requirements of AC 150/5345–47, Isolation Transformers for Airport Lighting Systems.

119–2.4 TRANSFORMER HOUSING. Transformer housings, if specified, shall conform to AC 150/5345–42, Specification for Airport Light Base and Transformer Housings, Junction Boxes, and Accessories.

119–2.3 PAINT.

a. Priming paint for aluminum and ungalvanized metal surfaces, and the mixing thereof, shall conform to ASTM D 83.

b. Use zinc dust-zinc oxide primer paint for galvanized metal surfaces, conforming to Fed. Spec. TT–P–641.

c. Use a ready-mixed nonfading Orange paint for the body and the finish coats on metal and wood surfaces, meeting the requirements of Fed. Spec. TT–P–59. The color shall be in accordance with Federal Standards 595, Aviation Gloss Orange Number 12197.

d. Use ready-mixed white paint for body and finish coats on metal and wood surfaces conforming to Fed. Spec. TT–P–102.

e. Mix priming paint for wood surfaces on the job by thinning the previously specified orange or white paint by adding 1/2 pint (0.06 liters) of raw linseed oil to each gallon (liter).

f. Paint, poles, pole steps, 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.

119–2.4 FLASHER. The beacon flasher for the L–864 obstruction light shall be a standard commercially available unit designed for the service intended. The mechanism in the flasher shall be designed to flash not more than 40 and not less than 12 flashes per minute. The flashing switch shall be of the mercury contact–type encapsulated in nonbreakable plastic. The entire unit shall be housed in a weatherproof cabinet.

CONSTRUCTION METHODS

119–3.1 PLACING THE OBSTRUCTION LIGHTS. Furnish and install obstruction lights as specified and shown in the Contract Documents. Mount the obstruction lights on poles, buildings, towers or beacon structures at the location shown in the Contract Documents. Install the power source and the electric utility service at the locations indicated in the contract documents.

119–3.2 INSTALLATION ON POLES. Where obstruction lights are to be mounted on poles, install each obstruction light with its hub at least as high as the top of the pole. Run all conductors in not less than 1–inch (25 mm) galvanized rigid steel conduit. If specified, furnish and install pole steps, the lowest step being 5 feet (1.5 m) above ground level. Install steps alternately on diametrically opposite sides of the pole to give a rise of 18 inches (450 mm) for each step. Fasten conduit to the pole with galvanized steel pipe straps and secure by stainless round head wood screws. Paint poles as shown in the Plans and Specifications.

When obstruction lights are installed on existing telephone or power poles, install a large fiber insulating sleeve over the conduit to the obstruction light, and extend it 6 inches (150 mm) above the conductors on the upper crossarm. In addition, the sleeve shall be at least 18 inches (450 mm) below the conductors on the lower crossarm. The details of this installation shall be in accordance with the plans.

119–3.3 INSTALLATION ON BEACON TOWER. Where obstruction lights are installed on a beacon tower structure, mount two obstruction lights on top of the beacon tower using 1–inch (25 mm) conduit. Screw the conduit directly into the obstruction light fixtures and support them at a height of not less than 4 inches (100 mm) above the top of the rotating beacon. The obstruction lights at the lower levels of a tower, shall be 1/2–inch (12 mm) galvanized rigid steel conduit with standard conduit fittings for mounting the fixtures. Mount the fixtures in an upright position in all cases. Fasten the conduit to the tower members with "wraplock" straps, clamps, or approved fasteners spaced

approximately 5 feet (1.5 m) apart. Apply three coats of aviation–orange paint (one prime, one body, and one finish coat) to all exposed material installed including conduit and straps and clamps.

119–3.4 INSTALLATION ON BUILDINGS, TOWERS, SMOKESTACKS, AND SIMILAR STRUCTURES. Where obstruction lights are to be installed on buildings or similar structures, installing accordance with details shown in the Contract Documents. The hub of the obstruction light shall be not less than 1 foot (300 mm) above the highest point of the obstruction except in the case of smokestacks where the uppermost units shall be mounted not less than 5 feet (1.5 m), nor more than 10 feet (3 m) below the top of the stack. Fasten conduit supporting the obstruction light units to wooden structures with galvanized steel pipe straps and secure by 1–1/2 inch (37 mm) No. 10 stainless round head wood screws. Fasten conduit to masonry structures using expansion shields, screw anchors, or toggle bolts using No. 10, or larger, stainless round head 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 5 feet (1.5 m) apart. Apply three coats of aviation–orange paint (one prime, one body, and one finish coat) to all exposed material installed including conduit straps and clamps.

119–3.5 FLASHER. If required in the Contract Documents, install a separate flashing mechanism for the L–864 obstruction light adjacent or near the L–864 obstruction light. Design the mechanism in this flasher to flash not more than 40 and not less than 12 flashes per minute.

119–3.6 SERIES ISOLATION TRANSFORMERS. If the obstruction light is powered from a constant current regulator, an isolation transformer is required with each series lamp. Double series units of this type require two series isolation transformers. The transformer shall be housed in a base or buried directly in the earth in accordance with the details shown in the Contract Documents.

119–3.7 ELECTRICAL. Furnish all necessary labor and materials and make complete electrical connections from the underground cable or other source of power in accordance with the Contract Documents.

119–3.8 LAMPS. Furnish and install one or two lamps in each unit, as required, conforming to the following requirements:

a. Series lamp—6.6 ampere, 1020–lumen, a–21 clear bulb, medium prefocus base.

b. Multiple lamp—100, 107, or 116 watts; 115, 120, or 125 volts; a–21 clear bulb, medium screw base.

119–3.9 TESTS. The 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 10 times.

METHOD OF MEASUREMENT

119–4.1 Airport Obstruction Lighting and Electric Utility Service will be measured as complete units per lump sum at locations indicated in the Contract Documents.

BASIS OF PAYMENT

119–5.1 Payment will be made at the Contract price per lump sum for the Classification of Airport Obstruction Lights, at the locations indicated, complete and accepted.

Payment will be made at the Contract price per lump sum for the Electric Utility Service, at the locations indicated, complete and accepted.

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 L-100-2.2 and L-10-0-2.3

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item L11901 through L11910	Obstruction lighting, L–810, Location No. ___, per lump sum
Pay Item L11911 through L11920	Obstruction lighting, L–856, Location No. ___, per lump sum
Pay Item L11921 through L11930	Obstruction lighting, L–857, Location No. ___, per lump sum
Pay Item L11931 through L11940	Flashing Red Beacon, L–864, Location No. ___, per lump sum
Pay Item L11941 through L11950	Obstruction lighting, L–865, Location No. ___, per lump sum
Pay Item L11951 through L11960	Obstruction lighting, L–866, Location No. ___, per lump sum
Pay Item L11960	Obstruction lighting, L-885, Location No. ___, per lump sum
Pay Item L11961	Electric Utility Service, Location No. ____, per lump sum

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 will be included in Pay Items contained in the Schedule of Prices.

MATERIAL REFERENCE

AC 150/5345-42	Specification for Airport Light Base and Transformer Housings, Junction Boxes, and Accessories
AC 150/5345-43	Specification for Obstruction Lighting Equipment

SPECIFICATION L–125. INSTALLATION OF AIRPORT LIGHTING SYSTEMS

DESCRIPTION

125–1.1 GENERAL.

a. This Work consists of Airport lighting systems furnished and installed in accordance with this Specification, the referenced Specification, and the applicable Advisory Circulars. The systems are installed at the location and in accordance with the dimensions, design, and details shown in the Contract Documents. This Work includes furnishing of all equipment, materials, services, and incidentals necessary to place the systems in operation as completed units.

125-1.2 THIS SPECIFICATION INCLUDES:

a. Regulatory Requirements.
b. Runway and Taxiway Edge Lights.
c. Guidance Signs.
d. Transformer Access Handhole.
e. Runway End Indicator Light System (REILS).
f. Precision Approach Path Indicator System (PAPIS).
g. Isolation Transformers.
h. Retroreflective Markers.
i. Cable Connectors.
j. Base Cans.

L-125-1.3 OTHER RELATED DOCUMENTS.

a. L-100-1.1 through L-100-2.17 General Requirements.
b. L-100-3.2 Raceways.

L-125-1.4 CLASSIFICATIONS.

a. L-860 Runway edge, VFR runways, Omnidirectional: white, Bidirectional: white-red, white-green
b. L-860E Runway threshold/end, Bidirectional: red-green, red-red, VFR runways, Unidirectional green
c. L-861 Runway edge, non-precision, Omnidirectional: white, IFR runways, Bidirectional: white-yellow, white-red, yellow-red, white-green
d. L-861E Runway threshold/end, Bidirectional: red-green, red-red, non-precision IFR runways, Unidirectional: green
e. L-861SE Runway threshold/end, Bidirectional: red-green, non-precision IFR runways, Unidirectional: green
f. L-861T Taxiway edge, Omnidirectional: blue
g. L-862 Runway edge, precision, Bidirectional: white-white, white-yellow, IFR runways, white-red, yellow-red, white-green
h. L-862E Runway threshold/end, Bidirectional: red-green, red-red, precision IFR runways, Unidirectional: green
i. L-804 Holding position edge, Unidirectional: yellow: flashing
j. L-849 REILS, Style A, Unidirectional, high intensity, one brightness stop, REILS, Style B, Omnidirectional, high intensity, one brightness step, REILS, Style C, Unidirectional, low intensity, one brightness step, REILS, Style D, Omnidirectional, low intensity, one brightness step, REILS, Style E, Unidirectional, three brightness steps
k. L-880 PAPI, 4 light unit, L-881 PAPI, 2 light unit, Style A, Voltage powered unit, Style B, Current powered unit, Class I, Operation to -35°C, Class II, Operation to -55°C
l. L-853 Retroreflective Marker, Type 1, Semi-flush for centerline machine, Type 2, Elevated marker for edge marking, Style 1, Snow plowable (Type 1 only), Style 2, Non snow plowable (Type 1 only)
m. L-858 Signs Refer to the drawing legend and schedules

EQUIPMENT AND MATERIALS

125–2.1 REGULATORY REQUIREMENTS.

a. Airport lighting equipment and materials requiring FAA specifications shall have the prior approval of the Federal Aviation Administration, and be listed in the latest edition of Advisory Circular (AC) 150/5345–53, Appendix 3.

b. All other electrical equipment and materials shall be subject to acceptance through the manufacturer's certification of compliance as required in Specification L–100.

125-2.2 RUNWAY AND TAXIWAY EDGE LIGHTS. The runway and taxiway edge lights shall conform to the most recent edition of AC 150/5345-46.

125-2.3 GUIDANCE SIGNS. The guidance signs shall conform to the most recent edition of AC 150/5345-44.

125-2.4 TRANSFORMER ACCESS HANDHOLE. The transformer access handhole shall be non-metallic with replaceable lid, UL listed for two purpose.

125-2.5 REILS. The REILS shall conform to the most recent edition of AC 150/5345-51.

125-2.6 PAPIS. The PAPIS shall conform to the most recent edition of AC 150/5345-28D.

125-2.7 ISOLATION TRANSFORMERS. The isolation transformers shall conform to the most recent edition of AC 150/5345-47.

125-2.8 RETROREFLECTIVE MARKERS. The retroreflective markers shall conform to the most recent edition of AC 150/5345-39.

125-2.9 CABLE CONNECTORS. The cable connectors shall conform to the most recent edition of AC 150/5345-26.

125-2.10 BASE CANS. The base cans shall conform to the most recent edition of AC 150/5345-42.

CONSTRUCTION METHODS

125–3.1 LIGHTING SYSTEMS.. Install the lighting systems at the location indicated in the Contract Documents. Install the power source and electric utility service at the location indicated in the Contract Documents.

125–3.2 GROUNDING STAKE MOUNTED LIGHTING FIXTURES. 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.

Install the system grounding electrode conductor 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.

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.

125–3.3 GROUNDING L–867 BASE CANS. Grounding of L–867 base cans consists of grounding all L–867 base cans for edge lighting fixtures, REIL's, taxiway guidance signs, and L–867 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.

Install the system grounding electrode conductor 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.

The cable lug shall be a UL listed copper compression connector, Thomas and Betts, Burndy, Blackburn, or equal. Attach the connector to the can with a separate self locking nut/bolt arrangement compatible with the can manufacturer's ground mounting provision. Use the manufacturer's approved mechanical indentor tool for installing the compression connector. Torque the bolted connection to the factory grounding provision for adequate bond. Stripped threads will be a cause for rejection.

When the L–867 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 L–867 base can. Plastic components are not allowed anywhere in the fixture to base can assembly.

125–3.4 GROUND RODS FOR REGULATOR SECONDARY 5KV LIGHTING CIRCUITS. Ground the regulator secondary circuit according to the Contract Documents.

a. Standard Grounding Method. The standard grounding method consists 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 the ground rods to the grounding electrode conductor by exothermic welds or other FAA approved grounding connection.

NOTE TO SPECIFIER:
If the alternate method of grounding is desired, it should be specified in the Special Provisions.

Alternate Grounding Method: When specified in the Special Provisions, the alternate method for grounding lighting circuits described in the following paragraphs shall be used.

The test shall include Contractor supplied manpower and test equipment to test each grounding system. The test instrument shall be a 3 pole ground resistance tester, AEMC, Biddle, or equal, as approved by the Engineer, with a ±5% or better accuracy for 10% to 100% 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.

The test shall achieve a maximum 25 ohms less 5% (23.75 ohms) to ground with each installation beginning with one 8-foot length installed and tested. If 23.75 ohms are not attained on the first rod, install additional lengths and test again until no more than 23.75 ohms is achieved. Ground rod shall be 5/8" diameter x 8 feet long sectional type copper clad steel. Ground rod installation shall comply with all the requirements of the latest edition of NFPA Section 70, specifically, Article 250, Section H, J, and K.

Exothermic weld or use other FAA approved grounding connector to connect the grounding electrode conductor to the ground rod below the coupling thread line. The Contractor will be paid only once for this connection. More specifically, the Contractor will only be paid for one grounding electrode conductor weld per ground rod. The 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, the 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, reweld the electrode conductor, and retest to determine the specified resistance. Use a threaded coupling and driving stud to protect the ground rod threads during the installation of the ground rod. When the rod is installed in a L–867 can base, weld the grounding electrode conductor before the rod is driven past the top elevation of the can base. Leave exposed all exothermic welds to ground rods at stake mounted fixtures until tested.

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, include in the log 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.

METHOD OF MEASUREMENT

125–4.1 Lights. Runway and Taxiway Edge Lights, and Threshold End Lights will be measured for payment on a unit basis per each.

125–4.2 Runway and Taxiway Signs, Retroreflective Markers, Handholes, and Removals will be measured for payment on a unit basis per each.

125–4.3 Measurement for removal of edge light fixtures and signs will be for the quantity removed.

125-4.4 Electric utility service will be measured as complete units per lump sum at locations indicated in the Contract Documents.

BASIS OF PAYMENT

125–5.1 Payment will be made at the Contract unit price for each complete Lighting System, Retroreflective Marker, Light, Sign, Handhole, and Removal Item, of the type indicated, installed in place by the Contractor and accepted by the Engineer. 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, and incidentals necessary to complete this Work.

a. Lights. Light units include fixtures, stems, frangible couplings, stakes or L–867 base cans, can lids, gasket, isolation transformer, grounding, connections to the system, testing, and incidental items required to provide a functioning unit in accordance with the Contract Documents. Base cans (bases) include excavation, backfill, restoration, cans, gaskets, conduit, concrete, and conduit hubs and other items shown on details or required for a complete unit, all in accordance with the Contract Documents.

b. Signs. Sign units include modules of the type specified, concrete pad, L–867 base cans, can lids, gaskets, conduit, excavation, backfill, isolation transformers, grounding, restoration, connection to the system, testing, excavation, backfill, restoration, conduit and conduit hubs, and other incidental items required for a complete unit, all in accordance with the Contract Documents.

c. Replacement sign panels include panels, appurtenant items and installation.

d. Removal. Removals include disconnection from the electrical system, maintaining and restoring the electrical system service if required, site restoration and disposal of materials.

e. REILS and PAPIS. The REILS and PAPIS include fixtures, stems, frangible couplings, L-867 base cans, can lids, gaskets, power adapters, master/slave controllers, wire, cable, conduit testing, system connectors, foundations, excavating, backfill, restoration, and other items, all in accordance with the Contract Documents.

f. The Electric Utility Service shall 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 particular, L-100-2.2 and L-100-2.3.

Standard Pay Items for Work covered by this Specification are as follows:

Pay Item L12501	Retroreflective Marker, L-853, Type 1, Style 1
Pay Item L12502	Retroreflective Marker, L-853, Type 1, Style 2
Pay Item L12503	Retroreflective Marker, L-853, Type 2
Pay Item L12504	Low Intensity Runway Lights, L-860, Stake Mounted, per each
Pay Item L12505	Low Intensity Runway Threshold Lights, L-860E, Stake Mounted, per each
Pay Item L12506	Medium Intensity Runway Lights, L-861, Stake Mounted, per each
Pay Item L12507	Medium Intensity Runway Lights, L-861, Base Mounted, per each
Pay Item L12508	Medium Intensity Runway Threshold Light, L-861E, Stake Mounted, per each
Pay Item L12509	Medium Intensity Threshold Light, L-861E, Base Mounted, per each
Pay Item L12510	Medium Intensity Taxiway Light, L-861T, Stake Mounted, per each
Pay Item L12511	Medium Intensity Taxiway Light, L-861T, Base Mounted, per each
Pay Item L12512	High Intensity Runway Light, L-862, Base Mounted, per each
Pay Item L12513	High Intensity Runway Threshold Light, L-862E, Base Mounted, per each
Pay Item L12514	L-867 Base Can with Lid and Gasket, per each
Pay Item L12515	Remove Runway or Taxiway Stake Mounted Light, per each
Pay Item L12516	Remove Runway or Taxiway Base Mounted Light, per each
Pay Item L12517	Guidance Sign, 1-Module, per each
Pay Item L12518	Guidance Sign, 2-Module, per each
Pay Item L12519	Guidance Sign, 3-Module, per each
Pay Item L12520	Guidance Sign, 4-Module, per each
Pay Item L12521	Extend Guidance Sign, 1-Module, per each
Pay Item L12522	Replace Guidance Sign Legend Panel, per each
Pay Item L12523	Distance Remaining Sign, per each
Pay Item L12524	Transformer Access Handhole, per each
Pay Item L12525	Remove Taxiway Guidance Sign, per each
Pay Item L12526	REILS Constant Voltage L-849, Style A, per lump sum
Pay Item L12527	REILS Constant Voltage L-849, Style B, per lump sum
Pay Item L12528	REILS Constant Voltage L-849, Style C, per lump sum
Pay Item L12529	REILS Constant Voltage L-849, Style D, per lump sum
Pay Item L12530	REILS Constant Voltage L-849, Style E, per lump sum
Pay Item L12531	REILS Constant Current L-849, Style A, per lump sum
Pay Item L12532	REILS Constant Current L-849, Style B, per lump sum
Pay Item L12533	REILS Constant Current L-849, Style C, per lump sum
Pay Item L12534	REILS Constant Current L-849, Style D, per lump sum
Pay Item L12535	REILS Constant Current L-849, Style E, per lump sum
Pay Item L12536	PAPI L-880, Style A, Class I, per lump sum
Pay Item L12537	PAPI L-880, Style A, Class II, per lump sum
Pay Item L12538	PAPI L-880, Style B, Class I, per lump sum
Pay Item L12539	PAPI L-880, Style B, Class II, per lump sum
Pay Item L12540	PAPI L-881, Style A, Class I, per lump sum
Pay Item L12541	PAPI L-881, Style A, Class II, per lump sum
Pay Item L12542	PAPI L-881, Style B, Class I, per lump sum
Pay Item L12543	PAPI L-881, Style B, Class II, per lump sum
Pay Item L12544 through L12555	Electric Utility Service, Location No. ____, per lump sum

Measurement and Payment will be made for Pay Items included in the Schedule of Prices. The cost of all Work required by the Contract Documents will be included in Pay Items contained in the Schedule of Prices.