Utah Department of Transportation

2004 Standard Specifications

FOR ROAD AND BRIDGE CONSTRUCTION

U.S. Standard Units (Inch-Pound Units)

Basic

March 15, 2004

Introduction

This book is a compilation of Standard Specifications in U.S. Standard Units (Inch-Pound Units) for insertion into the Department's construction contracts.

The Standard Specifications are written to the Contractor. The Specifications define the Contractor's responsibility in meeting each specification, enumerate the Department's expectations, and explain what the Contractor is expected to provide. Unless otherwise noted, all actions are to be performed by the Contractor. A Special Provision may revise the Standard for a specific contract.

References

Standard Specifications are available on the Web site at:
http://www.udot.utah.gov/index.php?m=c&tid=302

All Web references within sections of these Standards all refer to the common Web site of http://www.udot.utah.gov/index.php/m=c/tid=719. Refer to this page to see a listing of appropriate Web sites.

All references to AASHTO and ASTM documents as well as other references are to the current version unless specified otherwise, at time of award.

Layout

The layout of each specification is as follows:
SECTION NUMBER
TITLE
PART (One, Two, and Three)
ARTICLE (For example, 1.1, 1.2, 2.1, 2.2, 3.1, and 3.2)
Paragraph (For example A, B, C under an article)

Example:

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	A.	Paragraph			(Second level)
		1.	Subpargraph		(Third level)
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SECTION 00120

INSTRUCTIONS TO BIDDERS

PART 1 GENERAL

1.1 PREQUALIFICATION OF BIDDERS

A. Applies to all projects where the Department Engineer's advertised Estimate is greater than or equal to $500,000.

B. Provide experience information on the Contractor's Application for Prequalification and a confidential financial statement attested to by a certified public accountant.
   1. Include a complete report of the bidder's financial resources and liabilities, equipment, work history, and personnel. Department establishes prequalification amount and work classification.
   2. Allow a minimum of 10 days for Department approval of the Contractor's Application for Prequalification and financial statements to assure acceptance of a valid bid.

C. Renew prequalification a minimum of once a year.
   1. The Department may change the prequalification amount during that period upon the submission of an application and additional favorable reports or upon evidence of unsatisfactory reports or performance.
   2. The prequalification amount limits bidding to individual contracts of a given size or for a particular type of work.

1.2 BIDDING DOCUMENTS

A. Prequalified bidders must acquire and submit all proposals in the identical name used on their prequalification statement, or in accordance with a filed affidavit of change in firm name or personnel.

B. Bidders must reference the UDOT Website to acquire bidding documents.

1.3 JOINT VENTURE BIDDING

A. Prior to submitting a joint proposal on a single project, and at least 4 working days before the bid opening, submit a letter of intent to the Department's Prequalification Board Secretary indicating the precise name of the joint venture and the designated administrative partner. The Department will consolidate individual prequalification amounts for the joint venture bid.

1.4 CONTENTS OF BID PROPOSAL

A. Contents:
1. Location and description of the contemplated construction.
2. Estimated quantities.
3. Schedule of unit bid items.
4. The time in which the work must be completed.
5. Amount of the proposal guarantee.
6. The date, time and place of the opening of proposals.
7. DBE requirements, as required.
8. Mandatory Pre-Bid Conference, as required.

B. The Department considers all forms associated to the Bid Proposal as a required part of the Proposal.

1.5 ACCEPTANCE OF BID PROPOSALS

A. The Department reserves the right to refuse a Bid Proposal for any or all of the following reasons:
1. Lack of or insufficient amount of prequalification or unauthorized work classification.
2. Uncompleted work under contract that the Department determines will hinder or prevent the prompt completion of additional work if awarded.
3. Failure to pay or settle claims.
4. Failure to comply with any qualification regulations.
5. Default under previous contracts.
6. Unsatisfactory performance on previous or current Contract(s)
7. Debarment by the Department or the Federal Government.
8. Serious misconduct that adversely affects the ability to perform future work.
9. Failure to reimburse for monies owed on any previously awarded Department contract including contracts where the prospective bidder was a party in a joint venture that failed to reimburse the Department.
10. Bid Guarantee received after date and time specified.
11. Non-attendance to a mandatory pre-bid meeting.

12. Proposal received after date and time for the opening of bids.
13. DBE non-compliance.
14. Not submitted using UDOT's current EBS program.

B. If the Department refuses to issue a Bid Proposal for any of the foregoing reasons, bidder may appeal in writing to the UDOT Deputy Director.
   1. Specify the basis for the appeal in the written request.
   2. The Deputy Director may schedule either an informal or formal hearing.

1.6 INTERPRETATION OF QUANTITIES IN BID PROPOSAL

A. Proposal quantities are estimates used for comparison and may be increased, decreased, or eliminated in their entirety. Department pays for actual work performed and accepted, and materials furnished.

1.7 EXAMINATION OF PLANS, SPECIFICATIONS, SPECIAL PROVISIONS, AND WORK SITE

A. Examine proposed work site and all documents before submitting a Bid Proposal.
   1. Bidder is responsible for all site conditions that should have been discovered had a reasonable site investigation been performed.
   2. The Department considers submitting a Bid Proposal as conclusive evidence the bidder knows the conditions to be encountered in performing the work and the requirements of the proposed Contract.

B. All Department boring logs and other records of subsurface investigations are available for information purposes only and are not substitutes for bidder's own investigation, interpretation, and judgment. It is understood such information was obtained and used for Department design and estimating purposes only.

C. Bidder is permitted to converse with Department personnel knowledgeable of the project, plans, specifications, materials sites, or conditions generally prevailing in the area of the proposed work to aid in pre-bid investigations.
   1. Bidder conducts independent investigation, including a visit to the site of work.
   2. The Engineer is available by appointment.

D. The Department is bound only by written statements, representations, or descriptions of conditions and work. No oral explanations or instructions are binding.

E. To request explanations of the written proposal documents, contact the Engineer 14 days prior to bid opening to allow a reply before proposal submission. The Department responds to written requests from prospective bidders by certified letter or electronic communications before the specified time for opening proposals.

F. Bidder acknowledges that he/she has investigated the nature and location of the work and knows the general and local conditions that can affect the work or its cost, including but not limited to:
   1. Conditions bearing upon transportation, disposal, handling, and storage of materials.
   2. The availability of labor, water, electric power, and roads.
   3. Uncertainties of weather, river stages, irrigation channel flow, lake and reservoir levels, or similar physical conditions of the ground.
   4. The type of equipment and facilities needed preliminary to and during work performance.

G. The character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is ascertainable from an inspection of the site, as well as from the drawings and specifications and all exploratory work made available by the Department.

H. Failure to take the actions described and acknowledged in this Article does not relieve the Contractor of the responsibility for estimating the difficulty and cost of successfully performing the work, or from proceeding to successfully perform the work without additional cost to the Department.

1.8 UDOT ELECTRONIC BID SYSTEM

A. Obtain UDOT's newest version of the Electronic Bid System (EBS) from the UDOT website. Refer to http://www.udot.utah.gov/index.php/m=c/tid=719.
   1. Contact the UDOT Construction Division for Contractor ID and EBS training.

B. Prepare and electronically submit bid Proposals using the Department's current Electronic Bid System prior to the specified opening date and time for bid.
   1. Complete all electronic bid documents specified on the Bid Submission Check List and Forms.

C. When the Proposal permits a choice (alternate items) to be made, indicate the choice in the Electronic Bid System. The program will not permit an additional choice.

D. Save Electronic bid documents until project has been awarded.

E. Submit bid Guarantee using the current version of EBS. Apparent low bidder delivers original guarantee if in the form of cashier's or certified check within 3 working days of bid opening.

F. Confirm receipt of addenda.

G. Provide the name and address of the individual signing the Proposal as well as the following names and addresses, as applicable.

Type of Bidder	Names and Office Addresses Required
Individual	Individual and Post Office address
Partnership	Each Member of the Partnership and each Post office address
Joint Venture	Each Member or officer of Firms represented and each post office address
Corporation	Corporation Name and corporate address

H. By signing the Bid Report (electronically or manually), bidders certify they understand and are in compliance with all contract standard and special provisions.

1.9 IRREGULAR BID PROPOSALS

A. The Department considers a Bid Proposal irregular and rejects the Bid Proposal as non-responsive if:
   1. The Proposal is incomplete or in a format other than the newest version of the electronic bid system.
   2. Contains unauthorized additions, conditional or alternate bids, or irregularities that make the Bid Proposal incomplete, indefinite, or ambiguous.
   3. Includes added provisions reserving the right to accept or reject an award, or to enter into a contract pursuant to an award.
      a. This does not exclude a bid proposal limiting the maximum gross amount of awards acceptable to any one bidder at any one bid letting.
      b. Department selects awards.
   4. Does not contain a unit price for each pay item listed and the amount for each lump sum item, except in the case of authorized alternate pay items.
   5. Unsigned or not properly signed (electronically or manually).
   6. A bid guarantee that is not submitted in accordance with this Section, article 1.10, Proposal Guarantees.

7. Does not contain a Status of Work Under Contract if required, reflecting the contractor's current prequalification status or:
   a. Is incomplete and improperly executed.
   b. Indicates the sum of the amount of all uncompleted work plus the estimate of the amount of work to be bid upon exceeds the amount for which the Contractor is prequalified.
8. Any of the unit bid prices are significantly unbalanced to the potential detriment of the Department. The Department may require written justification for the basis of the unit prices before making a decision as to whether the bid is irregular.
9. The receipt of Addenda is not acknowledged.
10. Proposal does not comply with conditions of current special provision for certification of Affirmative Action (DBE).
11. Manually submitted diskette is bland or unreadable.
12. Surety Company is not listed in Department of Treasury Circular 570.

1.10 PROPOSAL GUARANTEES

A. Provide a proposal guaranty in the form of a certified check or an electronic guaranty bond for not less than 5 percent of the total amount of the bid made payable to the Utah Department of Transportation and issued from a surety company listed on the Department of Treasury Circular 570.
   1. Use UDOT approved surety clearing house for electronic guaranty bond.
   2. Use current version of the UDOT EBS program.
   3. Apparent low bidder delivers proposal guaranty in the form of cashier's or certified check within 3 days of bid opening.

1.11 ELECTRONIC DELIVERY OF BID PROPOSALS

A. Electronically transmit the Bid Proposal prior to the time specified in the Notice to Contractor.

B. A manually submitted bid takes precedence over an electronically submitted bid.

1.12 WITHDRAWAL OR REVISION OF BID PROPOSALS

A. Prior to the 2:00 p.m. advertised bid opening date, a bid proposal may be withdrawn.

B. Provide the request for withdrawal to the Department in writing to include a company authorized signature and the UDOT Contractor ID, or a telephone call followed by documented electronic communications to include a company authorized signature and the UDOT Contractor ID before the time set for opening bid proposals.

1.13 COMBINATION OR CONDITIONAL BID PROPOSALS

A. Bid Proposals may be issued for projects in combination or separately.
   1. Bid Proposals may be submitted either on the combination or on separate units of the combination.
   2. The award of combination bid proposals or separate bid proposals are made to the advantage of the Department.
   3. The Department will not consider combination bid proposals other than those specifically set up in the Bid Proposal.
   4. The Department writes separate contracts for each individual project included in the combination.

B. The Department considers conditional bid proposals only when specified in the advertisement.

1.14 PUBLIC OPENING OF BID PROPOSALS

A. Bid Proposals will be downloaded from the third party repository and publicly opened at the time indicated in the advertisement.

1.15 DISQUALIFICATION OF BIDDERS

A. Department disqualifies a bidder and rejects a Bid Proposal for any of the following:
   1. More than one Proposal for the same work from an individual, firm, or corporation under the same or different names.
   2. Evidence of collusion among bidders. Collusion participants are not recognized as bidders for future work until they are reinstated as a qualified bidder.

1.16 NON-COLLUSIVE BIDDING CERTIFICATION

A. By submitting this Bid Proposal, each bidder and each person signing on behalf of any bidder certifies as to its own organization, under penalty of perjury, that to the best of their knowledge and belief:
   1. The prices in this Bid Proposal have been arrived at independently without collusion, consultation, communication, or agreement with any other bidder or with any competitor for the purpose of restricting competition.
   2. Unless required by law, the prices that have been quoted in this bid proposal have not been and will not be knowingly disclosed by the bidder, directly or indirectly, to any other bidder or competitor before opening of Bid Proposals.

3. No attempt has been made or will be made by the bidder to induce any other person, partnership, or corporation to submit or not to submit a Bid Proposal for the purpose of restricting competition.
4. The signers of the Bid Proposal will tender to the Department a sworn statement that the named Contractor(s) has not, whether directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action to restrain free competitive bidding in connection with this Proposal.

B. The Department considers no a Bid Proposal for award, nor makes any award where there has not been compliance with this article, paragraph A, except as follows:
1. If the bidder cannot make the foregoing certification, the bidder must furnish with the bid proposal a signed statement that describes in detail the reasons why the certification cannot be made.
2. The Executive Director, or designee, determines that such disclosure was not made for the purpose of restricting competition.

C. Any of the following does not constitute a disclosure within the meaning of this article, paragraph A, line 1:
1. A bidder has published price lists, rates, or tariffs covering items being procured.
2. A bidder has informed prospective customers of proposed or pending publication of new or revised price lists for such items.
3. A bidder has sold the same items to other customers at the same prices being bid.

D. A Bid Proposal made by a corporation is considered authorized by the board of directors of the bidder. Authorization is defined as signing and submitting the bid proposal, and includes the declaration of non-collusion on the part of the corporation.

E. **UTAH DEPARTMENT OF TRANSPORTATION NON-COLLUSIVE BIDDING CERTIFICATION**

"I declare under penalty of perjury under the laws of the United States and the State of Utah that neither I, nor to the best of my knowledge any member or members of my firm or company have either directly or indirectly restrained free and competitive bidding on this project by entering into any agreement, participating in any collusion, or otherwise taking any action unauthorized by the Utah Department of Transportation, with regard to this Contract."

F. Signing the Bid Proposal (manually or electronically) certifies compliance with all provisions of this Non-Collusive Bidding Certification.

1.17 DEBARMENT

A. The Department may debar a Contractor from performing any work on Department or Department administered projects if:

1. The Contractor or an affiliate (defined as an owner, director, manager, officer or fiscal agent of the Contractor) has been convicted of or entered a plea of guilty or *nolo contendere* to a bid-related or a contract-related crime in any Court of competent jurisdiction.
2. The Contractor or an affiliate has made a public admission of any bid-related or contract-related crime.
3. The Contractor or an affiliate has falsified information or submitted deceptive or fraudulent statements in connection with prequalification, bidding, or performance of a contract.
4. The Contractor or an affiliate has violated relevant antitrust laws covering bid rigging, collusion or restraint of free competition among contractors; (Violations covered by the Sherman Antitrust Act, 15 U.S.C. 1, *et seq.* and Title 76, Chapter 10, Section 911, *et se.,* U.C.A. 1953, as amended).
5. The Contractor or an affiliate has demonstrated willful wrongdoing reflecting a lack of integrity in bidding or performing public projects.
6. The Contractor, joint venturer, stockholder of 5 percent or more of the Contract, an affiliate, or any immediate relatives of the aforementioned, has been debarred or affiliated with another debarred person or contractors by the Federal Government or by another State government.
7. The UDOT Deputy Director has reasonable grounds to believe and finds that the Contractor has acted in collusion with others to perform work on a project that supposedly satisfies disadvantaged business enterprise goals or requirements through other than *bona fide* disadvantaged business entities in any combination of individuals, firms or corporations.
8. The Contractor or affiliate has defaulted under previous contracts.
9. The Contractor or affiliate has unsatisfactory performance on previous work or current Contract(s) consisting of, but not limited to:
    a. Noncompliance with Contract.
    b. Failure to complete work on time.
    c. Instances of substantial corrective work before acceptance.
    d. Instances of completed work that requires acceptance at reduced pay.
    e. Production of non-specification work or materials, and when applicable, required price reductions or corrective work.
    f. Failure to provide adequate safety measures and appropriate traffic control that endangered the safety of the work force and public.
10. The Contractor or an affiliate has questionable moral integrity as determined by the Department, the Attorney General of Utah or the Attorney General of the United States.

11. Failure to reimburse the State for monies owed on any previously awarded contract including those where the prospective bidder is a party to a joint venture and the joint venture has failed to reimburse the State for monies owed.
12. The UDOT Deputy Director has reasonable grounds to believe and finds that the public health, welfare or safety imperatively requires such action.

1.18 STATUS PENDING DEBARMENT

A. Contractor notified of proposed debarment as provided above is not permitted to contract with the Department, nor act as a subcontractor unless a request for either an information or formal hearing is pending.

B. The proposed debarment period does not commence until the Department decision has been issued following the said hearing or hearings.

1.19 LENGTH OF DEBARMENT

A. Debarment is for a term of not less than six months and up to three years as determined by the Deputy Director.

B. Department may adjust the period of debarment for mitigating circumstances including but not limited to the following:
1. Degree of culpability.
2. Restitution of damages to the State.
3. Cooperation in the investigation of other bidding crimes.
4. Disassociation with those involved in bidding crimes.
5. Protection of the State that may be required.
6. If such action would have unintended adverse consequences on competition.

C. Debarment in no way affects the obligation of a Contractor to the Department to perform under existing contracts.

D. The Department also reserves the right to declare a debarred Contractor in default on any existing contracts for adequate cause as provided in such contracts.

1.20 DEBARMENT - PROCEDURES

A. The procedure described in this Section, article Debarment applies if it is found that a contractor or an affiliate thereof is violating the prohibited activities.
B. The Engineer for Construction notifies the Contractor in writing and by certified mail of the Department's intention to debar. Written notice specifies:
1. The grounds for such intended debarment.

2. The date debarment becomes effective and the intended period of debarment.
3. The procedure to follow if the Contractor desires to challenge the debarment or to offer information to the Department in mitigation of its alleged actions.

C. Within 15 calendar days of receiving the notice of intended debarment, the Contractor may request either:
1. An informal hearing before the Engineer for Construction.
2. A formal hearing before the UDOT Deputy Director.

D. The Contractor who elects to proceed at an informal hearing has the opportunity to appear at a mutually agreed upon time and location.
1. Contractor may supply information in support of their position and has the opportunity to review the Department's evidence, present evidence, and discuss matters informally.
2. No legal counsel is permitted for either party at the informal hearing.

E. The UDOT Deputy Director of Transportation or designee conducts a formal hearing with assistance from the Department's legal counsel. The Contractor who appears may be represented by counsel and has the opportunity to review the Department's evidence, and to present evidence in rebuttal either by sworn affidavit or by sworn testimony.

F. Following either a formal or informal hearing, the Department representative conducting the hearing issues a written decision no later than 30 calendar days following the hearing.

G. The decision of the UDOT Deputy Director following a formal hearing is administratively final and specifies the facts justifying the Department's actions and conclusion.

H. If the Engineer for Construction's decision is to be appealed, the Contractor files notice in writing with the UDOT Deputy Director within 20 calendar days after receiving the decision from the Engineer for Construction. The Deputy Director then schedules a formal hearing as specified above.

PART 2 PRODUCTS Not used

PART 3 EXECUTION Not used

END OF SECTION

SECTION 00515

AWARD AND EXECUTION OF CONTRACTS

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Section 00570: Definitions.

1.2 CONSIDERATION OF BID PROPOSALS

A. The Department publicly opens properly executed Bid Proposals using the current version of the EBS to compare bids on the basis of the summation of the products of the quantities and the unit bid prices.
   1. Department makes the results of the comparisons available to the public.
   2. The unit bid prices govern if a discrepancy exists between unit bid prices and extensions.

B. The Department reserves the right to reject any or all Bid Proposals, waive technicalities, advertise for new Bid Proposals or proceed to do the work.

C. The bidder can request withdrawal of a bid after bid opening by:
   1. Submitting to the Engineer for Construction a notarized affidavit within 24 hours after bid opening declaring a clerical or mathematical error in bid preparation.
   2. Submitting accompanying declaration with original work sheets used in bid preparation.
   3. Describing specific error(s) in detail.
   4. Verifying that error has a significant monetary effect in the amount of 3 percent of the bid or greater.

D. Judgmental errors are not grounds for requesting bid withdrawal.

1.3 AWARD OF CONTRACT

A. The Department awards the Contract to the lowest responsible bidder within 30 calendar days.

B. The Department may withhold award beyond the 30 days with the approval of the successful bidder.

C. If the award is not made within 30 calendar days, the bidder may withdraw the Bid Proposal without liability.

D. The Department notifies the successful bidder by letter mailed to the address shown on the Bid Proposal that the bid has been accepted and the Contract has been awarded.

1.4 CANCELLATION OF AWARD

A. The Department reserves the right to cancel the award of any Contract before execution without liability.

1.5 RETURN OF PROPOSAL GUARANTY

A. Proposal guaranties are returned after satisfactory contract bonds and all insurances have been furnished and the Contract has been executed.

B. A bidder is not released from the bidding obligation because of an alleged error in the preparation of the Bid Proposal unless the Department returns the proposal guaranty.

1.6 CONTRACT BONDS

A. The Department furnishes required contract bond forms.

B. Return executed forms to Department as required by the Utah Procurement Code.
   1. **Payment Bond** secures the payment of the claims of laborers, mechanics or materialmen employed on the work under the Contract.
   2. **Performance Bond** guarantees the faithful performance of the Contract.

C. Each bond must equal 100 percent of the contract price.

D. Underwriting Limitation is stated in the United States Department of Treasury Circular 570; Surety Companies Acceptable on Federal Bonds. Only companies listed in the Department of Treasury Circular 570 are acceptable.

E. The Department may make alterations, extensions of time, extra and additional work, and other changes authorized by the Contract without securing the consent of the surety or sureties on the contract bonds.

F. If a Contractor's surety is unable to provide payment, the Department cancels all work on the Contract, unless the Department determines it is in the public interest to continue the work.

G. As an alternate contract bond, furnish a cash bond of two cashier's checks, each in the amount of Contractor's bid amount.
   1. The Department holds the cash bond and uses it when needed for correction of any non-performance or non-payment.
   2. Upon release by the Engineer for satisfactory completion of the work, Department returns to the Contractor one half of the cash bond minus any cost against the bond.
   3. If no payment claims have arisen within 90 days after release by the Engineer, the Department releases the remaining cash bond.
   4. The Department holds the cash bond until the non-performance and non-payment issues are resolved. Contractor accrues no liability during this time.
   5. The Department decides the need for withholding the cash bond.

1.7 EXECUTION AND APPROVAL OF CONTRACT

A. Return the signed Contract, properly executed contract bonds, and all required insurances to the Department within 15 calendar days after notice of award.
   1. The bidder can withdraw the bid proposal without penalty if the Department does not execute the Contract within 30 calendar days after receiving signed Contracts and Bonds and insurances.
   2. The Contract is not considered in effect until executed by all parties.

1.8 MATERIALS GUARANTY

A. The successful bidder must:
   1. Furnish a complete statement of the origin, composition, and manufacturer of material proposed for use in the construction.
   2. Furnish samples to be tested and inspected for meeting the Contract.

B. Contractor may be required to furnish a written guaranty covering certain items of work for varying periods of time from the date of acceptance of the Contract.
   1. Department specifies in the Contract the work to be guaranteed, the form, and the time limit of the guaranty.
   2. Sign and deliver the guaranty to the Engineer before acceptance of the Contract in accordance with Section 00570.

3. Upon completion of the Contract, the required Performance Bond may be reduced to conform to the total amount of the contract bid prices for the items of work to be guaranteed. This amount continues in full force and effect for the duration of the guaranty period. Refer to this Section, article 1.6, Contract Bonds.

1.9 FAILURE TO EXECUTE CONTRACT

A. The Department can cancel the notice of award and keep the proposal guaranty if the successful bidder fails to execute the Contract and file acceptable Bonds and insurance certificates evidencing coverage within 15 calendar days after the date of the Notice of Award.

B. The Department may then award the Contract to the next lowest responsible bidder, or may re-advertise the work.

PART 2 PRODUCTS Not used

PART 3 EXECUTION Not used

END OF SECTION

SECTION 00555

PROSECUTION AND PROGRESS

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Section 00570: Definitions

B. Section 01282: Payment

C. Section 01355: Environmental Protection

1.2 PRECONSTRUCTION CONFERENCE

A. Contact Engineer to schedule Pre-Construction Conference following Notice of Award.

1.3 NOTICE TO PROCEED

A. Proceed with the work after receipt of written notice from the Department.

B. Notify the Engineer at least five calendar days before beginning work.

1.4 SUBLETTING CONTRACT

A. Obtain written approval of the Department before subletting, selling, transferring, assigning or disposing any portion of the Contract or Contracts.

B. Sublet no more than 70 percent of the total contract work bid amount.

C. Subcontracts whether committed to in writing or by an informal, unwritten arrangement or transfer of the Contract, or any part of it or its obligations, do not relieve liability under the Contract and bonds. As part of its contract with the Department, the Contractor accepts liability for any claims for damages or liability resulting from an act or omission of any person who carried out work on its behalf, whether that working relationship is codified into a subcontract or carried out by an informal, unwritten agreement. The Contractor agrees to

indemnify the Department for any damages or liability, including attorney's fees and court costs, that may be incurred by such a person.

D. Do not allow subcontract work to begin until approved by Engineer.

E. In computing the percentage of subcontracted work, Department considers an item as subcontracted in its entirety unless otherwise designated in the subcontract.
   1. Department uses the accumulated percentages of all approved subcontracts to assure that the maximum subcontracted limitation is not exceeded.
   2. To determine the amount of work subcontracted, the Department uses the total dollar amount of the items subcontracted in the Contract Bid Proposal, divided by the original contract amount.
   3. If the prime Contractor is to perform a portion of an item, the Department determines the amount of work subcontracted by using the dollar amount of the item agreed to between the prime Contractor and the subcontractor, excluding bonds, insurance, profit, and office transaction, etc. performed by the Contractor.

F. Provide for a reduction in retained monies commensurate with the percentage held as retainage as provided for in Section 01282.

G. Include a statement agreeing on a method of distribution of any adjustments due to price increases or decreases using applicable price adjustment specifications for fuel, cement, common carrier rates, etc.

1.5 ANTICIPATED MONTHLY PAYMENT SCHEDULE

A. Prepare the Anticipated Monthly Payment Schedule based on the proposed sequence of activities shown in the baseline construction schedule.
   1. Use form provided by the Engineer
   2. Submit the proposed Monthly Payment Schedule before the date established for the first partial payment.
   3. Include both monthly and semi-monthly payments when anticipated due to the volume of work on the project.
   4. Include all months during the life of the contract when payments are anticipated.
   5. Include dates of contract start, suspension, completion and milestones that impact payments.

B. Submit Revised Payment Schedule within 30 days of notification by the Engineer. Payment Schedule Revisions are required when:
   1. Actual Payments vary 10 percent or more (plus or minus) from the submitted Payment Schedule and the variance is sustained for 60 days.
   2. Contract start, suspension, completion and milestones dates change.

3. Change Orders are approved increasing or reducing the contract amount sufficient to vary actual payments 10 percent or more (plus or minus) from the accepted Payment Schedule.

1.6 BASELINE CONSTRUCTION SCHEDULE

A. Develop a baseline construction schedule using Primavera SureTrak Project Manager or Primavera Project Planner. Assure the schedule accurately reflects the proposed approach to accomplish the work outlined in the Contract documents and conforms to all requirements of this article.

B. Use the baseline construction schedule to coordinate all activities on the project - particularly the interaction with other entities, including, but not limited to, utilities, local governments, special service districts, and the Department.

C. Schedule Submission

1. Within 14 calendar days of the Notice of Award, submit a baseline construction schedule in a Critical Path Method (CPM) format for the Engineer's review and acceptance. Submit one hard copy and one electronic copy in a format acceptable to the Engineer.
2. The Engineer reviews the schedule and returns it, accepted or with comments, within seven calendar days from the date of receipt.
3. If the schedule is returned with comments, address all comments and revise the schedule as necessary to the satisfaction of the Engineer. Complete the final baseline schedule and obtain the acceptance of the Engineer within 30 calendar days from the Notice of Award.
4. No progress payments are made before the Engineer accepts the baseline construction schedule.
5. Develop a 60-calendar day schedule for complex contracts exceeding 120 working days, when not practical to prepare, review, and approve the baseline construction schedule in the time frame specified above. Use the same format as required for the baseline schedule and include all activities worked on during the first 60 calendar days of the Contract. The Engineer reviews and accepts the schedule prior to the approval of the first pay estimate.
6. Acceptance of the baseline construction schedule by the Engineer does not imply approval of any particular construction methods or relieve the Contractor from its responsibility to provide sufficient materials, equipment, and labor to guarantee the completion of the project in accordance with the contract documents.

7. Acceptance of the baseline construction schedule by the Engineer does not attest to the validity of assumptions, activities, relationships, sequences, resource allocations, or any other aspect of the baseline construction schedule. Within the contractual constraints, the Contractor is solely responsible for the planning and execution of the work.
8. Failure by the Contractor to include any element of work required by the Contract in the accepted baseline construction schedule does not relieve the Contractor from its responsibility to perform such work.
9. In no way does the baseline construction schedule modify the contract documents.

D. Schedule Requirements

As a minimum, address the following in the baseline construction schedule:

1. Define a complete logical plan, that can realistically be accomplished, for executing the work defined in the Contract.
2. Include sufficient activities to assure adequate planning of the project.
3. Comply with the phasing, work constraints, and milestones defined in the Contract as well as all other contractual terms and conditions.
4. Clearly show the critical path (using the longest path definition) and other critical elements of work. If the schedule is resource loaded and leveled, define the critical path of the schedule based on resource limitations. If an early completion schedule is accepted, the Engineer defines the additional Department cost required to support the accelerated schedule (such as increased staff for inspection and testing, overtime, etc.). The Contractor is responsible for paying these added costs unless waived by the Engineer on the basis of other benefits accrued to the Department.
5. Clearly define significant interaction points between the Contractor, UDOT, and other entities (such as utilities, local governments, special service districts, etc.).
6. Designate the "Data Date" as the day prior to the Notice to Proceed.
7. Include a unique identification number for each schedule activity.
8. Clearly and uniquely define each activity description. Using descriptions referring to a percent complete of a multi-element task (i.e., "Construction 50 percent of Deck") are not acceptable.
9. Define the duration of each activity - limiting the maximum duration of any activity to 15 days unless otherwise accepted by the Engineer.
10. Clearly identify the relationships tying activities together.
11. Do not have any open ended activities (with the exception of one start and one finish activities).
12. Do not have any constrained activities unless the Engineer accepts such constraints.
13. Do not sequester project total float through manipulating the calendars, extending activities durations, or any other such methodology.

14. Use resource loading if resource limitations could affect the prosecution of the work. No time extensions tied to a shortage of resources will be considered unless the baseline and subsequent schedule updates are resource loaded.
15. Include milestones to define significant contractual events such as Notice to Proceed, Substantial Completion, and coordination points with outside entities such as utilities, special service districts, etc.
16. Include a well-defined activity coding structure that allows project activities to be sorted by total project, responsible party, location of work, type of work, work phase, or as mutually agreed to by the Contractor and the Engineer.
17. Have clearly defined calendars.
18. Include a Narrative that describes:
    a. The construction philosophy supporting the approach to the Work outlined in the baseline schedule. Address the reasons for the sequencing of work and describe any limited resources, potential conflicts, and other salient items that may affect the schedule and how they may be resolved.
    b. The justification(s) for activities with durations exceeding 15 working days.
    c. The justification(s) for constraints used.
    d. The justification(s) for unusual calendars used.
    e. The approach used to apply relationships between activities (for example, all ties are based on physical relationships between work activities - rebar must be placed before concrete is poured; or relationships are used to show limited resources - bridge two follows bridge one because the contractor only has one bridge crew; etc.).
    f. The project critical path and challenges that may arise associated with the critical path.
    g. How the Contractor intends to coordinate with other entities.

E. Project Float

Total Project Float is defined as the length of time activities can be delayed before they affect the finish date of the project or a contractual milestone.

1. Float is a shared commodity and not for the exclusive use or financial benefit of either party.
2. Either party has the full use of the project float until it is depleted.

F. Prosecution of the Work

Employ a sufficient work force, supply adequate materials and equipment, and prosecute the work with such diligence as to maintain the rate of progress indicated in the accepted baseline construction schedule.

1. Any additional or unanticipated costs required to maintain the schedule is solely the Contractor's obligation and is at no expense to the Department.

1.7 CONSTRUCTION SCHEDULE UPDATES

A. Update the construction schedule monthly using the closing date for the monthly progress payment and submit to the Engineer.
   1. The Engineer does not approve progress payment until the schedule update has been received.
   2. Show actual progress for each activity; actual start and finish dates for completed activities; actual start dates, percent complete, and remaining duration for activities in progress; projected sequences of activities for future work; revised relationships and durations for unfinished activities, if warranted; and a well defined critical path.

B. Submit one hard copy and one electronic copy of the schedule update to the Engineer for review and approval.

C. Along with the updated schedule, submit a narrative describing:
   1. Actual work performed during the estimate period.
   2. Any problems or delays that have been experienced to date, the party responsible for the problems or delays, and the Contractor's intentions to resolve the problems or bring the delayed activities back on schedule.
   3. Differences between the actual work performed and the work planned for the period, including explanations for the deviations.
   4. The current critical path of the project, highlighting any changes to this path since the last update and the impacts of such changes.
   5. All added or deleted activities and the reason(s) for and the impact(s) of such changes.
   6. All changes in activity durations and the reason(s) for and the impact(s) of such changes.
   7. All changes in relationships between activities and the reason(s) for and the impact(s) of such changes.
   8. The addition or deletion of constraints and the reason(s) for and the impact(s) of such changes.
   9. All changes to the project calendars and the reason(s) for and the impact(s) of such changes.
   10. The work to be accomplished during the next period. Provide reasoning for any deviations from the schedule.
   11. All potential problems that may be encountered during the next period and the proposed solutions to such problems. Particularly, identify all potential problems the Department may be party to. Explain what action the Department needs to take and the date by which time the action needs to taken to avoid the problem.

D. The Engineer conducts a monthly review of the updated construction schedule.
   1. This review occurs within one week of the receipt of the Contractor's updated information and serves as the forum to discuss activity slippages, remedies, schedule revisions, coordination requirements, change orders, potential Contractor delay claims, and other relevant issues.
   2. The Contractor's project manager, scheduler, and appropriate field personnel participate in these reviews.
   3. Compile an action item list that describes who is responsible for existing or pending issues and the date by which the issue needs to be resolved to avoid contract delays.
   4. Submit a revised schedule update if necessary.

1.8 CONSTRUCTION SCHEDULE DELAYS

A. A construction schedule delay is defined as an event, action, or other factor that impacts the critical path of the construction schedule and extending the time needed to complete the construction project. There are four types of delays:
   1. **Excusable Delay** - An excusable delay is one caused by an unforeseeable event beyond the Contractor's control. Such delays, where the Contractor may be granted added time but no additional money, include, but are not limited to, acts of God, acts of public enemies, fires, floods, area wide strikes, utility conflicts, and unusually severe weather.
   2. **Compensable Delay** - A compensable delay is one solely caused by the Department or its representatives. Such delays include, but are not limited to, Department ordered suspension of the work, design errors, and differing site conditions. Compensable delays may entitle the Contractor to additional time and monetary compensation.
   3. **Inexcusable Delay** - An inexcusable delay is one that the Contractor could have foreseen and prevented but failed to do so. In such cases, the Contractor is responsible for all cost and time impacts resulting from the delay for all parties affected. Examples of events that cause inexcusable delays include weather or failure by the Contractor to assign sufficient resources to the project.
   4. **Non-Critical Delays** - Non-critical delays are delays, regardless of cause, that do not impact the critical path of the project. No added time or monetary compensation is given the Contractor for such delays. If the delay is sufficiently long to eventually place the impacted activity(s) on the critical path of the construction schedule, the time period the delay affects the critical path will be handled as defined above.

B. Upon determining critical activities have been delayed, provide written notification to the Engineer within seven calendar days of the delay-causing event. Provide detailed information including:
   1. The events that caused the delay.
   2. Party(s) responsible for the events.

3. Activities in the construction schedule affected by the events.
4. The magnitude of the delay using the current update of the construction schedule.

C. The Engineer reviews the request and within 14 calendar days provides a written response to the Contractor. If the Engineer agrees with the request, a time extension and added compensation, if applicable, will be granted under the terms of the Contract.

D. If the Engineer disagrees with the request, a clear explanation will be included in the letter. This letter serves as formal rejection of the request by the Department.

E. Once a delay-causing event is identified, take all reasonable steps needed to minimize the impact of the delay. Failure to do so results in the rejection of all or part of the delay claim.

1.9 LIMITATION OF OPERATIONS

A. Conduct the work to minimize interference with traffic.

B. Sundays or holidays: Do not perform any work without written approval except repair or servicing of equipment, protection of work, maintenance or curing of concrete, or maintenance of traffic.

C. Night work:
1. Provide five calendar day's notice before starting night work.
2. Provide adequate lighting for performing satisfactory inspection and construction operations.
3. Control noise and vibration in accordance with Section 01355.

1.10 CHARACTER OF WORKERS

A. Provide sufficient resources to complete all work in accordance with the Contract and employ workers with the skills and experience necessary to perform the work.

B. Remove any person employed who performs the work in an improper or unskilled manner, or who is intemperate or disorderly. Rehire these employees only with the Engineer's written permission.

C. Failure to remove any employee(s) or to furnish suitable and sufficient personnel to perform the work may result in a written notice to suspend the work.

1.11 METHODS AND EQUIPMENT

A. Use equipment of the size and mechanical condition to perform and produce the specified work.

B. Do not damage the roadway, adjacent property, or other highways.

C. Use methods or equipment other than those specified only with the Engineer's written permission.
   1. Describe in writing the proposed methods and equipment to be used and the reasons for the change.
   2. Once approval is received, produce work meeting project requirements.
   3. Discontinue use of alternate methods or equipment if the Engineer determines that the work does not meet contract requirements.
   4. Remove and replace or repair deficient work to return it to specified quality at no cost to the Department.
   5. Department does not change the basis of payment for a change in methods or equipment.

1.12 CONTRACT TIME

A. Contract time begins 10 Calendar days after the date of the Notice to Proceed, unless otherwise specified.

B. The Contract Documents define the time allowed to complete the Contract. Contract time is measured in either Working Days or Calendar Days as defined in Section 00570.
   1. Department excludes Calendar days elapsing between the effective dates of any orders of the Engineer to suspend and resume work that are not the fault of the Contractor.
   2. Completion Date: The date when the Contract work is specified to be Substantially Complete.

C. The Engineer furnishes a Monthly Status of Contract Time showing the number of days expended to date and the number of days remaining for Substantial Completion.
   1. This statement is considered correct unless a written protest documenting the differences is submitted to the Engineer within 10 calendar days of the schedule update review meeting.
   2. Immediately resolve any differences with the Engineer.

D. **Substantial Completion -** the day, determined by the Engineer, when all of the following have occurred:
   1. The public (including vehicles and pedestrians) has full and unrestricted use and benefit of the facilities both from the operational and safety standpoint, and
   2. All safety features are installed and fully functional, including, but not limited to, illumination, signing, striping, barrier, guard rail, impact attenuators, delineators, and all other safety appurtenances, and
   3. Only minor incidental work, replacement of temporary substitute facilities or correction or repair remains for the Physical Completion of the Contract, and
   4. The Contractor and Engineer mutually agree that all work remaining will be performed without lane closures, trail/sidewalk closures, or further delays, disruption, or impediment to the public.

E. **Physical Completion** - the day, determined by the Engineer, when all construction work required by, or incidental to, the Contract (including all punch list work, final cleanup, and demobilization) is physically completed and the only outstanding obligation under the Contract is the submittal or processing of documentation.

F. **Contract Completion** - the day, determined by the Engineer, when all work specified in the Contract is completed and all obligations of the Contractor under the Contract are fulfilled.
   1. Furnish all documentation required by the Contract and required by law before this date.

1.13 EXTENDING CONTRACT TIME

A. Request additional contract time as part of project change orders covering quantity overruns, extra work requested by the Department, suspensions of work, and other excusable delays.
   1. Time added to Calendar Day and Completion Date contracts is in calendar days.
   2. Time added to Working Day contracts is in working days.

B. Provide a narrative clearly explaining the cause and duration of the delay.
   1. Support the narrative with a project schedule delay analysis showing the overall project critical path and substantial completion date is negatively affected by the number of days requested.
      a. Base the schedule analyses on the most current project schedule update.
      b. Explain any changes made to the schedule in the analysis.

c. Include an explanation of the addition or deletion of activities, modified activity durations, changes in activity relationships and constraints, and any other change that contribute to the schedule delay.

C. Partial Suspension: Suspension of work on some items as ordered by the Engineer is considered a partial suspension.
1. Applicable only to working day or calendar day contracts.
2. Engineer determines the time charged for each day on partial suspensions not the fault of the Contractor as the greater of:
a. 0.15 day
b. The quotient (rounded to hundredths) obtained by dividing the sum of the bid amount for the specific items of work not suspended by the total value of original contract amount.

1.14 FAILURE TO COMPLETE ON TIME

A. Achieve Substantial Completion within the required Contract Time. Department deducts from any money due the sum specified in the following Schedule of Liquidated Damages (Table 1) for each calendar day or working day that any work remains necessary to achieve Substantial Completion after the Substantial Completion date.

B. Achieve Physical Completion no later than 30 calendar days after achieving Substantial Completion. Department deducts from any money due $210.00 per day for each calendar day after the 30 days following Substantial Completion any work remains necessary to achieve Physical Completion.

C. Achieve Contract Completion no later than 30 calendar days after achieving Physical Completion. Department deducts from any money due $100.00 per day for each calendar day after the 30 days following Physical Completion any obligation of the Contractor under the Contract remains unfulfilled.

Table 1 - Schedule of Liquidated Damages

Original Contract Amount		Daily Charge	
From more than	**To and including**	**Calendar Day Completion Date**	**Work Day**
$0	$100,000	$210	$830
100,000	500,000	450	950
500,000	1,000,000	680	1380
1,000,000	5,000,000	1270	2170
5,000,000	10,000,000	1860	2950
10,000,000	30,000,000	2770	4930
30,000,000		4100	8240

D. Continuation and completion of the work after the contract time expires does not waive the Department's rights under the Contract.

1.15 TERMINATION FOR DEFAULT

A. Termination can occur if the Contractor:
   1. Fails to begin the work under the Contract within the time specified.
   2. Fails to perform the work with sufficient resources to assure the prompt completion of the work.
   3. Fails to perform the work in accordance with the Contract requirements or neglects or refuses to remove and replace rejected materials or unacceptable work.
   4. Discontinues the prosecution of the work.
   5. Fails to resume work within the time specified upon notification from the Department.
   6. Becomes insolvent, or is declared bankrupt, or commits any act of insolvency or bankruptcy.
   7. Allows any final judgment to remain unsatisfied for a period of 10 calendar days.
   8. Makes an assignment for the benefit of creditors without the Department's approval.
   9. Fails to comply with Contract requirements including minimum wage payments or EEO requirements.
   10. Is a party to fraud.

B. The Engineer may declare the Contract in default by written notice to the Contractor and the Surety advising them of the actions required for remedy.

C. Comply with the written notice within 10 calendar days of receipt or the Department has full power and authority to terminate the Contract.

D. The Department may appropriate or use any or all materials and equipment at the project site and enter into another contract for completion of the work according to the terms and provisions thereof, or use such methods as determined by the Department to complete the Contract.

E. All costs and charges incurred by the Department, including the cost of completing the work under the Contract, are deducted from monies owed or that may be owed the Contractor. Should the expense exceed the sum that would have been payable under the Contract, the Contractor and Surety are liable and must pay the Department the amount of the excess.

F. If, after termination of the Contractor's right to proceed, it is determined that the Contractor was not in default, or that the delay was excusable, the rights and obligations of the parties will be the same as if the termination had been issued for the convenience of the Department.

1.16 TERMINATION OF CONTRACT FOR CONVENIENCE OF THE DEPARTMENT

A. The Department may by written order terminate the Contract or any portion thereof after determining that for reasons beyond the Contractor's or the Department's control, the Contractor is prevented from proceeding with or completing the work and that termination would be in the public interest.

B. Reasons for termination may include, but are not limited to:
   1. Executive Orders of the President relating to prosecution of war or national defense.
   2. National emergency that creates a serious shortage of materials.
   3. Orders from duly constituted authorities relating to energy conservation.
   4. Restraining Orders or Injunctions obtained by third-party citizen action resulting from national or local environmental protection laws or where the issuance of such order or injunction is primarily caused by acts or omissions of persons or agencies other than the Contractor.

C. When the Department orders termination of a Contract effective on a certain date, the Department pays for all completed items of work as of that date at the Contract bid price.
   1. Department pays for partially completed work either at agreed prices or by force account methods.
   2. Department pays for items that are eliminated in their entirety in accordance with Section 01282.

D. Materials obtained by the Contractor that have not been incorporated into the project may be:
   1. Purchased from the Contractor at the option of the Department at actual cost delivered to a prescribed location.
   2. Disposed of as mutually agreed.

E. Contractor may submit a claim for additional costs not covered in the Contract after receipt of Notice of Termination from the Department.
   1. Submit within 60 calendar days of the effective termination date.
   2. Include cost items such as:
      a. Reasonable idle equipment time
      b. Mobilization efforts
      c. Bidding and project investigative costs
      d. Overhead expenses attributable to the project terminated

e. Reasonable profit on work completed
f. Subcontractor costs not otherwise paid for
g. Actual idle labor cost if work is stopped in advance of termination date.
h. Guaranteed payments for private land usage as part of original Contract
i. Any other direct cost the Contractor has incurred

3. The negotiated settlement figure reached with the Contractor does not include loss of anticipated profits.

F. Make cost records available to the Department for determining the validity and amount of each item claimed, and for providing a basis for negotiating an equitable settlement.

G. Termination of a Contract or portion thereof does not relieve the Contractor of contractual responsibilities for the work completed, nor does it relieve the Surety of its obligation for and concerning any just claim arising out of the work performed.

PART 2 PRODUCTS Not used

PART 3 EXECUTION Not used

END OF SECTION

SECTION 00570

DEFINITIONS

PART 1 GENERAL

1.1 REFERENCES

A. U. S. Code of Federal Regulations

1.2 ABBREVIATIONS

A. Wherever the following abbreviations are used in the Contract, they mean:

1.	AAN	American Association of Nurserymen
2.	AAR	Association of American Railroads
3.	AASHTO	American Association of State Highway and Transportation Officials
4.	ACI	American Concrete Institute
5.	AGC	Associated General Contractors
6.	AI	Asphalt Institute
7.	AIA	American Institute of Architects
8.	AISC	American Institute of Steel Construction
9.	AISI	American Iron and Steel Institute
10.	AMRL	AASHTO Materials Reference Laboratory
11.	ANSI	American National Standards Institute
12.	APL	Accepted Products Listing
13	ARA	American Railway Association
14.	AREA	American Railway Engineering Association
15.	ASCE	American Society of Civil Engineers
16.	ASLA	American Society of Landscape Architects
17.	ASTM	American Society for Testing and Materials
18.	ATMS	Advanced Traffic Management System
19.	AWPA	American Wood Preservers' Association
20.	AWWA	American Water Works Association
21.	AWS	American Welding Society
22.	CRF	Code of Federal Regulations
23.	CSI	Construction Specification Institute
24.	EBS	UDOT's Electronic Bid System
25.	EUSERC	Electric Utility Service Equipment Requirements Committee

26.	FHWA	Federal Highway Administration
27.	FSS	Federal Specifications and Standards
28.	GSA	General Services Administration
29.	IMSA	International Municipal Signal Association
30.	ITE	Institute of Traffic Engineers
31.	MIL	Military Specifications
32.	MUTCD	Manual on Uniform Traffic Control Devices
33.	NEMA	National Electrical Manufacturers Association
34.	NVLAP	National Verification Laboratory Acceptance Program, (Bureau of Standards)
35.	OSHA	Occupational Safety and Health Administration
36.	PCA	Portland Cement Association
37.	PDPL	Performance Data Products Listing
38.	SAE	Society of Automotive Engineers
39.	SSPC	Structural Steel Painting Council
40.	WP3	Storm Water Pollution Prevention Plan
41.	U.L.	Underwriter's Laboratory
42.	UDOT	Utah Department of Transportation
43.	UPDES	Utah Pollution Discharge Elimination System
44.	USAS	United States of American Standard Institute
45.	WWPA	Western Wood Products Association

1.3 TERMS

A. Wherever the following terms are used in the Contract, they mean:

1. **Acts of God:** Earthquake, tidal wave, tornado, hurricane, or any other cataclysmic phenomenon of nature beyond the Contractor's control that causes loss, damage, or injury to the work. Weather is not considered an "Act of God" unless it can be shown conclusively that such weather could not have been anticipated as a normal hazard of the contract.
2. **Addendum:** Change in bid proposals during time of advertisement.
3. **Advertisement:** The public announcement inviting bids for work to be performed or materials to be furnished.
4. **Award:** The acceptance of a Proposal or Statement of Qualifications by the Department resulting in a Contract for work between the Department and the Contractor.
5. **Backfill:** Material used to replace, or the act of replacing material removed during construction.
6. **Bidder:** Any individual or legal entity submitting a Proposal or Statement of Qualifications in response to the Departments' request.
7. **Bid Proposal:** The prescribed form on which the bidder's financial offer is submitted**.**
8. **Bridge:** A structure, including supports, erected over a depression or an obstruction such as water, highway, or railway, and having:
   a. A track or passageway for carrying traffic or other moving loads,

b. A length measured along the center of roadway of more than 20 ft between undercopings of abutments or extreme ends of openings for multiple boxes.

9. **Bridge Length:** The over-all length of a bridge measured along the line of survey stationing back to back of back-walls of abutments, if present, otherwise end to end of the bridge floor; but in no case less than the total clear opening of the structure.
   a. **Bridge Roadway Width**: The clear width measured at right angles to the longitudinal centerline of the bridge between the bottom of curbs or in the case of multiple height of curbs, between the bottoms of the lower risers or if curbs are not used, between inner faces of parapet or railing.
10. **Calendar Day:** Every day shown on the calendar, beginning and ending at midnight.
11. **Certificate of Compliance:** A document containing a certified statement from the manufacturer concerning the quality and quantity of material delivered.
12. **Change Order:** A written order to the Contractor covering contingencies, extra work, increases or decreases in contract quantities resulting in significant changes to the character of the work, and additions or alterations to the original Contract which establishes the basis of payment and time adjustments for the affected changes.
13. **Commercial Plants:** A plant that sells material to the general public before the Department's advertisement of the Contract, and possesses the required retail sales tax license and business license in its residential State.
14. **Commission:** The Utah Transportation Commission.
15. **Completion Date:** The date when the Contract work is specified to be Substantially Complete.
16. **Concrete - Small Structure:** 8 cubic yards or less of concrete.
17. **Conformity:** Compliance with reasonable and customary manufacturing and construction tolerances where working tolerances are not specified. Where working tolerances are specified, conformity means compliance with such tolerances.
18. **Contract:** The written agreement between the Department and the Contractor establishing the obligations of the parties for the performance of the work prescribed. The Contract includes the following, all of which constitute one instrument:
    a. Invitation for Bids
    b. Proposal
    c. Contract Bond
    d. Specifications
    e. Special Provisions
    f. General and detailed plans
    g. Notice of award
    h. Notice to proceed

i. Authorized contract time extensions.
j. Any change orders and agreements that are required to complete the construction of the work in an acceptable manner

19. **Contract Amount (Price component)** - The summation of the products of the quantities shown in the bid schedule multiplied by the unit bid prices for the items in Bid Proposal, but not including Time.
20. **Contract Bid Item:** A specific unit of work for which a price is provided in the contract. For projects that include P+T bidding, Time is a bid item.
21. **Contract Bond:** The approved form of security, executed by the Contractor and the Contractor's Surety or Sureties, guaranteeing complete execution of the Contract and all pertinent change orders and the payment of all legal debts pertaining to the construction of the project.
22. **Contract Completion** - the day, determined by the Engineer, when all work specified in the contract is completed and all obligations of the Contractor under the contract are fulfilled. Furnish all documentation required by the contract and required by law before this date.
23. **Contract Pay Item:** A specific unit of work for which a price is provided in the contract. Exceptions to this include, but are not limited to, the items Time, and Lane Rental, which are not pay items. No payment will be made for the bid items titled Time and Lane Rental.
24. **Contract Payment Bond:** The security executed by the Contractor and furnished to the Department to guarantee payment of all legal debts of the Contractor pertaining to the construction of the Contract.
25. **Contract Performance Bond:** The security executed by the Contractor and furnished to the Department to guarantee completion of the work under the Contract.
26. **Contract Time:** The number of working days or calendar days allowed for Substantial Completion of the Contract, including authorized time extensions. When a Completion Date is specified, achieve Substantial Completion on or before that date, even when that date is a Saturday, Sunday or holiday.
27. **Contractor:** The individual or legal entity contracting with the Department for performance of prescribed work.
28. **Contractor Affiliate:** Any person associated therewith in the capacity of owner, partner, director, officer, principal investigator, project director, manager, or auditor, or other like position.
29. **County:** the County where the contracted work is located.
30. **Culvert:** Any structure that provides an opening under the roadway not meeting the classification of a bridge as defined in this Section.
31. **Debarment:** Action taken by the Department or Federal Government pursuant to regulation that prohibits a person or company from performing work on a public project.
32. **Department:** The Utah Department of Transportation.

33. **Electronic Communication:** A communication transmitted through facsimile (fax), e-mail, or other electronic means where a hard copy can be produced.
34. **Engineer:** The UDOT Deputy Director of the Department, acting directly or through a duly authorized representative (usually the Resident Engineer or Consultant Engineer), who is responsible for engineering supervision of construction covered by the Contract. A Consultant Engineer who is hired by the Department for Construction Project Management is considered an extension of the Department and has the same responsibility and authority as a Resident Engineer.
35. **Equipment:** All machinery, tools, apparatus, and supplies necessary for the upkeep, maintenance, construction, and completion of the Contract.
36. **Extra Work:** Work not provided for in the Contract, but found by the Engineer to be essential for the satisfactory completion of the Contract within its intended scope.
37. **Force Account Work:** Work performed as directed by the Engineer and paid for on the basis of actual costs and appropriate additives provided in the contract.
38. **Geotextile:** Any permeable textile material used with foundation, soil, rock, earth, or any other geotechnical engineering related material, as an integral part of a man-made project, structure, or system. Geotextile generally refers to knitted, woven, and non-woven fabrics.
39. **Highway, Street, or Road:** A general term denoting a public way for purposes of travel, including the entire area within the right-of-way.
40. **Holidays:** For determining working days, the following are considered holidays:

New Year's Day	Labor Day
Martin Luther King Day	Columbus Day
Presidents Day	Veteran's Day
Memorial Day	Thanksgiving Day
Independence Day	Christmas Day
Pioneer Day	

When the Holiday falls on a Saturday, Friday will be the Holiday; when the Holiday falls on Sunday, Monday will be the Holiday.

41. **Inspector:** The Engineer's authorized representative assigned to make detailed inspections of contract performance.
42. **Interpretations:** Unless otherwise stated in the Contract, all direction, approvals, permissions or acceptance is by the Engineer.
43. **Invitation for Bids:** The Advertisement for Proposals for all work or materials on which bids are requested. Such advertisement indicates with reasonable accuracy the quantity and location of the work to be performed or the character and quantity of the material to be furnished and the time and place of the opening of proposals.

44. **Laboratory:** The testing laboratory of the Department or any other testing laboratory designated by the Engineer.
45. **Lane Rental:** A method to assess the Contractor daily or hourly rental fees for each lane, shoulder, or combination of lanes and shoulders taken out of service.
46. **Limits of Construction:** An area with established boundaries, identified within the highway right-of-way or construction easements, where the Contractor's use for construction purposes is permitted. The limits of construction may also be referred to as the roadway.
47. **Liquidated Damages:** A predetermined sum to be assessed the Contractor. This sum is not considered as a penalty, but as liquidated damages due the Department by reason of inconvenience to the public, added cost of engineering and supervision, and other items for extra expenditures of public funds for the Contractor's failure as specified.
48. **Major Contract Item:** Any bid item, or item added by change order, having a contract value in excess of 5 percent of the original contract amount.
49. **Materials:** Any substances specified for incorporation into the completed project.
50. **Minor Contract Item:** Any bid item not meeting the definition of a Major Contract Item.
51. **Notice to Proceed:** Written notice to the Contractor to begin the Contract.
52. **Overburden:** Any material that overlays material designated for road or bridge construction.
53. **Pavement Structure:** The combination of subbase, base course, and surface course placed on a subgrade to support and distribute the traffic load to the roadbed.
    a. **Surface Course:** One or more layers of a pavement structure designed to accommodate the traffic load, the top layer of which resists skidding, traffic abrasion, and the disintegrating effects of climate. The top layer is sometimes called the "Wearing Course."
    b. **Base Course**: One or more layers of specified material and thickness placed on a subbase or a subgrade to support a surface course.
    c. **Subbase**: Layer(s) of specified material thickness placed on a subgrade to support a base course.
    d. **Subgrade:** The top surface of a roadbed upon which the pavement structure, shoulders, and curbs are constructed.
    e. **Subgrade Treatment**: Stabilization of roadbed material.
54. **Physical Completion** - the day, determined by the Engineer, when all construction work required by, or incidental to, the contract (including all punch list work, final cleanup, and demobilization) is physically completed and the only outstanding obligation under the Contract is the submittal or processing of documentation.

55. **Plans:** Approved contract drawings showing the location, type, dimensions and details of the Contract to be performed.
    a. **Standard Plans**: Detailed drawings approved for repetitive use.
    b. **Working Drawings:** Supplemental design sheets or similar data that the Contractor is required to submit to the Engineer such as shop drawings, erection plans, falsework plans, framework plans, cofferdam plans, and bending diagrams for reinforcing steel.
56. **Prequalification/Initial Financial Screening Statement:** The specific forms on which required information is furnished about the Contractor's ability to perform and finance the work.
57. **Price + Time Bidding (P+T):** A Price plus time bidding procedure.
58. **Profile Grade:** The trace of a vertical plane intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of such trace according to the context.
59. **Project:** The specific section of the highway or other specific property on which construction is to be performed under the Contract.
60. **Proposal:** A bidder's written offer on Department furnished forms, to perform stated work at the quoted prices.
61. **Proposal Form:** The prescribed form on which the bidder's offer is submitted.
62. **Proposal Guaranty:** The security furnished with a proposal to assure that the bidder will enter into the Contract if the Proposal is accepted.
63. **Responsible Bidder:** A bidder determined by the Department to possess the ability to perform the Contract work.
64. **Responsive Bid:** A bid that meets all requirements of the invitation for bids.
65. **Right-of-Way:** A general term denoting land, property, or interest acquired for or devoted to transportation purposes.
66. **Roadbed:** The graded portion of highway within top and side slopes, prepared as a foundation for the pavement structure and shoulders.
67. **Roadbed Material:** Material in cuts, embankments, and in embankment foundations from the subgrade down that supports the pavement structure.
68. **Roadside:** The areas between the outside edges of the shoulders and the right-of-way boundaries including unpaved median areas between inside shoulders of divided highways and areas within interchanges.
69. **Roadside Development:** Items necessary for the preservation or replacement of landscape materials. Features may include suitable plantings and other improvements or ground cover to preserve and enhance the appearance and stability of the highway right-of-way or acquired easements for scenic improvements.
70. **Roadway:** The portion of a highway within limits of construction.
71. **Shoulder:** The portion of the roadway adjacent to the traveled way where vehicles may stop for emergencies, and which supports base and surface courses.

72. **Sidewalk:** That portion of the roadway constructed for pedestrian use.

73. **Site of Work:** As defined in Title 29 CFR 5.2 (1).

   a. The physical place or places where the construction called for in the Contract remain(s) when the work is completed and any other site where a significant portion of the building or work is constructed, provided that such site is established specifically for the performance of the contract or project.

   b. The adjacent nearby property used by the Contractor or subcontractor in such construction.

   c. Fabrication plants, mobile factories, batch plants, borrow pits, job headquarters, tool yards, etc., provided they are dedicated exclusively, or nearly so, to the performance of the Contract and are adjacent or virtually adjacent to the actual construction location such that it would be reasonable to include them, except as noted in the following exclusions.

   d. Exclusions:

      1. The **permanent** home offices, branch plants, fabrication plants, and tool yards of a Contractor or subcontractor whose location and continuance in operation is determined wholly without regard to a particular Federal or Federally assisted contract.

      2. Fabrication plants, borrow pits, job headquarters, etc., of a commercial supplier or materialman that are established by the supplier of the materials for the project before opening of bids and not on the project site.

74. **Specifications:** The compilation of provisions and requirements for the performance of prescribed work.

   a. **Special Provisions**: A unique specification or a modification or revision to the standard specifications applicable to an individual contract.

   b. **Supplemental Specifications**: Approved additions and revisions to the Standard Specifications.

   c. **Standard Specifications**: Specifications approved for general application and repetitive use.

75. **Specifications Format:** The layout of each specification is as follows:
SECTION NUMBER
TITLE
PART (One, Two, and Three)
ARTICLE (For example, 1.1, 1.2, 2.1, 2.2, 3.1, and 3.2)
Paragraph (For example, A, B, C under an article)

Example:

PART 1	GENERAL					
1.1	ARTICLE					(First level)
	A.	Paragraph				(Second level)
		1.	Subparagraph			(Third level)
			a.	Subparagraph		(Fourth level)
				1)	Subparagraph	(Fifth level)

The titles or headings of the Sections, Parts, Articles, paragraphs, and sub-paragraphs in Standard Specifications and Special Provisions are intended for convenience of reference and have no bearing on their interpretation.

76. **Stabilization:** Modification of soils or aggregates by incorporating materials that increases load-bearing capacity, firmness, and resistance to weathering or displacement.
77. **State:** The State of Utah acting through its authorized representative.
78. **Structures:** Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, endwalls, buildings, sewers, service pipes, underdrains, foundation drains and other such features that may be encountered in the work.
79. **Subcontractor:** An individual or legal entity that performs part of the Contractor's required work through a contract agreement with the Contractor.
80. **Substantial Completion** - the day, determined by the Engineer, when all of the following have occurred:
    a. The public (including vehicles and pedestrians) has full and unrestricted use and benefit of the facilities both from the operational and safety standpoint, and
    b. All safety features are installed and fully functional, including, but not limited to, illumination, signing, striping, barrier, guard rail, impact attenuators, delineators, and all other safety appurtenances, and
    c. Only minor incidental work, replacement of temporary substitute facilities or correction or repair remains for the Physical Completion of the contract, and
    d. The Contractor and Engineer mutually agree that all work remaining will be performed without lane closures, trail/sidewalk closures, or further delays, disruption, or impediment to the public.

81. **Substructure:** All of the structure below the bearings of simple and continuous spans, skewbacks of arches and tops of footings or rigid frames; including backwalls, wingwalls and wing protection railings.
82. **Superintendent:** The Contractor's authorized representative in responsible charge of the work.
83. **Superstructure:** All that part of a structure except the substructure as defined in this Section.
84. **Surety:** The legal entity or individual other than the Contractor, executing a bond furnished by the Contractor.
85. **Time Related Cost (Time component)** - A lump sum bid item titled "Time" for which there is no pay. The sum of the products of the daily time-related cost-rates multiplied by the number of calendar days estimated by the Contractor to achieve the milestones specified.
86. **Town, City or District:** A subdivision of the county used to designate or identify the location of the Contract.
87. **Traveled Way:** The portion of the roadway designated for the movement of vehicles, excluding shoulders and auxiliary lanes.
88. **Unbalanced Bid:**
    a. **Materially Unbalanced**: A mathematically unbalanced bid that generates a reasonable doubt that awarding the Contract to the bidder will result in the lowest ultimate cost to the Department.
    b. **Mathematically Unbalanced**: A bid containing lump sum or unit bid items that do not reflect reasonable actual costs plus a reasonable proportionate share of the bidder's anticipated profit, overhead costs, and other indirect costs.
89. **Unrestricted Traffic**: No traffic control measures in use that obstruct, delay, or in any way impede traffic flow, other than those specifically permitted in the contract.
90. **Utility:** All privately, publicly or cooperatively owned lines, facilities and systems for producing, transmitting or distributing communications, power, heat, gas, oil, water, waste, storm water not connected with the highway drainage, signal systems and other products that directly or indirectly serve the public; the utility company.
91. **Work:** All labor, materials, equipment, documents, and other incidentals necessary to complete the Contract, including all alterations, amendments or extensions made by change order or other written orders of the Engineer.
92. **Working Day:** Any calendar day, except:
    a. Saturdays, Sundays and Holidays.
    b. Days between December 1, and February 29, inclusive.
    c. Days when the Contractor is specifically required by the Contract or letter from the Engineer to suspend operations through no fault of the Contractor.

d. Days when the Engineer determines that inclement weather or adverse conditions interfere with the progress of the work.

1) When the Engineer determines that inclement weather prevents the Contractor from working with at least 75 percent of the normal labor and equipment force engaged in the work for at least 75 percent of the normal working day.

2) When inclement weather stops the Contractor from beginning work at the normal starting hour, and the crew is released as a result, it is not considered a working day even though conditions may improve and the major portion of the day could be considered suitable for operations.

93. **Working Drawings:** See "Plans."

94. **Written Permission of the Engineer**: A letter signed by the Engineer granting specific permission and outlining limitations of the permission.

PART 2 PRODUCTS Not used

PART 3 EXECUTION Not used

END OF SECTION

SECTION 00725

SCOPE OF WORK

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Section 01282: Payment

B. Section 01355: Environmental Protection

C. Section 01741: Final Cleanup

1.2 REFERENCES

A. Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)

1.3 INTENT OF CONTRACT

A. Furnish all resources and incidentals required to complete the specified work.

1.4 PARTNERING

A. Partnering does not change the legal relationship of the parties to the Contract, and does not relieve either party from any of the terms of the Contract.

B. The Department encourages the formation of a strong partnership among the Department, the Contractor, and the Contractor's principal subcontractors. This partnership draws on the strengths of each organization to identify and achieve mutual goals.

C. Both the Department and the Contractor agree to and share equally any costs to accomplish partnering.

D. Workshops may be held periodically as agreed by the Contractor and the Department.

1.5 DIFFERING SITE CONDITIONS, CHANGES AND EXTRA WORK

A. Promptly notify the Engineer in writing of alleged changes to the Contract due to differing site conditions, extra work, altered work beyond the scope of the Contract, or actions taken by the Department that change the Contract terms and conditions. Conditions to report include:
   1. Conditions differing materially from those indicated in the Contract.
   2. Unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent to the work provided for in the Contract.

B. Do not perform further work or incur further contract item expense relating to the claimed change after the date the change allegedly occurred, unless directed otherwise in writing by the Engineer.

C. Immediately notify the Engineer verbally of the alleged change or extra work occasioned by differing site conditions or actions by the Department. Provide the following applicable information to the Engineer in writing within five calendar days of the date the change or action was noted:
   1. The date of occurrence and the nature and circumstances of the occurrence that constitute a change.
   2. Name, title, and activity of each Department representative knowledgeable of the claimed change.
   3. Identity of any documents and the substance of any oral communication involved in the claimed change.
   4. Basis for a claim of accelerated schedule performance, if applicable.
   5. Basis for a claim that the work is not required by the Contract, if applicable.
   6. Failure to provide the required notice constitutes a waiver of any and all claims that may arise as a result of the alleged change. Department does not allow adjustments to the Contract that benefit the Contractor unless the Contractor has provided the required written notice.

D. Particular elements of contract performance for which additional compensation may be sought include:
   1. Pay items that have been or may be affected by the claimed change.
   2. Labor or materials, or both, that are added, deleted or wasted by the claimed change and what equipment is idled or required.
   3. Delay and disruption in the manner and sequence of performance that has been or will be caused.
   4. Adjustments to contract prices, delivery schedules, staging, and contract time estimated due to the claimed change.
   5. Estimate of the time within which the Department must respond to the notice to minimize cost, delay, or disruption of performance.

E. After notifying the Engineer, and in the absence of directions received to the contrary from an authorized representative of the Department, continue diligent prosecution of the work under the Contract to the maximum extent possible under the contract provisions.

F. Within 10 calendar days after receipt of notice, the Engineer responds in writing to the Contractor to:
   1. Confirm that a change occurred and, when necessary, direct the method and manner of further performance, or
   2. Deny that a change occurred and, when necessary, direct the method and manner of further performance, or
   3. Advise the Contractor that information necessary for deciding to confirm or deny the change has not been submitted, and indicate what information is needed for further review and date by which the Contractor should submit it to the Engineer. The Engineer responds to such additional information within 10 calendar days of receipt from the Contractor.
   4. Modify the Contract in writing accordingly.

G. Any adjustments made to the Contract do not include increased compensation or time extensions for delay resulting from the Contractor's failure to provide additional information requested by the Engineer.

1.6 SIGNIFICANT CHANGES IN THE CHARACTER OF WORK

A. The Engineer reserves the right at any time during the work to make written changes in quantities and alterations in the work that are necessary to satisfactorily complete the project.

B. Such changes in quantities and alterations do not invalidate the Contract or release the surety, and the Contractor agrees to perform the work as altered.

C. Department adjusts the Contract, excluding anticipated profits, if the alterations or changes in quantities significantly change the character of the work under the Contract.
   1. Such alterations or changes can be in themselves significant changes to the character of the work, or by their effect, can cause other work to become significantly different in character.
   2. Agree upon the basis for Contract adjustment before beginning work.
   3. If a basis cannot be agreed upon, the Engineer may order the work to proceed under the Force Account provisions of Section 01282.

D. If the alterations or changes in quantities do not significantly change the character of the work to be performed under the Contract, the Department pays for the altered work as provided elsewhere in the Contract.

E. The term "significant change" applies only to the following circumstances:
   1. When the character of the altered work differs materially in kind or nature from that involved or included in the original proposed construction, or
   2. When a major item of work, as defined elsewhere in the Contract, is increased in excess of 125 percent or decreased below 75 percent of the original contract quantity.
      a. Any adjustment for an increase in quantity applies only to that portion in excess of 125 percent of the original contract quantity.
      b. When a major item of work is decreased below 75 percent of the estimated quantity, the Department pays actual costs up to a maximum amount equal to the dollar value of 75 percent of the estimated quantity at the Contract unit price. The Department does not allow for any other compensation resulting from work decreased below 75 percent of the estimated quantity.
   3. When a minor item of work, as defined elsewhere in the Contract, is increased in excess of 150 percent or decreased below 50 percent of the original contract quantity.
      a. Any adjustment for an increase in quantity applies only to that portion in excess of 150 percent of the original contract quantity.
      b. When a minor item of work is decreased below 50 percent of the estimated quantity, the Department pays actual costs up to a maximum amount equal to the dollar value of 50 percent of the estimated quantity at the Contract unit price. The Department does not allow for any other compensation resulting from work decreased below 50 percent of the estimated quantity.
   4. Adjustments may be either for or against the Contractor in such an amount the Engineer may determine to be fair and equitable.

1.7 SUSPENSIONS OF WORK ORDERED BY THE ENGINEER

A. If the Engineer suspends or delays in writing the performance of all or any portion of the work for an unreasonable period of time (not originally anticipated, customary, or inherent to the construction industry), and the Contractor believes that additional compensation or contract time or both are due as a result of such suspension or delay, submit to the Engineer a written request for adjustment within seven calendar days of receipt of the notice to resume work. Explain in the request the reasons and support for such adjustment.

B. Upon receipt of request, the Engineer:
   1. Evaluates the request.
   2. Adjusts (excluding profit) and modifies the Contract in writing accordingly, if the Engineer agrees that:
      a. The suspension increased the cost and/or time required for the performance of the Contract.

b. The suspension was caused by conditions beyond the control of and not the fault of the Contractor, its suppliers, or subcontractors at any approved tier.

c. The suspension was not caused by weather.

C. The Engineer notifies the Contractor of whether or not an adjustment of the Contract is warranted.

D. Department does not allow adjustment to the Contract unless the Contractor has submitted the request for adjustment within seven calendar days of receipt of the notice to resume work.

E. Department does not allow adjustments to the Contract to the extent that performance would have been suspended or delayed by any other cause, or for which an adjustment is provided for or excluded under any other term or condition of this Contract.

1.8 MAINTAINING TRAFFIC

A. Keep roads open to traffic during the work and work suspensions or provide and maintain detour roads as specified or directed.

1. Keep publicly and privately used roadways in a condition that safely and adequately accommodates traffic 24 hours a day and seven days a week.
2. Provide traffic control in compliance with the current edition of the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), the Traffic Control provisions of the Specifications, and the Traffic Control Plans.
3. Maintain the sections of road undergoing improvement.
4. Failure to maintain traffic is cause for the Department to take action to meet the requirements of this specification. Department deducts its costs incurred in such action from money due the Contractor.

B. Snow removal is not required during periods of winter shutdown or when the Department suspends construction operations. The Department does not additionally compensate for maintenance except for specific work directed by the Engineer.

C. Suspensions ordered by the Engineer: The Department maintains temporary roadways and portions of the project during work suspensions.

1. Resume maintenance for the entire project once work proceeds.
2. Replace or restore any work or materials lost or damaged because of temporary use of the project.
3. Remove work or materials used for temporary maintenance, and complete the project as though the work had been continuous and without interference.

4. Department pays for maintenance required for events beyond the Contractor's control during work suspensions at contract prices or as extra work.

D. Other Suspensions of Work: Maintain the roadway at no additional cost to Department to accommodate traffic during suspensions resulting from:
1. Seasonal or climatic conditions.
2. Failure to correct conditions unsafe for the workers or the general public.
3. Failure to carry out orders of the Engineer.
4. Any other reasons caused by the Contractor.

1.9 USE OF ON-SITE MATERIALS

A. Obtain approval before using excavated materials found on the work site that are suitable for completing other bid items of work. The Department pays for the quantity of excavated materials at the Contract unit price for roadway excavation and under the pay item for which the material is used.

B. Replace excavated material used for completing other bid items of work with acceptable material at no additional cost to the Department.
1. Department does not charge for the materials used.
2. Obtain approval before excavating material outside grading limits but within the highway right-of-way.
3. Compact replacement material to the density requirements specified for roadway embankment construction.

C. Structure materials designated for removal may be used temporarily in the work.

1.10 FINAL CLEANUP

A. Clean the highway, project, borrow and local material source sites, and all areas occupied in connection with the work of all rubbish, excess materials, temporary structures, and equipment, etc. before final inspection and acceptance. Refer to Section 01741.

1.11 RESTORATION OF SURFACES OPENED BY PERMIT

A. Allow individuals, firm or corporation with authorized permits to enter the project to construct or reconstruct any utility service.

B. Repair damage caused by the permit holder when directed. Department pays for repair work as extra work, or as provided in the Contract.

1.12 RAILWAY - HIGHWAY PROVISIONS

A. The Department arranges with the railway for new crossings or for existing crossings used during the work.

B. Obtain approval from the railway and pay for the use of crossings not specified in the Contract.

C. Avoid accidents, damage, unnecessary delay, or any interference with the movement of trains, traffic of the railway company, or other property.

D. Department does not reimburse for railroad flagging and inspection.

E. Hold a preconstruction conference and give written notice to the Manager of Industry and Public Projects or equivalent position for the railroad company, when railroads are involved, at least 15 days before beginning any construction work on railroad right-of-way. Coordinate a work schedule based on the actual date both parties can begin work.

F. Give at least 48 hours verbal notice to the Manager of Track Maintenance or equivalent position for the railroad company having responsibility for the area the project is in before beginning work once the work dates have been established.

G. Give written notification to the Superintendent or equivalent position least five days before any cancellation of work, and 15 days before continuing work.

H. Execute a Right-of-Entry Agreement with the railroad company prior to performing any work within the railroad's right-of-way. Send executed copies of this agreement to the Engineer and UDOT's Region Utilities and Railroads Coordinator.

I. Cleanup the right-of-way to the satisfaction of the railroad company. Contractor pays for any cleanup done by the railroad company to the railroad company's right-of-way that should have been done by the Contractor.

J. Railroad company personnel do flagging and inspection when work and/or equipment of the Contractor is within 25 ft of any of the railroad company's tracks.

K. Determine the cost of required railroad flagging and/or inspection and cleanup crew. Include these costs in mobilization.

L. UDOT deducts payment under a construction accounting item for "Railroad Flagging, Inspection and Cleanup," and pays the railroad directly for verified billings. No other compensation to the Contractor for this item is allowed.

M. Refer to project plans for names of railroad companies.

1.13 CONSTRUCTION OVER OR ADJACENT TO NAVIGABLE WATERS

A. Do not interfere with the navigation of waterways when conducting work over, on, or adjacent to navigable waters.

B. Comply with all conditions of the permit from the U.S. Coast Guard or the U.S. Army Corps of Engineers.

1.14 CONTRACTOR'S RESPONSIBILITY FOR WORK

A. Protect the work against injury or damage from all causes whether or not related to performing the work until written acceptance of the project is given.

B. Pay to rebuild, repair, restore, and make good all losses, injuries, or damages to any portion of the work, under the control of the Contractor at no cost to the Department before receiving final acceptance.

C. Pay to rebuild, repair, restore, and make good all losses, injuries, or damages to any portion of the work, not under the control of the Contractor, under agreed unit prices or as extra work under Section 01282.
   1. Items not under the Contractor's control include, but are not limited to, acts of God or other cataclysmic phenomena of nature, acts of the public enemy, or acts of governmental authorities, damage caused by third party errant vehicles, and vandalism.

D. When work is suspended for any cause:
   1. Protect the project from damage.
   2. Provide for normal drainage.
   3. Erect any necessary temporary structures, signs, or other facilities.
   4. Maintain all newly established plantings, seeding, and sodding and protect new tree growth and other designated vegetative growth in acceptable condition.

1.15 ENVIRONMENTAL PROTECTION

A. Refer to Section 01355.

1.16 VALUE ENGINEERING - CONTRACTOR PROPOSALS

A. Savings resulting from a Value Engineering Change Proposal (VECP) offered by the Contractor and approved by the Department is shared equally.

B. Base contract bid prices on specified work rather than on VECPs that are subject to Department approval. If a VECP is rejected, complete the Contract as bid.

C. The Department considers proposals that may potentially result in savings without damaging essential functions and characteristics of the facility, including but not limited to service life, economy of operation, ease of maintenance, desired ability, safety, and approximate estimated savings.

1.17 VALUE ENGINEERING - SUBMITTING PROPOSALS

A. Submit the following materials and information with each proposal:
   1. A statement that the submission is a VECP.
   2. A description of the existing work and the proposed changes for performing the work. Discuss the comparative advantages and disadvantages of each.
   3. A complete set of plans and specifications showing proposed revisions to the original Contract.
   4. A detailed cost estimate for performing the work under the existing Contract and under the proposed change.
   5. A time frame within which the Department must make a decision.
   6. A statement of the probable effect the proposal would have on the contract completion time.
   7. A description of any previous use or tests of the proposal, the conditions, and the result and the dates, project numbers, and the Department's action on the proposal if previously submitted.

B. The Department determines and notifies the Contractor within five working days that there is insufficient review time for a response.

C. The Department evaluates the need for a non-compensable delay adjustment to the Contract based on additional review time necessary and its effect on the Contractor's schedule.

D. The Contractor has no claim against the Department for compensable or noncompensable delay resulting from the failure to respond within the time indicated in this article when additional information is necessary to complete the review.

1.18 VALUE ENGINEERING - CONDITIONS FOR PROPOSALS

A. The Department only considers VECPs that meet the following conditions:
   1. Value Engineering proposals, regardless of their approval by the Department, apply only to the current proposal and become property of the Department.
      a. Submit proposals without restrictions on use or disclosure.
      b. The Department may duplicate or disclose any data necessary to use the proposal.
      c. The Department can apply a proposal for general use on other Contracts it administers.
      d. The purpose of this provision is to ensure legal right with respect to patented materials or processes.

B. Use only proven features that have been employed under similar conditions or projects acceptable to the Department.

C. The Department decides whether or not to accept a proposal. Basis for proposal rejection include requirements for excessive review, evaluation, and/or investigation, or inconsistency with project design policies or criteria.

D. The Department rejects proposals that:
   1. Provide equivalent options to those already in the Contract.
   2. Reduce overall pavement structural value.

E. VECPs related to pavement section changes must include the following:
   1. A pavement design for each pavement section in the proposal, performed according to the UDOT Pavement Management and Pavement Design Guide.
   2. A life-cycle cost analysis that identifies the benefits, overall cost savings, or increase in quality to the Department, based on the new pavement section.
   3. Documentation from an AASHTO accredited lab regarding the determination of structural properties of any materials not currently identified within the contract.

F. The Department may reject proposals that:
   1. Contain revisions the Department is already considering or has approved for the Contract.
   2. Do not generate sufficient savings.
   3. Do not provide additional information as requested by the Department including requests for field investigation results and surveys, design computations, and field change sheet for proposed design changes.

G. If the proposal is rejected, the Contractor has no claim to additional costs or delays, including development costs, loss of anticipated profits, or increased material or labor costs.

H. The Engineer can reject all unsatisfactory work resulting from an approved proposal.
   1. Remove rejected work and reconstruct under the original contract provisions at no additional cost to Department.
   2. Reimbursement for modifications to the proposal to adjust field or other conditions is limited to the total amount of the contract bid prices.
   3. Rejection or limitation of reimbursement is not basis for any claim against the Department.

I. The Department does not consider savings generated by contingency items when it is reduced as part of a VECP, unless it can be tied to a reduction in contract time.

1.19 VALUE ENGINEERING - PAYMENT

A. The Department pays by change order for Value Engineering proposals accepted in whole or in part. Department pays as follows:
   1. The Contract incorporates changes in quantities of unit bid items, and/or new agreed price items, as appropriate.
   2. Department pays directly for cost of the revised work. The Department pays the Contractor 50 percent of the savings reflected by the difference between cost of revised work and the original bid price.
   3. Department does not reimburse costs to develop, design, and implement the proposal.
   4. Only a Contractor may submit proposals and be reimbursed for savings. The Contractor can submit proposals for an approved subcontractor.

PART 2 PRODUCTS **Not used**

PART 3 EXECUTION **Not used**

END OF SECTION

SECTION 00727

CONTROL OF WORK

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Section 00555: Prosecution and Progress

B. Section 00725: Scope of Work

C. Section 01282: Payment

D. Section 01721: Survey

1.2 REFERENCES

A. Utah Regulations for Legal & Permitted Vehicles

1.3 AUTHORITY AND DUTIES OF THE ENGINEER

A. The Engineer decides all questions regarding the quality and acceptability of materials furnished, work performed, rate of work progress, interpretation of the Contract Documents, and the acceptable fulfillment of the Contract.

B. The Engineer has the authority by written order to suspend the work without liability to the Department wholly or in part if the Contractor fails to:
   1. Correct conditions unsafe for the project personnel or the public, or
   2. Complete contract provisions, or
   3. Comply with the Engineer's orders.

C. The Engineer can suspend work wholly or partially for:
   1. Periods of unsuitable weather, or
   2. Conditions unsuitable for the prosecution of the work, or
   3. Any other condition or reason determined to be in the Department's interest.

1.4 PLANS AND WORKING DRAWINGS

A. Keep one full set of plans and specifications on the project site at all times.

B. Furnish to the Department structure plans with working drawings that detail required work not included in the Contract Plans.

C. Include the cost of furnishing all working drawings in the related Contract Bid Items.

1.5 CONFORMITY WITH PLANS AND SPECIFICATIONS

A. Perform work and furnish materials to meet Contract requirements.

B. If the Contract provides for acceptance of a Contract item not complying fully with the minimum requirements, the Department uses the specified pay adjustment factors for payment.

C. When a Contract item fails to meet Contract requirements but is adequate to serve the design purpose, the Engineer decides the extent to which the work will be accepted and remain in place. The Engineer documents the basis of acceptance by change order and adjusts the Contract unit price.

D. Remove, replace, or correct work at no cost to the Department when a Contract item does not meet specified requirements and results in work inadequate to serve the design purpose.

1.6 COORDINATING PLANS, STANDARD SPECIFICATIONS, AND SPECIAL PROVISIONS

A. All supplementary documents are essential parts of the Contract and a requirement occurring in one is binding as though occurring in all. Supplementary documents are complementary and provide and describe the complete Contract.

B. If there is a discrepancy, the governing ranking is:

Dimensions		**Information**	
1.	Plan	1.	Special Provisions
2.	Calculated	2.	Plans
3.	Scaled	3.	Supplemental Specifications
		4.	Measurement and Payment
		5.	Standard Specifications
		6.	Standard Plans

C. Do not take advantage of any apparent error or omission in the Contract.

D. Notify the Engineer promptly of any omissions or errors in the Contract so that necessary corrections and interpretations can be made.

1.7 CONTRACTOR COOPERATION

A. Facilitate progress of the work, and cooperate with Department inspectors and other contractors.

B. Employ a competent superintendent experienced with the work being performed and capable of reading and understanding the Contract Documents.

C. The superintendent must be:
   1. Present at the project site at all times.
   2. Available to execute instructions and directions from the Engineer or authorized representatives.
   3. Authorized to act as agent for the Contractor on the work.

D. Supply all necessary resources to complete the Contract regardless of the amount of work sublet.

1.8 COOPERATION WITH UTILITIES

A. Relocate or adjust utilities when specified.
   1. Use work procedures that consider the potential of inaccurate or inexact utility locations provided by utility owners, especially for underground installations.
   2. Cooperate with the utility owners to remove and rearrange underground or overhead utilities to avoid service interruption or duplicate work by the utility owner.

B. Cooperate with the utility owners to adjust utility fixtures and appurtenances shown in the Contract plans.

C. Use work procedures that protect utilities or appurtenances that remain in place during construction.

D. The Department notifies utility companies, pipeline owners, or other utility agencies affected by the work to verify that all utility adjustments, within or adjacent to the construction limits, are made as soon as possible.

E. Notify the appropriate utility authorities of any service interruption resulting from breakage within the construction limits.

1. Cooperate with authorities until service is restored.
2. Work around fire hydrants only after obtaining approval by the local fire authority and then only after making provisions for continued service.

F. Repair damages to utilities that result from carelessness or omission. Restore damaged facilities to the preexisting condition at no additional cost to the Department.

G. When directed by Engineer, adjust or relocate utility facilities or appurtenances found but not noted in Contract Documents.

1.9 COOPERATION BETWEEN CONTRACTORS

A. The Department reserves the right to contract for and perform other or additional work on or near the work covered by the Contract.

B. Cooperate with other contractors working within the project limits. Conduct work without interrupting or inhibiting the progress or completion of work by other contractors.

C. Each contractor involved accepts all liability, financial or otherwise, in connection with the Contract.

D. Each contractor protects and saves harmless the Department from any damages or claims caused by inconvenience, delay, or loss from the presence and work of other contractors working within the same project limits.

E. Coordinate and sequence the work with other contractors. Arrange, place, and dispose of materials without interfering with the operations of other contractors on the same project.

1.10 DEPARTMENT-PROVIDED CONTROL POINTS AND ELEVATION BENCH MARKS

A. The Department provides control points and elevation benchmarks.

B. Department deducts the cost of replacing disturbed control points and elevation benchmarks from contract payment.

1.11 CONSTRUCTION SURVEY

A. Perform the Construction Surveying necessary to properly control the entire work. Refer to Section 01721.

1.12 DUTIES OF INSPECTOR

A. Department Inspectors are authorized to inspect all work and materials furnished.
   1. Inspection may extend to the preparation, fabrication, or manufacture of the materials to be used.
   2. Do not alter or waive the contract provisions, issue instructions contrary to the Contract, or act as foreman for the Contractor.
   3. Reject work or materials until any issue in question can be referred to and decided by the Engineer.

1.13 INSPECTION OF WORK

A. Provide information, assistance, and safe access to the Engineer for all parts of the work to obtain a complete and detailed inspection.

B. Remove and replace work performed or materials used without inspection by an authorized Department representative at Contractor expense, if ordered by the Engineer. **Exception:** If the Department representative fails to inspect the work after receiving written notice 24 hours in advance of beginning work.

C. Remove and uncover portions of finished work, as directed. Once inspected, restore work to Contract requirements.
   1. If the uncovered work is found acceptable, the Department pays for the additional cost to uncover, remove, and replace or make good the parts removed as extra work.
   2. If the work is found unacceptable, the Department does not pay for additional costs to uncover, remove, and replace the covering, or make good the parts removed.

D. When a government agency, utility or railroad company is to accept or pay a portion of the Contract cost, that organization's representatives may inspect the work. The right to inspect does not make that entity a party to the Contract and does not interfere with the rights of parties to the Contract.

1.14 REMOVAL OF UNACCEPTABLE AND UNAUTHORIZED WORK

A. Remove and replace any unacceptable work before final acceptance.
   1. Work is considered unacceptable if it fails to meet the Contract requirements, unless accepted under this Section

B. Work performed contrary to Engineer's instructions, work beyond plan limits, or extra work performed without the Engineer's permission is excluded from pay consideration and may be ordered removed, restored, or replaced at the Contractor's expense.

1.15 LOAD RESTRICTIONS

A. Observe legal load restrictions when hauling equipment or materials on public roads beyond project limits.
   1. A special permit does not decrease Contractor liability for damage.
   2. Refer to the "Utah Regulations for Legal & Permitted Vehicles."

B. Do not apply weight restrictions to equipment or materials hauled over subgrade.

C. Do not exceed legal gross weight limits on any public roads, structures, or on any component of the pavement structure excluding granular borrow.

D. Suspend construction operations when load restriction violations are observed until the Engineer approves acceptable corrective measures.

E. When public roads are used to haul any type of excavation, borrow, backfill, base, or surfacing material, the Engineer contacts the appropriate law enforcement agency, if excess load violations are suspected.

F. For materials imported to the job site (i.e. Asphalt, Cement, Concrete, Steel, etc.):
   1. Provide the Engineer with invoices showing the gross load weights.
   2. Department withholds payment for material used in the project if invoices are not provided.
   3. The Engineer notifies the appropriate enforcement agency if it is suspected that legal gross load limits are exceeded.

1.16 MAINTAINING THE WORK DURING CONSTRUCTION

A. Maintain the work during construction in a satisfactory condition until the project is accepted.
   1. Maintain traffic detour routes and project travel ways in accordance with the Traffic Control Plan.

B. The Engineer immediately notifies the Contractor of failure to meet these provisions.
   1. The Engineer maintains the project if unsatisfactory maintenance is not remedied within 24 hours after receiving notice.
   2. The Department deducts the entire cost for the Engineer to maintain the work from the monies due or to become due the Contractor.

C. Include in the bid unit prices the cost of maintaining work during construction until final acceptance.

1.17 OPENING SECTIONS OF PROJECT TO TRAFFIC

A. The Engineer may order certain sections of work opened to traffic before completion or acceptance of the work.

B. Opening sections of work does not constitute acceptance of the work or a waiver of any contract provisions.

C. Maintain any section of roadway opened to traffic by order of the Engineer.
   1. When the ordered opening to traffic is not the result of Contractor fault or inactivity, Contractor is paid in accordance with Section 01282.
   2. The Department prepares a change order when the opening is not provided for in the Contract. Department does not compensate the Contractor if the order to open is the result of Contractor fault or inactivity.

D. Engineer gives written notice establishing a time period for completing features of the work for which the Contractor is late.
   1. Engineer may order all or a portion of the project opened to traffic if the Contractor fails to complete or make a reasonable effort to complete the late work.
   2. Assume liability and responsibility for maintaining the work and conduct the remaining construction operation with minimum interference to traffic without additional compensation.

E. Repair damage to the project that is not attributable to traffic (except landslides) at no additional cost to Department.

1.18 FURNISHING RIGHT-OF-WAY

A. The Department secures all necessary rights-of-way in advance of construction, except as provided in the Contract.

1.19 PROJECT ACCEPTANCE

A. Partial Acceptance
   1. May request final inspection of a unit when:
      a. A unit or portion of the project is substantially complete.
      b. The unit or portion is considered or determined necessary for the convenience of traffic such as a structure, an interchange, section of road, intersection, substation, or portion of highway lighting or traffic signal systems.

2. If the unit has been completed according to the Contract, the Engineer may make written acceptance of that unit as complete and relieve the Contractor of further responsibility for that unit.

B. Final Acceptance

The Engineer conducts an inspection upon receiving notice from the Contractor of project Substantial Completion. The Engineer identifies any necessary corrective work and work necessary to achieve physical completion of the project. If the Contract is found to be substantially complete, the Engineer notifies the Contractor in writing.

1. Immediately comply with and execute instructions given by the Engineer if the inspection discloses any unsatisfactory work.
2. Execute all work necessary to achieve Physical Completion in accordance with Section 00555.
3. Upon correction of work and upon receipt of notification from the Contractor the project is Physically Complete, the Engineer conducts another inspection that constitutes the final inspection.
4. If the project has been satisfactorily completed and determined to be Physically Complete, the Engineer notifies the Contractor in writing of the date of final inspection and acceptance.

1.20 PROCEDURES FOR RESOLUTION OF DISPUTES

A. Notify Department verbally and in writing of the dispute in accordance with Section 00725 before beginning or continuing the affected work, if additional compensation is considered due for work or material not covered in the Contract.

B. The Engineer responds as described under Section 00725 following notification, indicates whether or not a change has occurred, and provides further information concerning the method and manner of further performance of the work.

C. Provide cooperation and information to the Engineer during the period of notification review and evaluation.

D. Department does not grant additional compensation if verbal and or written notification is not given, or if the Engineer is not given proper facilities for keeping strict account of actual costs.

1. Department does not construe notice by the Contractor, and the Engineer's accounting of costs as substantiating the validity of the claim.
2. Department equitably adjusts the Contract if the dispute is found to have merit.

1.21 PROCEDURES FOR RESOLUTION OF CLAIMS

A. Disputes that are not resolved are escalated to the claims procedure.
   1. Provide written notification of the intent to make a claim.
   2. Submit the formal claim in writing and with sufficient detail to enable the Engineer to ascertain the basis and amount of the claim.

B. As a minimum, include the following information with each claim submitted:
   1. A detailed factual statement of the claim for additional compensation and time, providing all necessary dates, locations, and items of work affected by the claim.
   2. The date actions resulting in the claim occurred or conditions resulting in the claim became evident.
   3. The name, title, and activity of each Department employee knowledgeable about facts that gave rise to the claim.
   4. The name, title, and activity of each Contractor employee knowledgeable about facts that gave rise to the claim.
   5. The specific provisions of the Contract that support the claim and a statement of the reasons why such provisions support the claim.
   6. All detailed facts that support positions related to a decision that the Contract leaves to the Engineer's discretion or provides that the Engineer's decision is final.
   7. Identity of pertinent documents, and the substance of any material verbal communications relating to the claim.
   8. A statement whether the additional compensation or extension of time is based on alleged breach of Contract.
   9. Copies of any identified documents, other than Department documents and documents previously furnished to the Department that support the claim (manuals that are standard to the industry may be included by reference).
   10. For an extension of time include:
      a. The specific days for which a time extension is requested.
      b. The specific reasons a time extension should be granted.
      c. The specific provisions under which a time extension is requested.
   11. The exact amount of compensation requested and a breakdown of the cost into the following categories:
      a. Direct labor.
      b. Direct materials.
      c. Direct equipment. Do not exceed actual cost on rates claimed for each piece of equipment. In the absence of actual equipment cost, the rates for the equipment, when in use, cannot exceed the rates established by Section 01282.
      d. Job overhead.
      e. Overhead (general and administrative).

f. Subcontractor's claims (in the same level of detail as specified in Contract documents is required for any subcontractor's claims).

12. Certification: Submit a statement to the Engineer containing the following language:

Under the penalty of law for perjury or falsification, the undersigned,

_____	_____	_____
Name	Title	Company

hereby certifies that the claim for extra compensation and time, if any, made herein for work on this Contract is a true statement of the actual costs incurred and time sought, and is fully documented and supported under the Contract between the parties.

Dated _____/s/_____
Subscribed and sworn before me this _____day of _____
Notary Public _____
My Commission Expires _____

C. Failure to submit information and details as described in this Section for any claim constitutes a waiver of the claims.

1.22 RECORD KEEPING FOR RESOLUTION OF CLAIMS

A. Maintain full and complete records of all costs and additional time incurred for any alleged claim.

B. Permit the Engineer access to those records and any other records as required to determine the facts or contentions involved in the claim.

C. Retain all records for a period of not less than three years after final acceptance.

1.23 AUDITING OF CLAIMS

A. All claims filed against the Department are subject to audit at any time following the filing of the claim.

B. Employees of the Department or an auditor under contract with the Department may conduct the audit. The audit may begin at any time during the life of the Contract, or 20 calendar days after notice is provided to the Contractor, the subcontractors, or the Contractor's agents if more than 60 calendar days after the final acceptance date of the Contract have elapsed.

C. Provide adequate facilities acceptable to the Engineer for the audit during normal business hours. Cooperate with the auditors.

D. Failure of the Contractor, subcontractors, or agents to maintain and retain sufficient records to allow the auditors to verify all or a portion of the claim or to permit the auditor access to the books and records of the Contractor, subcontractors, or agents constitutes a waiver of the claim and bars any recovery.

E. As a minimum, make the following documents available to auditors:

1. Daily time sheets and supervisor's daily reports
2. Union agreements
3. Insurance, welfare, and benefits records
4. Payroll registers
5. Earnings records
6 Payroll tax forms
7. Material invoices and requisitions
8. Material cost distribution work sheet
9. Equipment records (list of company equipment, rates, etc.)
10. Vendors', rental agencies', subcontractors', and agents' invoices
11. Subcontractors' and agents' payment certificates
12. Canceled checks (payroll and vendors)
13. Job cost report
14. Job payroll ledger
15. General ledger
16. Cash disbursements journal
17. All documents that relate to each and every claim together with all documents that support the amount of damages as to each claim
18. Work sheets used to prepare the claim establishing the cost components for items of the claim including but not limited to labor, benefits and insurance, materials, equipment, subcontractors, all documents that establish the time periods, individuals involved, the hours for the individuals, and the rates for the individuals.

F. Full compliance with the provisions of this article is a contractual condition precedent to the right to seek judicial relief.

1.24 HIGHER LEVEL REVIEW FOR RESOLUTION OF CLAIMS

A. Submit all claims for higher-level review to the Engineer in writing within 10 calendar days of the Engineer's denial of a claim.

B. Failure to submit a request within this 10-day time frame is considered acceptance of the Engineer's denial action.

1.25 CLAIMS BOARD OF REVIEW

A. Pursue administrative resolution of any claim with the Engineer or the designee of the Engineer.

B. If no agreement is reached, at the Contractor's written request to the Engineer, the Engineer for Construction and Materials schedules a hearing before a Department "Claims Board of Review" when deemed to be in the best interest of both the Contractor and the Department.

C. The Board makes recommendations and outlines their reasoning to the UDOT Deputy Director within 30 calendar days after the claim hearing.

D. The UDOT Deputy Director makes offer of settlement within 45 calendar days after the claim hearing.

E. The decision of the UDOT Deputy Director is administratively final.

PART 2 PRODUCTS Not used

PART 3 EXECUTION Not used

END OF SECTION

SECTION 00820

LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Section 00570: Definitions

B. Section 01355: Environmental Protection

1.2 REFERENCES

A. OSHA Safety and Health Regulations for Construction

B. UDOT Construction Safety and Health Manual

C. U. S. Code of Federal Regulations

1.3 GENERAL LEGAL COMPLIANCE

A. Observe and comply with:
   1. Federal and State Laws
   2. Local laws and ordinances
   3. Regulations, orders and decrees of bodies or tribunals having jurisdiction or authority
   4. UDOT Construction Safety and Health Manual

B. Protect and indemnify the Department and its representatives against claim or liability arising from the violation of any of the above listed items, whether violated by the following companies or their employees:
   1. The Contractor
   2. Subcontractor(s) at any tier
   3. Suppliers of materials or services
   4. Any others engaged by the Contractor

C. Immediately notify the Engineer in writing upon discovering any discrepancy or inconsistency between the Contract and any law, ordinance, regulation, or order, except as noted in article 1.9.

1.4 SANITARY, HEALTH, AND SAFETY

A. Observe the rules and regulations of Federal, State, UDOT Construction Safety and Health Manual, and local health officials.

B. Do not require employees of the Contractor or subcontractor(s) to work in surroundings, or under conditions that are unsanitary, hazardous, or dangerous to health or safety.

C. Allow access to all areas of work on the project and admit any inspector of the OSHA or other legally responsible agency involved in safety and health administration without delay and without presentation of an inspection warrant to all areas of the work and project site upon presentation of proper credentials.

D. Immediately correct any conditions that do not comply with the foregoing provisions.

1. The Engineer issues a stop work order when either site conditions and/or work practices present an imminent danger (i.e. may result in serious injury, death, or extensive property damage) until those conditions and/or practices are corrected.

   a. A stop work order does not provide relief from completing the project within the specified contract completion time.

1.5 EXPLOSIVES

A. Comply with all laws and ordinances as well as Code of Federal Regulations Title 29, Part 1926 - Safety and Health Regulations for Construction (OSHA) and Title 30 and the UDOT Construction Safety Manual, whichever is the most restrictive, in the use, handling, loading, transportation, and storage of explosives and blasting agents.

B. Do not endanger life, property, or work with the use of explosives.

C. Accept liability for property damage, injury, or death resulting from the use of explosives.

D. Notify property owners and public utility companies in the vicinity of the proposed detonation before using any explosives.

1.6 CIVIL RIGHTS

A. Comply with Federal, State and local laws, rules, and regulations that enumerate unlawful employment practices including discrimination because of race, religion, color, sex, age, disability, or national origin, and that define actions required for Affirmative Action and Minority/Disadvantaged Business programs.

1.7 FORESTS

A. Perform work within or adjacent to State or National Forest under regulations of the State Fire Marshal, Conservation Commission, Forestry Department, or other authority having jurisdiction governing the protection of forests.

B. Keep the project site orderly and clean.

C. Obtain all required permits.

D. Prevent and assist with the suppression of forest fires.

E. Cooperate with responsible forestry officials.

1.8 PERMITS, LICENSES, AND TAXES

A. Acquire all permits and licenses; pay applicable charges, fees, and taxes; and give all notices necessary to perform the work.

B. Include these costs in the appropriate unit prices bid for the Contract items.

1.9 PATENTED DEVICES, MATERIALS, AND PROCESSES

A. Provide proof of legal agreement with the patentee or owner, if necessary, for use of any of the following:
   1. Design(s)
   2. Devised(s)
   3. Material(s)
   4. Process(es)
   5. Trademark(s)
   6. Copyright(s)

B. Indemnify and hold harmless the Department and any affected third party or political subdivision from claims of infringement that result from use of any patented or copyright item listed above.

C. Indemnify the Department for costs, expenses, and damage obligated for payment resulting from infringement during the conduct of the work or after the project is completed.

1.10 FEDERAL AID PARTICIPATION

A. Federal requirements of a federally assisted Contract supersede conflicting provisions of laws, rules, or regulations.

B. The Department supervises all work but appropriate Federal officials inspect and approve the work when there is Federal participation in the Contract. The U.S. Government, however, is not a party to the Contract and will not interfere with the rights of Contract parties.

1.11 PUBLIC CONVENIENCE AND SAFETY - TRAFFIC AND PEDESTRIANS

A. Perform work with minimal obstruction to traffic.

B. Follow the safety provisions of all applicable laws, rules, codes, and regulations to ensure the safety and convenience of the public and property.

C. Provide, erect, and maintain all traffic control devices such as barriers, barricades, and warning signs to protect the work and the public safety.
   1. Use barriers and barricades to delineate highway sections closed to traffic.
   2. Illuminate obstructions during darkness and provide warning signs to control and direct traffic.

D. Erect warning signs before work that may interfere with traffic or where work crosses or coincides with an existing road.
   1. Place and maintain warning signs according to the project traffic control plan.
   2. Obtain approval before dismantling or removing traffic control devices.

E. For Pedestrians:
   1. Place and maintain warning signs under project traffic control plan.
   2. Provide pedestrian access in areas where construction interferes with existing pedestrian access.

1.12 PROTECTION AND RESTORATION - PROPERTY AND LANDSCAPE

A. Preserve public and private property during the work.

B. Engineer verifies reference to the location of monuments and property line markers before they are moved, disturbed, or damaged.
   1. Obtain written approval from the Engineer before moving or disturbing any monuments or markers.

C. Accept liability for any damage to public or private property resulting from defective work, materials, or non-execution of the Contract.

D. Maintain liability until the project is accepted.

E. Restore damaged property to a condition similar or equal to that existing before the damage at no additional cost to the Contract.

F. Temporarily discontinue work if remains of prehistoric dwelling sites or artifacts of historical or archeological significance are encountered. Refer to Section 01355.

1.13 PERSONAL LIABILITY OF DEPARTMENT EMPLOYEES

A. The Department's authorized representatives act solely as agents and representatives of the Department when carrying out the provisions of or exercising the power or authority granted to them under the Contract.

B. They are not liable either personally or as employees of the Department for actions in their ordinary course of employment.

1.14 NO WAIVER OF LEGAL RIGHTS UPON COMPLETION

A. Upon completion of the Contract, the Department makes final inspection and notifies the Contractor of acceptance.
   1. Final acceptance does not prevent the Department from correcting any measurement, estimate, or certificate made before or after completion of the work.
   2. The Department is not prevented from recovering from the Contractor or Surety or both, overpayment sustained for failure of the Contractor to fulfill the obligations under the Contract.
   3. A waiver from the Department for any breach of any part of the Contract is not held as a waiver of any other or subsequent breach.

B. Assume liability to the Department for latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards to the Department's rights under any warranty or guaranty without prejudice to the terms of the Contract.

1.15 RESPONSIBILITY FOR DAMAGE CLAIMS

A. Protect, indemnify, and hold the State of Utah, UDOT, and their officers, agents, and employees (State) harmless from and against all claims, demands, damages, and causes of action of every kind or character on account of bodily injuries, death, or damage to property arising out of, resulting from, or in any way connected with, the performance of the Contract.

B. Defend all suits brought upon such claims and pay all costs and expenses incidental to them. The Department has the right, at its option, to participate in the defense of any such suit without relieving the Contractor of any obligation under the Contract.

C. Provide insurance as defined in article 1.16 below from reliable insurance companies authorized to do business in Utah, rated "A" or better and with a financial size category of Class VII or larger by A.M. Best Company, at the time of contract execution.

D. Comply with the following insurance claims notification and processing procedures:
   1. Notify the Engineer of all claims within seven days of notification.
   2. Prior to the final acceptance of the project provide written notification for all pending claims to the Engineer.
   3. Notify claimants of denied or partially denied claims of $5,000.00 or less of their right to request re-examination by the
      UDOT Claims Re-Examination Board
      4501 South 2700 West
      West Valley City, UT 84114-8430
      phone (801) 964-4556.
      a. The information provided to the claimant includes:
         1) A time deadline for requesting re-examination equal to seven days after notification of denial or partial denial
         2) Address and name of the person to whom it should be directed
         3) General information helpful in making a determination
   4. The Board can waive the time deadline.

E. Cooperate with the UDOT Claims Re-examination Board in resolving disputes regarding denials or partial denials from an insurance carrier.
   1. Provide any information possessed by the carrier that the Board believes is pertinent to the determination.
   2. The Board may refer to an insurance carrier's decision and the reason for it.

3. The determination is based on general applicable standards of insurance adjusting.
4. The Board does not grant in-person hearings, but relies on documentation prepared by the Contractor, the insurance carrier, the claimant, and the Department.
5. Neither the insurance carrier nor the Contractor has the right to intervene in a re-examination before the Board.
6. The board decides the claim as expeditiously as possible.
7. The decision by the UDOT Claims Re-examination Board is administratively final.

F. The Department deducts from the Contractor's pay estimate claims that the Contractor's liability insurance carrier denied but are directed to be paid by the UDOT Claims Re-Examination Board.

1.16 INSURANCE REQUIREMENTS

A. Workers' Compensation Insurance
1. Provide Workers' Compensation Insurance to cover full liability. As a minimum, comply with the statutory limits defined by the State of Utah.

B. General Liability Insurance
1. Provide General Liability insurance with the following minimum limits of liability:
a. $1,000,000 Bodily Injury and Property Damage – Each Accident
b. $2,000,000 General Aggregate
c. $2,000,000 Products and Complete Operations Annual Aggregate

C. Excess General Liability Insurance
1. Provide Excess Liability Insurance with the following minimum limits:
a. $5,000,000 Each Claim
b. $5,000,000 Aggregate

D. Contractors' Pollution Liability Insurance
1. Provide Contractors' Pollution Liability Insurance to cover pollution releases during construction with the following minimum limits:
a. $5,000,000 Each Claim/Each Occurrence
b. $5,000,000 Aggregate

E. Builders' Risk Insurance
1. Provide Builders' Risk Insurance to protect against physical loss to the Work or any part thereof with the following minimum limits:
a. $5,000,000 Project Limit per Occurrence

F. Railroad Protective Insurance
   1. Provide Railroad Protective Insurance with the following minimum limits:
      a. $5,000,000 Each Occurrence
      b. $10,000,000 Aggregate

G. Automobile Liability Insurance
   1. Provide Automobile Liability Insurance for claims arising from the ownership, maintenance, or use of motor vehicles involved in project work with the following minimum limits:
      a. $1,000,000 Combined single Limit Bodily Injury and Property Damage per Occurrence

H. Professional Errors and Omission Liability Insurance
   1. Provide Professional Errors and Omissions Liability Insurance to cover the negligent acts, errors, and omissions of the insured that provides professional services from the project.
   2. Provide this insurance with the following minimum limits:
      a. $1,000,000 Each Claim
      b. $2,000,000 Aggregate

I. Aircraft Liability Insurance
   1. Provide Aircraft Liability Insurance for aircraft used in connection with the project. Minimum coverage should not be less than:
      a. $1,000,000 Each Claim
      b. $2,000,000 Aggregate

J. Provide the following for all required liability insurance policies:
   1. Where and when applicable, name as insured, only in respect to work to be performed under this Contract, the State of Utah and all institutions, agencies, departments, authorities, and instrumentalities, and while acting within the scope of their duties, all volunteers as well as members of governing bodies, boards, commissions, and advisory committees.
   2. Coverage for the above insured is primary and not contributing.
   3. Incorporate into the insurance policy this statement: "Insurance coverage is extended to include claims reported up to one year beyond the date of substantial completion of this Contract."

K. Contractor and all subcontractors provide UDOT with certificates of insurance showing that they are covered as required above prior to entering the project site or beginning project work. The certificates will also state that the policies required are endorsed to give UDOT (the Engineer) not less than 30 days prior notice in the event of cancellation or change in coverage.

L. Regardless of the Contractor insurance requirements required in this section, insolvency, bankruptcy, or failure of any insurance company to pay all claims accrued does not relieve Contractor of any obligations.

M. Endorse all policies to include waivers of subrogation in favor of UDOT.

1.17 SITE OF WORK

A. Refer to definition in Section 00570.

1.18 HAULING BY TRUCK - GENERAL

A. When additional trucks are needed for hauling on site only, on a Federal or State funded project, a subcontract must be in the project office before the additional trucks begin work on the project site. Hauling to the project site or away from the project site does not require a subcontract approved by the UDOT engineer.

B. When using additional trucks to fulfill the DBE goal for that project a subcontract approved by the UDOT engineer is always required.

1.19 HAULING BY TRUCK - COMPLIANCE WITH STATE REGULATIONS

A. Comply with all State regulations regarding hauling by truck.

B. Comply with all Federal and State regulations regarding hauling for Federal funded projects, including wages and hours.

1.20 AIR QUALITY PROTECTION

A. Refer to Section 01355.

B. Contact the Utah Division of Air Quality (DAQ) and obtain the appropriate Air Quality Permit for the project. Permit application forms can be obtained from DAQ's web site. Refer to http://www.udot.utah.gov/index.php/m=c/tid=719.
Utah Division of Air Quality
150 North 1950 West
PO Box 144820
Salt Lake City, UT 84114-4810
Phone: (801) 536-4000
Fax: (801) 536-4099

C. The Contractor is not allowed to proceed with work affecting air quality without an Air Quality Approval Order or Notice of Intent to Approve letter or a Temporary Approval Order for the project, process, or equipment to be used.

PART 2 PRODUCTS Not used

PART 3 EXECUTION Not used

END OF SECTION

SECTION 01280

MEASUREMENT

PART 1 GENERAL

1.1 REFERENCES

A. ASTM D 633: Standard Volume Correction Table For Road Tar

B. ASTM D 1250: Standard Guide for Petroleum Measurement Tables

1.2 DEFINITIONS

A. Station: 100 ft.

B. Ton: 2,000 pounds avoirdupois.

1.3 GENERAL MEASUREMENT OF QUANTITIES

A. All work completed under the Contract is measured in U. S. Standard measure.

B. The methods of measurement and computations for determining quantities of material furnished and of work performed under the Contract are methods generally recognized as conforming to good engineering practice.

C. When the plan quantities for a specific portion of the work are designated to be the pay quantities for the Contract:
   1. They are the final quantities for which payment for such specific portion of the work will be made, unless the Engineer revises the plan dimensions.
   2. If revised dimensions result in an increase or decrease in the quantities of work, Department will revise the final quantities for payment in the amount represented by the authorized changes in the dimensions.

D. Measurements for area computations:
   1. Longitudinal measurements: made horizontally.
   2. Transverse measurements: the neat dimensions shown on the plans.

E. Computing volumes of excavation: Average end area method, or computer generated Digital Terrain Model (DTM) method, unless the Engineer and Contractor agree in writing to an alternate method.

F. Measure complete structure or structural unit, signal or lighting system, ("lump sum" work) unit to include all necessary fittings and accessories.

G. Structures: Neat lines shown on the plans or as altered to fit field conditions.

H. Standard manufactured items (fence, wire, plates, rolled shapes, pipe conduit, etc.), are identified by gauge, unit, weight, section dimensions, etc.
   1. Identification will be nominal weights or dimensions.
   2. Use industry manufacturing tolerances, unless more stringently controlled by specifications.

I. Items measured by the foot, (pipe culverts, guardrail, underdrains, etc.): measure parallel with the base or foundations upon which structures are placed.

J. The thickness of plates and galvanized sheet used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing: measured in fractions of inches.

K. Measure in final position materials measured by volume.

L. Materials specified to be measured by the cubic yard may be weighed and converted to cubic yard for payment purposes, when requested by the Contractor and approved by the Engineer in writing. Engineer determines and Contractor agrees to the factors for conversion from weight measurement to volume before this method of measurement of pay quantities is used.

M. Rental of equipment: measure hours of actual working time and necessary traveling time of the equipment within the limits of the project.
   1. If the Engineer orders special equipment in connection with force account work, the Department measures travel time and transportation to the project.
   2. If the Engineer orders equipment held on the project on a standby basis, the Department pays the agreed rental rate minus the operating cost.

1.4 MEASUREMENT OF QUANTITIES - MATERIALS

A. Asphalt materials: gallon or ton.
   1. Department measures volumes at 60 degrees F or corrects to the volume at 60 degrees F using ASTM D 1250 for asphalts or ASTM D 633 for tars.

2. Department uses net certified scale weights or weights based on certified volumes in the case of rail shipments as a basis of measurement, subject to correction when asphalt material has been lost from the car or the distributor, wasted, or otherwise not incorporated in the work.
3. When asphalt materials are shipped by truck or transport, net certified weights or volume subject to correction for loss or foaming may be used for computing quantities.

B. Cement: ton

1.5 WEIGHING REQUIREMENTS AND PROCEDURES

A. Weigh all materials that are measured or proportioned by weight, or contract items measured by the ton, such as aggregates and asphalt materials, on scales that have been approved, certified, and which meet specification requirements.

B. If material is shipped by rail, the car weight may be accepted provided only the actual weight of material will be paid for.
1. Car weights are not acceptable for material processed through mixing plants.
2. Weigh trucks used to haul material empty daily at times as directed by the Engineer, and place on each truck a legible identification mark.

C. An inspector observes materials delivered to the project or designated site.
1. Submit the printed or written haul ticket to Inspector.
2. At this time, the Inspector can accept materials, and initial and retain the ticket.
3. Department may return any loads of material that appear to be deficient or questionable to be reweighed.

1.6 SCALES

A. Have the Utah State Department of Agriculture, Division of Weights and Measures inspect and seal all scales at least once a year, and before use each time the scale is moved or adjusted.

B. Scale accuracy: to within 0.5 percent of the maximum load required.

C. Furnish, erect, have certified, and maintain, or use permanently installed and certified commercial scales for weighing highway and bridge construction materials that are required to be proportioned or measured and paid for by weight:
1. Scales must be accurate within the limits set by the laws of the State of Utah, meeting requirements of the U.S. Bureau of Standards.

2. Scales must bear a current seal of acceptance from the State of Utah Department of Agriculture, Division of Weights and Measures.

D. Physically arrange electronic, beam, dials, platform, and other scale equipment for convenient and safe viewing.

E. Cease using scales that overweigh (indicate more than true weight). Reduce all materials received subsequent to the last previous correct weighing accuracy test by the percentage of error in excess of one half of 1 percent.

F. Adjust scales that underweigh (indicating less then true weight). Department will allow no additional payment to the Contractor for materials previously weighed and recorded.

G. Include in the unit contract prices for the various pay items of the Contract, costs for furnishing, installing, certifying or testing, and maintaining scales, furnishing scale house, materials for proportioning or payment, and all other items specified in this section for the weighing of highway and bridge construction materials

1.7 PLATFORM SCALES

A. Install and maintain a level platform with rigid bulkheads at each end.

B. Must be of adequate size and capacity so the entire power unit and hauling unit can be weighed at the same time.
1. The Contractor may use a platform scale that will accommodate the power unit and the first hauling unit and all remaining hauling units in two weighing operations.
2. When using two weighing operations, provide a level approach at both ends of the scale at least 75 ft in length composed of a base course and a minimum of 3 inches of Hot Mix Asphalt or 3 inches of concrete cement pavement.
3. Repair or replace approach grades, or any portion that varies by more than one-tenth of one percent, or revert to weighing the entire power unit and hauling units at the same time.

C. Contractor is responsible for costs for constructing and maintaining the approaches.

1.8 ELECTRONIC HOPPER SCALE REQUIREMENTS

A. The Contractor has the option of furnishing an electronic hopper scale system. When this type of weighing system is used, the following applies:
1. Use hopper or load cells.

2. Weights must be accurate to 1.0 percent of true weights.
3. Provide an automatic printer that will provide the following information:
   a. Project number and name
   b. Date
   c. Time
   d. Ticket number
   e. Haul unit number
   f. Gross weight (if possible)
   g. Tare weight
   h. Net pounds or tons
   i. A minimum of two copies of each ticket
   j. Description of item

B. Maintain electronic and hopper scales and conduct necessary testing to assure continued scale accuracy within specification limits after certification by the Department of Agriculture and required by specification.

C. Comparison Test: The accuracy of the hopper scale may be checked by comparing the weight of the material from the hopper and the weight of the material after it is weighed on another certified scale. Comparisons within 0.5 percent tolerance or within the combined tolerance of the two scales are acceptable.

D. If no platform scales are readily available, use known weights to occasionally recalibrate the scales by hanging weights from the weigh hopper.

E. Furnish weights equal to 12.5 percent of capacity and of known accuracy. Use a buildup procedure in combination with the weights by batching or placing a measured amount of material in the hopper and adding known weights to verify.

F. Request written approval to use alternate weighing devices.

1.9 DEPARTMENT INSPECTION AND VALIDATION OF WEIGHTS

A. Continuously Observed Weighing Method to validate weights:
   1. When the Department provides a scale person who must either weigh, or observe, or weigh and observe the weighing of equipment or trucks both loaded and empty to determine the payload of materials to be hauled.
      a. The scale person issues a weigh ticket at the scale site when the Contractor provides truck scales without automatic printers.

B. Random Scale Weighing Check Method to validate weights:
   1. Use when a Department scale person does not weigh materials, or when an electronic scale with an automatic printer is used for weighing equipment, trucks, or materials.

2. The Engineer validates the equipment, truck, and material weight by random reweighing or by other methods as indicated.

C. Engineer or Inspector randomly checks the weight of the equipment, trucks, and he material indicated on the electronically produced weigh ticket or manually prepared ticket, by reweighing the loaded truck on another certified scale, if available.
   1. If no other platform scales are available, Engineer may check by operating the scale in the manual mode.
   2. When manual verification is used, Engineer reweighs the truck by running it back over the platform scale to manually check weights.

D. Conduct frequent checks at the beginning of the operations to verify proper scale function and accuracy.
   1. Frequency may be reduced after initial verification to a minimum of once per week when a substantial amount of material is being weighted.
   2. Scale Tests: Maintain scales and conduct necessary testing to verify scale accuracy within the specifications.
      a. When the scale does not meet specified tolerance, discontinue using the scale until it is operating within specifications.
      b. Comparison scale checks must be within a 0.5 percent tolerance of the net load or within the combined tolerance of the two scales or two weights.

1.10 PROJECTS WITH SMALL QUANTITIES

A. Engineer may accept and receive small quantities of materials paid by weight when the following conditions are met.
   1. The vendor, producer, or supplier issues a signed weight ticket to the truck driver, weighted on certified scales.
   2. A Department employee or inspector receives the certified weigh ticket at the site, and notes visual acceptance on the ticket for the quantity and other required information.
   3. The amount of material received on the project for any one day does not exceed:
      a. Hot Mix Asphalt or Open Graded Surface Course - 100 tons
      b. Untreated Base Course - 200 tons
      c. Borrow or Granular Borrow - 300 tons

PART 2 PRODUCTS **Not used**

PART 3 EXECUTION **Not used**

END OF SECTION

SECTION 01282

PAYMENT

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Section 00570: Definitions

B. Section 00725: Scope of Work

C. Section 00727: Control of Work

1.2 REFERENCES

A. Rental Rate Blue Book for Construction Equipment (Blue Book)

1.3 SCOPE OF PAYMENT

A. Department fully compensates Contractor as provided in the Contract for:
   1. Furnishing all materials, labor, equipment, tools, transportation, and incidentals required for completion of the work.

B. Lump sum: Complete payment for the work described in the Contract when used as an item of payment.

C. Department will not pay Contractor for:
   1. Work that is in excess of that contained in the Contract.
   2. Removal and replacement of defective work.
   3. Loss of anticipated profits.

D. Neither partial payment nor release of retainage relieves the Contractor of the obligation to correct all defective work or materials.

1.4 ALTERED QUANTITIES

A. When the accepted quantities of work vary from the estimated quantities in the Contract, the Department pays the original contract unit prices for the accepted quantities of work done.
   1. Department does not allow for any increased expenses, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the Contractor resulting either directly from such alterations or indirectly from unbalanced allocation among the contract items of overhead expense and subsequent loss of expected reimbursement or from any other cause.
   2. Request any cost adjustments in accordance with Section 00725.

1.5 DIFFERING SITE CONDITIONS, CHANGES, EXTRA WORK

A. Department pays for differing site conditions, changes, and extra work performed under Section 00725 at unit price or lump sum as stipulated in the order authorizing the work.

B. The Contractor's representative and the Engineer compare independent cost estimates to determine the cost of extra work.

C. At the Engineer's request, provide a cost analysis for the extra work detailed as follows:
   1. Labor classifications, total hours for each classification, wage rate, and extension for each classification.
   2. Cost of fringe benefits and subsistence.
   3. Quantities of materials, prices, and extensions.
   4. Equipment classifications, total hours, rental rate, and extension for each unit of machinery and equipment.
   5. Transportation of materials and equipment.
   6. If applicable, subcontractors' cost analysis.

1.6 FORCE ACCOUNT WORK - GENERAL

A. Instead of a unit price or lump sum basis specified above, the Department may require the Contractor to do such work on a force account basis.

B. Department does not make additional allowance for:
   1. Timekeepers, bookkeepers, or other general office help.
   2. General superintendent except for the time spent in direct supervision of the force account work.
   3. The use of small tools (tools costing $400 or less) or other costs for which no specific allowance is herein provided.

C. Department does not pay for pickup trucks used solely for transportation.

D. Department pays straight time for all hours worked. Overtime must have the prior written approval of the Engineer.

1.7 FORCE ACCOUNT WORK - LABOR

A. Compensation for labor: Department pays for all labor, including direct supervision, used in the actual and direct performance of the work, at the rate of wage (or scale) agreed upon in writing before beginning work.

B. Department reimburses for actual costs paid to or in behalf of workmen including subsistence and travel allowances and health and welfare required by collective bargaining agreements or other employment contract generally applicable to the classes of labor employed on the work.
   1. Department pays to Contractor an amount equal to 60 percent of the sum of the above items to cover the costs of bonds, insurance, taxes, etc.
   2. Submit wage, payroll, and cost records pertaining to work paid for on a force account basis to the Engineer. This information is open to inspection or audit.

1.8 FORCE ACCOUNT WORK - MATERIALS

A. Department pays for all materials accepted by the Engineer and incorporated in the project at actual cost:
   1. Including sales taxes and transportation charges plus 15 percent.
   2. Excluding machinery rentals as hereinafter set forth.

B. Include invoices with statements for all materials used. Certify by affidavit the cost of material furnished from Contractor's stocks when no invoice is available.

1.9 FORCE ACCOUNT WORK - CONTRACTOR OWNED EQUIPMENT

A. Department pays for machinery or special equipment, excluding small tools, authorized by the Engineer at an hourly rate obtained from the "*Rental Rate Blue Book for Construction Equipment*," (Blue Book). These hourly rental rates are determined by the monthly rental rate taken from the above-mentioned publication divided by 176. Updated supplements are authorized for use Statewide on specified dates. Obtain this publication through:

Equipment Watch
1735 Technology Drive, Suite 410
San Jose, CA 95110-1313
Phone: (800) 669-3282
Fax: (408) 467-6795
Refer to http://www.udot.utah.gov/index.php/m=c/tid=719.

B. The total hourly rates derived from the above have been computed from equipment costs currently in effect. The rates derived do not include costs for operating personnel.

C. The rates require adjustment by a Regional Factor and a Depreciation Factor.

D. Equipment Rental rates can fall in the following two categories:
   1. Operating Rate - For those hours the equipment is actually in use. Includes ownership and operating costs. Adjust for depreciation and region factors.
   2. Standby Rate - Compensation for equipment required to be at the work site but not operating. This rate is 50 percent of the adjusted ownership costs computed above. The duration of allowable standby time is to be approved in writing by the Engineer with a maximum of eight hours per day or 40 hours in a normal week.

E. When the "Manufacturer's Rated Capacity" falls between those shown in this manual, the Department uses the shown capacity that is closest to the manufacturer's. Do not interpolate for rates in between.

F. Agree upon all rates in writing before beginning work.

G. Obtain approval from the Office of Construction and Materials for any equipment rental rates not provided before the start of any "force account work."

H. Department allows "move-in" and "move-out" transportation cost for a piece of equipment not available on the job, if the particular piece of equipment is not moved onto the job under its own power.
   1. Department allows hourly operating rate for equipment moved to the site under its own power.
   2. Department pays these charges only once for any particular piece of equipment except in unusual circumstances that must be justified in writing and agreed to by the Engineer.

1.10 FORCE ACCOUNT WORK - RENTED OR LEASED EQUIPMENT

A. When the equipment to be used is specialized in nature and is not available in the Contractor's inventory and is rented or leased from an outside source, Department adds a 10 percent allowance on the first $5,000 plus five percent of the balance in excess of $5,000 for overhead for all rented or leased equipment paid for by invoices.

1. Where the rental rate charged exceeds the rate determined by the Blue Book, submit the rental or lease agreement to the Engineer for approval.
2. Department pays equipment-operating costs at the rate from the Blue Book for rented or leased equipment for each hour the equipment was actually used.

B. When the required equipment is in the Contractor's available inventory but not on the project site, the equipment may be rented from a local source. The Engineer may approve rental rates for equipment obtained from local sources when such rates are within 10 percent of the Blue Book. When the equipment is to be used less than a week, "move-in" and "move-out" costs for Contractor owned equipment may be considered when comparing rental costs of equipment obtained from local sources.

1. This option is only allowed when the cost of locally rented equipment would be less than using Contractor owned equipment including "move-in" and "move-out" charges.
2. Such rentals must be supported by a cost analysis indicating the method used was the least expensive.
3. If the Contractor elects to rent equipment of a type that is in the Contractor's inventory and the rental costs exceed that allowed by this article, the Department reimburses for such equipment based on the Blue Book.

1.11 FORCE ACCOUNT WORK - SUBCONTRACTS

A. For all force account work performed under an approved subcontract, Department pays an additional allowance equal to ten percent of the first $5,000 plus five percent of the balance in excess of $5,000 for overhead for the subcontract.

B. The Engineer reviews each situation to determine that performing the work by subcontract is justified.

1.12 FORCE ACCOUNT WORK - STATEMENTS

A. The Contractor's representative and the Engineer compare records of the cost of work done as ordered on a force account basis.

B. At the Engineer's request, provide an itemized statement of the cost of the force account work detailed as follows:
   1. Name, classification, date, daily hours designating straight time and overtime, total hours, rate, and extension for each laborer and supervisor. (Payrolls may be used for part of this information.)
   2. Designation, dates, daily hours, total hours, rental rate, and extension for each unit of machinery and equipment.
   3. Quantities of materials, prices, and extensions.
   4. Transportation of materials and equipment.
   5. Cost of fringe benefits and subsistence.
   6. Subcontractors.

1.13 ELIMINATED ITEMS

A. If the Department determines items contained in the Contract are unnecessary, the Engineer eliminates the items from the Contract with a Change Order to the Contractor. This action does not invalidate the Contract.

B. Request reimbursement for all costs incurred before notification of elimination. Refer to Section 00725.

1.14 PROGRESS PAYMENTS

A. Department makes progress payments at least once each month as the work is progressing.

B. More frequent payments may be made during any period when the Department determines that the value of work performed during the period is of sufficient amount to warrant a payment.

C. Payments are based on estimates prepared by the Engineer of the value of the work performed and materials in place under the Contract and for materials delivered under this Section, article, Payment for Material on Hand.

D. Department makes no progress payment when the total value of the work done since the last estimate is less than $1,000.

E. From the total of the payable amounts, the Department deducts and retains five percent until after the entire Contract has been completed in an acceptable manner. When no less than 95 percent of the work has been completed, and with the consent of the Surety, the Engineer may prepare a semi-final estimate from which the Department retains 1½ percent of the original contract amount. The Department certifies the remainder for payment, less all previous payments.

F. The Contractor may enter into an addendum agreement providing for the payment of retained monies into an escrow account, or the Department does so automatically.
   1. These monies are to be applied toward the purchase of approved securities that are to be held by an escrow agent until satisfactory completion of the construction Contract.
   2. The value of the securities placed in escrow has a minimum value equal to or greater than the amount that would otherwise be retained.
   3. The addendum agreement must be executed concurrently with the execution of the construction Contract. Agreement forms are available in the office of the Department's Engineer for Construction and Materials.

G. The Department pays the Contractor within 14 calendar days after certification and approval of billings and estimates.
   1. Contractor and Engineer agree to a Saturday partial estimate closing date. Succeeding partial estimates close on the same Saturday for each succeeding month.
   2. Contractor approves partial estimate prior to submission.

1.15 PAYMENT FOR MATERIAL ON HAND

A. When the Contractor presents delivery copies of invoices, the Department may include in the partial payment invoice, advance payments for acceptable nonperishable materials purchased expressly for incorporation in the work when delivered in the vicinity of the project, or stored in approved storage place.
   1. The Engineer determines the amount to be included in the estimate, but in no case will the amount exceed the value of the materials as shown on the delivery invoice, or 75 percent of the in-place price, whichever is less.
   2. When the approved storage location is other than the project site, furnish evidence that the stockpiled materials are irrevocably obligated to the project.
   3. Department does not pay when the invoice value of such materials, as determined by the Engineer, amounts to less than $2,000 or if materials are to be stored less than 30 calendar days.
   4. Within 60 calendar days following the date of the estimate invoice on which the stockpile material is to be paid by the Department, furnish to the Engineer certified paid invoices or a certified statement with a copy of the check showing payment.
   5. Material will be removed from the next partial estimate as stockpiled materials if proper invoices showing payment to the supplier is not received.

B. Department makes no partial payment on living or perishable materials until incorporated as specified in the Contract.

C. Department does not pay for materials brought onto the site at the Contractor's election that may be incorporated into the project such as fuels, supplies, metal decking forms, ties, or supplies used to improve efficiency of operations.

D. Approval of partial payment for stockpiled materials does not constitute final acceptance of such materials for use in completing items of work.

E. Department purchases at actual cost and without any percentage allowance for profit, materials delivered to the project in compliance with the Contract or left unused due to changes in plans or variation in quantities, if the materials are not practicably returnable for credit.
   1. Purchased materials become the property of the Department.
   2. Actual costs are based on invoice price plus transportation costs to the work.

F. Payment is limited to contract quantities unless ordered by the Engineer. Assume responsibility for excess materials delivered to the project, or aggregate produced beyond the contract amount without authority from the Engineer.

G. At the option of the Department, surplus aggregates up to the contract quantities may be purchased provided:
   1. The material is stockpiled where directed.
   2. The material meets specification requirements when stockpiled.

H. Department pays for material accepted on an agreed price basis, which price is normally the Contractor's production cost. In addition, the Department pays the cost to haul the materials to the stockpile site and place in pile at the rate of 9 cents per ton mile or 20 cents per cubic yard mile.

1.16 FINAL PAYMENT

A. When the project has been accepted in accordance with Section 00727, the Engineer prepares the final estimate of work performed.
   1. If the Contractor approves the final estimate or does not object to the quantities within 30 calendar days of receiving the final estimate, the Department processes the estimate for final payment.
   2. After approval of the final estimate by the Contractor, Department pays for the entire sum due after deducting all previous payments and all amounts to be retained or deducted under the provisions of the Contract.

B. If additional payment is due from the Department, file with the Department a full, complete, and itemized written statement justifying the adjustment within 30 calendar days after the final estimate is submitted for approval.
   1. All disputes not itemized in said statement are waived by the Contractor.

2. Submission of disputes by the Contractor will not be reason for withholding full payment of the total value of work shown on the Engineer's final estimate.
3. The Department evaluates the dispute. If it is determined that additional payment is due, the final estimate is revised accordingly, under the terms of the Contract. If not, the estimate as submitted is final.

C. All prior partial estimates and payments are subject to correction in the final estimate and payment.

D. The Department has the final estimate complete and to the Contractor within 90 days of when the Contractor reaches Contract Completion.

1.17 ADJUSTMENTS FOR FUEL COST

A. This price adjustment provision is intended to minimize risk to the Contractor due to potential volatile price fluctuations for fuel that might occur throughout the duration of the Contract.
1. The Contractor may invoke this provision at any time during the Contract by written notification to the Engineer.
2. Adjustments are then made on all prior and future partial estimates. When this provision becomes effective, it remains in effect for the duration of the Contract.

B. This provision is not designed to estimate actual quantities of fuel used in construction operations, but to provide a reasonable basis for calculating a fuel price adjustment based on average conditions.

C. Department determines compensation adjustments under the provisions of this Section, and presumes that the Contractor has relied on these provisions for compensation adjustments when determining unit bid prices.

D. Terms for calculating adjustments for fuel costs:
1. Fuel Partial Estimate Base Price (EP): - The average of all base prices determined during the partial estimate period.
   a. The Department determines the base price per barrel for crude on the first working day of each week, using postings from the commodities and futures section of the Wall Street Journal for West Texas Intermediate (WTI) crude using the spot price for that date as a basis.
   b. A conversion factor of 42 gallons per barrel is used.

2. Fuel Contract Base Price (CP): The base price determined for the week during which the bid opening is held. The source of the price is the same as that used for the (EP).

3. Fuel Usage Factors (FU): A combined diesel and gasoline factor. Table 1 contains the items for which adjustments may be made, and the fuel usage factors upon which the adjustment is based.

E. Determining Adjustments (AF): The Engineer computes the adjustments separately for each partial estimate period. The adjustment is determined based on appropriate items in Table 1 using the formula with the following constraints.

1. The Partial Estimate Base Price must change plus or minus 15 percent from the Contract Base Price before an adjustment is made, then add or deduct five percent per the formula.
2. Engineer adjusts only major contract items as defined by Section 00570, or items that have an individual value of $100,000 or more based on original contract quantities.
3. Adjustments in compensation may be either plus or minus depending on the differences between the Contract Base Price and the Partial Estimate Base Price.

F. Work beyond Contract time: Adjustment will not apply to any work performed after the expiration of contract time plus approved time extensions.

G. Upward Ceiling: If the Partial Estimate Base Price increases by more than 50 percent from the Contract Base Price for an adjustable bid item, the Department determines whether it is feasible for the remainder of the project to proceed, and notifies the Contractor in writing if the project is to be terminated.

H. Adjustment Formula:

EP greater than CP:

$$AF = \frac{[(EP - CP) - 0.05\ CP]\ Q\ (FU)}{42}$$

EP less than CP:

$$AF = \frac{[(EP - CP) + 0.05\ CP]\ Q\ (FU)}{42}$$

Where:

EP	=	Partial Estimate Base Price per barrel (dollars)
CP	=	Contract Base Price per barrel (dollars)
Q	=	Quantity of Acceptable Work Performed on Item
FU	=	Fuel Usage Factor for that Item
AF	=	Adjustment for Fuel Costs in Dollars
42	=	Gallons per Barrel of Crude

Table 1
Adjustable Items and Fuel Usage Factors

Item of Work	Quantity of Work (Q)	Combined Diesel & Gasoline Usage Factor (FU)
Roadway Excavation, Borrow, Embankment, Granular Borrow, Top Soil	Cubic Yard Ton	0.45 0.25
Loose Riprap	Cubic Yard	0.57
Underdrain Granular Backfill	Cubic Yard	1.16
Untreated Base Course	Ton	0.84
Hot Mix Asphalt	Ton	3.60
Open-Graded Surface Course	Cubic Yard Ton	7.20 3.60
Cover Material: Produced and Placed on Roadway Produced and Stockpiled	 Ton Ton	 0.64 0.36
Portland Cement Concrete Pavement Lean Concrete Base Course	1 inch thick Sq Yard	0.214 0.048
Structures (includes: Concrete, Piles, Reinforcing Steel, Structural Steel) Pipe Culvert Special Pipe Culvert (includes excavation for structures) Underdrains Right-of-Way Fence & Gates Seeding Concrete Small Structures Portland Cement Concrete Highway Traffic Paint Precast Concrete Barrier Guardrail	$	0.038 Gal

1.18 ADJUSTMENT FOR ASPHALT MATERIALS

A. This price adjustment provision is intended to minimize risk to the Contractor due to potential volatile price fluctuations for asphalt materials that might occur throughout the duration of the Contract.
   1. The Contractor may invoke this provision at any time during the Contract by written notice to the Engineer.
   2. Department then adjusts future partial estimates. When this provision becomes effective it remains in effect for the duration of the Contract.

B. Department adjusts the price of asphalt materials for work done on bid items that contain asphalt materials, including asphalt cement, liquid asphalt, and emulsified asphalt.

C. Department determines compensation adjustments under the provisions of this Section, and presumes that the Contractor has relied on these provisions for compensation adjustments when determining unit bid prices.

D. Terms for calculating adjustments for asphalt materials are as follows:
   1. Asphalt Partial Estimate Base Price (EP): The average of all the base prices determined during the partial estimate period.
      a. On the first working day of each week, the Department determines the base price per barrel for crude oil using postings from the commodities and futures section of the Wall Street Journal for West Texas Sour (WTS).
      b. A conversion factor of 5.6 barrels per ton is used.
   2. Asphalt Contract Base Price (CP) - The base price determined for the week during which the bid opening is held is the Contract Base Price. The source of the price is the same as that used for the (EP).

E. Determining Adjustments (AF): The Engineer computes the adjustments separately for each partial estimate period. The adjustment on each item is determined using the formula with the following constraints.
   1. The Partial Estimate Base Price of asphalt materials must change plus or minus 15 percent from the Contract Base Price before an adjustment is made, then add or deduct 5 percent per the formula.
   2. Adjustments in compensation may be either plus or minus depending on the differences between the Contract Base Price and the Partial Estimate Base Price.

F. Work beyond Contract time: Adjustment will not apply to any work performed after the expiration of contract time plus approved time extensions.

G. Upward Ceiling: If the Partial Estimate Base Price increases by more than 50 percent from the Contract Base Price for an adjustable bid item, the Department determines the feasibility for proceeding with the remainder of the project and notifies the Contractor in writing if the project is to be terminated.

H. Adjustment Formula

EP greater than CP:

AF = [(EP - CP) - 0.05 CP] (5.6) Q

EP less than CP:

AF = [(EP - CP) + 0.05 CP] (5.6) Q

Where:

EP	=	Partial Estimate Base Price per barrel (dollars)
CP	=	Contract Base Price per barrel (dollars)
Q	=	Quantity in ton of Asphalt Materials used
AF	=	Adjustment for Asphalt Costs in dollars
5.6	=	Barrels per ton of Asphalt

The Engineer calculates the tons of asphalt product that will be Q in the above equation for the following:

HMA (Hot Mix Asphalt)
Open-Graded Surface Course
Emulsified Asphalts
Cutback Asphalts

PART 2 PRODUCTS Not used

PART 3 EXECUTION Not used

END OF SECTION

SECTION 01285

MOBILIZATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparatory work and operations necessary for moving personnel, equipment, supplies, and incidentals to the project site before beginning work.

1.2 PAYMENT PROCEDURES

A. Refer to Measurement and Payment document.

PART 2 PRODUCTS **Not used**

PART 3 EXECUTION **Not used**

END OF SECTION

SECTION 01315

PUBLIC INFORMATION SERVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Responsibilities of Public Information Manager (PIM) for the duration of a project.

1.2 RELATED SECTIONS

A. Section 01554: Traffic Control

1.3 PERFORMANCE REQUIREMENT

A. Designate the Public Information Manager at the project pre-construction conference.
   1. Responsible for project public information services.
      a. Public Information Manager duties take precedence over other assigned duties.

1.4 PUBLIC INFORMATION MANAGER (PIM) RESPONSIBILITIES

A. Establishes a local public information office. Office can be located within the Contractor's regular office provided that the telephone line is a local call line.
   1. Has established working hours and days.
   2. Is equipped with a telephone and answering machine dedicated to project public information services.

B. Maintains daily communication with the Engineer.

C. Maintains and documents weekly communications with Region Public Involvement Coordinator, affected residents, businesses, organizations, and public agency (local emergency services, public works, transit authorities, city offices) and other stakeholders.

D. Maintains availability by telephone.
   1. Maximum 24 hours response time during project working hours.
   2. On call status required during non-working hours.

E. Develops a data base of stakeholders and stakeholder contact information (name, address, phone number, E-mail address and fax number)

F. Establishes method of producing and distributing printed information (fliers).

G. Be available to organize, participate, and document public and private meetings involving project, when requested by the Engineer.

1.5 PAYMENT PROCEDURES

A. Compensation includes:
   1. Office space, when provided off site of Contractors offices.
   2. Printed information
   3. Telephone service
   4. Internet E-mail service
   5. All labor, materials, and meeting facilities required to meet provisions of this section.

B. The Engineer monitors and evaluates the Public Information Manager and all public information services.

C. Department makes:
   1. Partial payments for the pay item Public Information Services as the work progresses when the Contractor provides public information services in accordance with this specification.
   2. Payments a percentage of project completion.

D. Failure to provide public information services in accordance with this specification results in a $10,000 weekly deduction.

PART 2 PRODUCTS

2.1 OFFICE SPACE AND EQUIPMENT

A. Office Space

B. Telephone Services

C. Answering Machine

D. Labor and material required to preform the duties and responsibilities of this section.

PART 3 EXECUTION

3.1 ESTABLISH LOCAL PUBLIC INFORMATION SERVICES

A. Provide office address and local telephone number.
   1. Establish and publish office hours, working days, telephone number, and E-mail address.
      a. Answer all email within 24 hours of receipt during business hours.

B. Provide answering machine.
   1. Updated message with project information a minimum of once each week concerning the activities on the project.
   2. Public information office hours.
   3. Opportunity for caller to leave a recorded message.
   4. Check answering machine a minimum of twice daily.
   5. Document and respond to messages within 24 hours of receipt.

C. Maintains a logbook.
   1. Information and corresponding communications
      a. Date, time
      b. Contact information
         1. Name, phone number, address and/or E-mail address
      c. Description of inquiry and/or request
      d. Response
      e. Subsequent responses or actions taken during construction
   2. Follows up all inquires with a phone call, in writing or with a meeting as warranted.

3. Document discussions, resolutions and actions.
    a. Provide copies of logbook documentation to the Engineer and Region Public Involvement Coordinator on a weekly basis.

D. Develops and maintains data base of stakeholders and stakeholder contact information (name, address, phone number, email address and fax number)
    1. Make available for review by the Engineer and Region Public Involvement Coordinator at all times during the project
    2. Deliverable to the Region Public Involvement Coordinator upon completion of the project.

E. Respond to questions concerning project activities and schedules.

F. Organize, participate, and document meetings held with affected individuals and/or organizations.
    1. Provides meeting minutes to Engineer in a weekly report.

G. Maintains and documents weekly communication and project updates with the following:
    1. Department, Region, and Public Involvement Coordinator
    2. Affected local public agencies
        a. Emergency Service Agencies
            1. Fire Departments
            2. Police Departments/Highway Patrol
            3. Ambulance Services
        b. Local City Offices
        c. Public works departments
        d. Local transit authorities
        e. Local school districts
    3. Affected businesses
    4. Affected trucking and carrier associations
    5. Local organizations interested in the project
    6. Private citizens, when requested
    7. Other stakeholders as required
    8. Engineer and Region Public Involvement Coordinator, providing copies of logbook documentation.

H. Prepare and distribute information to all stakeholders adjacent to the construction zone in flier format, or through documented personal contact, one week prior to beginning construction and subsequently each week until the end of the project.
    1. Provide copies of all fliers, E-mail or other materials containing project information to the Engineer and the Region Public Involvement Coordinator for review prior to distribution.
    2. Include in flier the following information:
        a. Project name

b. Description of the work to be done including completion dates
c. Work locations
d. Lane restrictions and directions
e. Traffic management plans or detours
f. Work times and days of the week
g. Impacts to access
h. Schedule for forthcoming week
i. Name of the Contractor's Public Information Manager, telephone number, and office hours of the Public Information Office.

3. Communicates construction changes to established weekly schedule to all affected stakeholders. Provide draft copy of changes to Engineer prior to distribution.

I. Provide telephone number to sign manufacturer or Traffic Control Maintainer for placement on Construction Zone Information Sign as per TC series Standard Drawings and refer to Section 01554.

J. Provides updates to the Engineer and Pubic Involvement Coordinator on project activities that affect traffic and access.

K. Forwards all media inquires, written and verbal, regarding the project or project activities to the UDOT Communications Office.

END OF SECTION

SECTION 01355

ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.1 GENERAL PROVISIONS

A. Comply with all Federal, State, local laws and regulations, and provisions of this Section.

B. Prevent pollution of streams, lakes, ponds, and reservoirs with sediment, fuels, oils, bitumens, chemicals, or other harmful materials and pollution of the atmosphere from particulate and gaseous matter.

C. Use Best Management Practices to prevent hazardous material releases by segregating wastes, providing secondary containment and having spill kits and absorbents on hand.

1.2 REFERENCES

A. ANSI

B. U.S. Code of Federal Regulations

C. U.S. Environmental Protection Agency Regulations

D. Utah Administrative Code

E. Utah State Department of Environmental Quality Regulations

1.3 HAZARDOUS MATERIAL - DISCOVERED DURING CONSTRUCTION

A. Immediately suspend work in the area and notify the Engineer if abnormal conditions are encountered or exposed during construction that indicates the presence of a hazardous material, toxic or hazardous waste.
   1. Treat the conditions with extreme caution.

2. Abnormal conditions include, but are not limited to, the following: presence of barrels; buried storage tanks; above ground tanks; obnoxious odors; excessively hot earth; stained and discolored soils; smoke; unidentifiable powders, sludges, pellets; or any other condition that could be a possible indicator of hazardous material, toxic or hazardous waste.

B. Resume operation in this area when directed by the Engineer. Continue working in other areas of the project, unless otherwise directed by the Engineer.

C. Dispose of the hazardous material, toxic or hazardous waste under the requirements and regulations of the Utah State Department of Environmental Quality and United State Environmental Protection Agency.
   1. Perform necessary work required to dispose of these materials as extra work.
   2. Disposition of waste materials requiring special procedures by certified personnel will be arranged by the Department with qualified persons to dispose of the material.

1.4 HAZARDOUS MATERIAL - CONTRACTOR CAUSED

A. Notify the Engineer and the Department of Environmental Quality of spills of petroleum based products or hazardous waste if the release would meet the definition of a hazardous waste as defined in 40 U.S. Code of Federal Regulations 261.
   1. Notify the Engineer immediately after the discovery of the spill.
   2. Notify the Department of Environmental Quality (DEQ) in writing within five calendar days of the discovery.
   3. Notify the DEQ in accordance with R315.9 of Utah Administrative Code. 24-hour phone number: (801) 536-4123.

B. Dispose of spilled material according to the requirements and regulations of the Utah State Department of Environmental Quality.

C. Pay for all required clean-up operations.

1.5 LIVE STREAMS

A. Ford or work in live streams or any live body of water (live water) only with approval from the Utah Division of Water Quality and Utah Division of Water Rights. Do not operate mechanized equipment in live water unless provided for in the Contract. Minimize stream siltation.

B. Use a dike or barrier to separate work areas or pits located in or adjacent to streams from the main stream. Prevent sediment from entering adjacent streams.

C. Treat water used to wash aggregate or water from other operations that produce sediment by filtration, settling basins, or other methods that reduce sediment concentrations to the level of the stream or lake into which it is discharged.

1.6 OPEN BURNING

A. Prohibited along highway rights-of-way without approval orders from the Executive Secretary of the Utah Division of Air Quality.

1.7 ABRASIVE BLASTING - VISIBLE EMISSION STANDARDS

A. **Visible Emission Standards:**

1. Abrasive blasting outside of Weber, Davis, Salt Lake and Utah Counties: Do not discharge into the atmosphere opacity darker than 40 percent for a period or periods aggregating more than three minutes in any one hour.
2. Abrasive blasting inside Weber, Davis, Salt Lake or Utah Counties where the performance standards in this article, paragraph C are used: Do not discharge into the atmosphere opacity darker than 20 percent for a period or periods aggregating more than three minutes in any one hour.
3. Abrasive blasting inside Weber, Davis, Salt Lake or Utah Counties where the performance standards in this article, paragraph C are not used: Do not discharge into the atmosphere opacity darker than 40 percent for a period or periods aggregating more than three minutes in any one hour.

B. **Visible Emission Evaluation Techniques:**

1. Read emissions from unconfined blasting at the densest point of the emission after a major portion of the spent abrasive has fallen out. Densest point will be between 6 ft and 25 ft from the impact surface of the abrasive blasting nozzle.
2. Judge emissions from unconfined blasting employing multiple nozzles as a single source unless each nozzle meets the emission and performance standards.
3. Read emissions from confined blasting at the densest point after the air contaminant leaves the enclosure.

C. **Performance Standards:** Any one of the following may be used as a performance standard.

1. Confined blasting
2. Wet abrasive blasting
3. Hydroblasting
4. Unconfined blasting using abrasives defined below:
    a. Before blasting, the abrasive will not contain more than one percent by weight material passing a #70 U.S. standard sieve.

b. After blasting, the abrasive will not contain more than 1.8 percent by weight material 5 micron or smaller.

c. Abrasives reused for dry unconfined blasting are exempt from the requirements of "after blasting," but must conform to the requirements of "before blasting" above.

D. **Abrasive Certification:** Sources using the performance standard for unconfined blasting must demonstrate they have obtained abrasives from persons who have certified (submitted test results) to the Utah Air Quality Executive Secretary at least annually that such abrasives meet the requirements outlined above for abrasives.

1.8 NOISE AND VIBRATION CONTROL

A. Identify haul routes and percussive noise sources that annoy sensitive receptors and prevent these sources from becoming a problem.

B. Definitions and Standards - Use terminology that meets applicable American National Standards Institute (ANSI) publications and commonly accepted practices of acoustical measurements.

1. Receptor - An occupied residential dwelling, church, hospital, school, outdoor stage, or structure confining other noise sensitive activities.
2. Noise Sensitive Zone - The land enclosed within a 1500-ft radius circle of any receptor.
3. Sound Level - The total sound pressure level from all concurrent construction activities related to the subject project, as measured with a sound level meter using the A-weighting network (ANSI S1.4). The standard notation is dB(A) or dBA.
4. Percussive Noise - Short burst(s) of banging or clattering noise including but not limited to blasting, pile driving, and jack-hammering.

C. Prohibitions - Suspend construction work under the following conditions:

1. Construction activity in a noise sensitive zone causes the sound level within 10 ft of the nearest receptor to exceed: 95 dBA in daytime (7 a.m. - 9 p.m.), or 55 dBA in nighttime (9 p.m. - 7 a.m.)
2. A noise sensitive zone on Sundays and State Holidays.
3. Project related construction noise or vibration does not meet specifications. Suspend the portion of construction work responsible for the problem until noise is reduced to the required noise standards.

D. Compliance:

1. Follow all local noise ordinances, except where a variance in accordance with local regulations has been granted.
2. Local noise ordinance variance does not provide an exemption from complying with the requirements of this article, paragraph C.

E. Percussive Noise:

1. Notify the Engineer at least two weeks in advance of any percussive noise activity that is expected to exceed the provisions of this article, paragraph C.
2. Coordinate notification of the public with the Engineer.

1.9 ENVIRONMENTAL CLEARANCE BY THE CONTRACTOR

A. Obtain and provide the following environmental clearances before beginning project activity when adding or selecting any ground- or resource-disturbing features such as material (gravel, borrow or waste) sites, equipment staging sites, office sites, water lines, holding ponds, etc., not provided in the Contract:

1. Cultural and Paleontological - Initiate consultation concerning proposed additional feature(s) with a Department staff archeologist. (Hiring a private archeological subconsultant and coordination with the Utah State Historic Preservation Office may be required.) The Department staff archeologist provides clearance to the Contractor via written notification. See article 1.10.
2. Threatened and Endangered Species: Obtain written clearance from the U.S. Fish and Wildlife Service.
3. Wetlands: Obtain written clearance from the U.S. Army Corps of Engineers.
4. Floodplains - Initiate consultation concerning the proposed additional feature(s) with the Region Hydraulics Section. Subsequent coordination with the Federal Emergency Management Agency (FEMA) may be required. The Region Hydraulic Engineer provides verification of non-interference by the Contractor with a floodplain or compliance with FEMA guidelines to the Contractor.
5. Prime, Unique, and Important Farmland - Initiate consultation concerning the proposed additional features with the farmland specialist with the Region's Environmental Engineer. Subsequent coordination by the Contractor with the U.S. Natural Resources conservation service may be required. The Region provides written clearance to the Contractor.
6. Utah Pollutant Discharge Elimination System (UPDES) - Obtain UPDES permit for storm water discharge from Utah Division of Water Quality (DWQ). Comply with the requirements of the permit including submittal of Notice of Intent (NOI) form to DWQ and development and approval of the storm water pollution prevention plan by the DWQ when required.
7. Air Quality: Obtain construction approval from the Utah Division of Air Quality if construction project or area of disturbance outside of the project is in an area of air quality non-attainment for any pollutant.

B. Contractor is responsible for all costs of pursuing and obtaining all the above clearances, and is not entitled to time extension for delays encountered in obtaining these clearances.

1.10 DISCOVERY OF HISTORICAL, ARCHEOLOGICAL, OR PALEONTOLOGICAL OBJECTS

A. Immediately suspend construction operations in the vicinity of the discovery if a suspected historic, archeological or paleontological item, feature, prehistoric dwelling sites or artifacts of historic or archeological significance are encountered.

B. Verbally notify the Engineer of the nature and exact location of the findings.

C. The Engineer contacts the State archeological authorities to determine the disposition of the objects.

D. Protect the discovered objects and provide written confirmation of the discovery to the Engineer within two calendar days.

E. The Engineer keeps the Contractor informed concerning the status of the restriction.
   1. The time necessary for the Department to handle the discovered item, feature, or site is variable and dependent on the nature and condition of the discovered item.
   2. Expect a two week or more delay in the vicinity of the discovery.
   3. The Engineer will provide written confirmation when the restriction is terminated.

PART 2 PRODUCTS Not used

PART 3 EXECUTION Not used

END OF SECTION

SECTION 01452

PROFILOGRAPH AND PAVEMENT SMOOTHNESS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for smoothness testing of (HMA) Hot Mix Asphalt, Open Graded Surface Course (OGSC) and Portland Cement Concrete Pavement (PCCP).

B. Requirements for 25-foot wheel base, California type profilograph with electronic data recording, storing, data reduction, and printing capabilities.

1.2 RELATED SECTIONS

A. Section 02741: Hot Mix Asphalt (HMA)

B. Section 02748: Prime Coat/Tack Coat

C. Section 02752: Portland Cement Concrete Pavement

D. Section 02786: Open-graded Surface Course (OGSC)

1.3 REFERENCES

A. UDOT Materials Manual of Instruction

1.4 GENERAL REQUIREMENTS

A. Certify profilograph operators and equipment through the Department. Engineer verifies certifications.

B. Comply with project Traffic Control Plan and all applicable safety requirements when performing profilograph testing.

C. Contractor Quality Control
   1. Comply with requirements identified in Section 02741 and Section 02752.

2. Address the following minimum items in the QCP:
   a. Identify person(s) responsible for managing smoothness issues and monitoring compliance with requirements.
   b. Identify equipment used to measure and monitor smoothness along with calibration and correlation information.
   c. Identify personnel responsible for operation of equipment and their qualifications.
   d. Identify construction methods employed to obtain smoothness, including:
      1) Method of grade control for rotomilling and paving operations.
      2) Actions taken to prevent paver from stopping and starting, including any use of additional equipment.
      3) Placement of manholes outside of projected wheel paths and methods of matching surface elevations and slopes
   e. Identify potential problems that could interfere with meeting pavement surface requirements.
   f. Describe grinding process and operation:
      1) Equipment and operators
      2) Must-grind layout, grade control, sealing process, etc.
      3) Schedule

1.5 ACCEPTANCE

A. Notify the Engineer in writing a minimum of two working days prior to scheduling Department inspection of acceptance testing on the final pavement surface, after all corrective work has been performed.
   1. Clearly define the areas to be tested for acceptance in the written notification.
   2. Do not perform any work on the final surface after acceptance testing, except as directed by the Engineer.

B. The Department evaluates the surface by section, defined as:
   1. Traffic lane, 0.1 mile in length, including adjacent shoulder with a design width 8.0 ft or less, meeting the Class I description. (See Table 1)
      a. Testing consists of a single trace measurement of each wheel path, defined as a continuous parallel line 2.5 ft inside the projected lane lines, of the traffic lane.
      b. Testing of adjacent shoulder consists of a single trace measurement approximately centered in the shoulder when the design width is 6.0 ft or greater. Do not test shoulders having design widths less than 6.0 ft.
      c. Determine the Profile Index (PI) by taking the average of all profile traces taken on the section.

2. Shoulder, 0.1 mile in length, with a design width greater than 8.0 ft, meeting the Class I description.
   a. Testing consists of two profile traces, 2.0 ft inside each edge, approximately centered in the shoulder.
   b. Determine the Profile Index (PI) by taking the average of profile traces taken on the section.

C. Begin the initial section(s) at the start of the project. Lay out subsequent sections consecutively to the end of the project.

D. The Department does not measure the PI for Class II surfaces.

E. The Department evaluates longitudinal and transverse deviations for both Class I and Class II surfaces.

F. If the final lift of pavement cannot be completed due to seasonal limitations, the Department evaluates all roadway sections paved through the final lift and evaluates the remaining final lift of pavement upon completion.

1.6 MEASUREMENT AND PAYMENT PROCEDURE

A. All work necessary to prepare the pavement for testing, such as but not limited to sweeping, is incidental to the work and is not measured for payment. Include all costs and resources for smoothness testing, preparation and correction in the surfacing bid items.

PART 2 PRODUCTS

2.1 FRAME

A. Construction:
   1. All welded of light-weight square aluminum tubing in three separate units of the same dimensions in width and within 6 inches in length of each other.
   2. Design: reinforced truss.

B. Length:
   1. Effective wheel base of the frame assembly: 25 ft.
   2. Overall length with multiple wheel assemblies attached: not to exceed 35 ft.

C. Frame Connections:
   1. Indexed with steel location pins or dowels to prevent misalignment of frame assembly.
   2. Secured with quick acting clamps rated at a minimum of 800 lbs each.

D. Parts: Each of the three frame units manufactured to allow interchangeable replacement of individual units.

2.2 WHEEL SUPPORT ASSEMBLIES

A. Tubing: All welded, light-weight square aluminum.

B. Connections: All connection points between wheel assemblies and frame sections secured with quick-acting clamps.

C. Support wheels: Cast aluminum hubs with ball bearing supported steel axles and cushion rubber tires. Caster wheel assemblies: Ball bearing supported.

D. Front Wheels: Steerable from the center of the machine.

E. Rear Wheels: Quick setting manual adjustment to allow for short radius turning, moving laterally, and for trimming to avoid crabbing on superelevations.

2.3 RECORDING WHEEL

A. Light weight, 24 inch to 26 inch nominal diameter, and heavy duty spokes.
   1. Tire: pneumatic tube type with non-aggressive tread design.
   2. Frame: all welded of light-weight square aluminum tubing. Frame pivot points and rotating shafts supported by sealed ball bearings.

2.4 GENERAL MECHANICAL

A. All exposed steel components anodized, nickel plated, or zinc plated for corrosion protection.

B. Interchangeable parts.

C. Capable of being broken down in segments that can fit into the back of a standard pickup truck or van for ease of transport.

D. Constructed to allow complete assembly in less than 15 minutes without tools.

2.5 AC POWER GENERATING UNIT

A. Self-contained, capable of delivering 120 VAC at 60Hz.

B. Mount on the frame with appropriate vibration and shock control hardware.

2.6 MICROCOMPUTER

A. Control the system by a dedicated on-board microcomputer.

B. The microcomputer components replaceable and interchangeable with like items from the manufacturer's stock to facilitate controller repairs and provide the following minimum operation characteristics:

1. Processor:
   a. Minimal 16 bit microprocessor capable of running at a nominal 8 MHz processing speed.
   b. On-board memory sufficient to store Profile Index (PI) and bump Discrimination software.
   c. RAM memory sufficient to input control parameters and process project documentation variables at the test site.

2. Displacement Transducer Interface:
   a. Contains an analog to digital converter compatible with the operating characteristics of the microprocessor.
   b. Include signal conditioning for analog filtering and scaling.
   c. Overall resolution for displacement transducer less than or equal to 0.004 inches.

3. Odometer Transducer Interface: Provides digital logic to encode positive or negative signals to microprocessor.

4. Clock:
   a. Provides time and calendar functions to microprocessor unit automatically.
   b. Independent battery power required to avoid documentation errors and input data losses caused by on-board power shut downs.

2.7 TRANSDUCERS

A. Rated to withstand shock, vibration, dust, and extremes of humidity. Operational from -30 degrees C to 100 degrees C.

1. Vertical Displacement Transducer: Resolution of 0.01 inches.

2. Odometer: horizontal resolution of 0.39 inches and operational in either an incrementing or decrementing mode.
3. Temperature transducer: Accurate to " 1 degree C.

2.8 PRINTER/PLOTTER

A. Compatible with and provide suitable interfaces with the microprocessor.

B. The data acceptance (baud rate) and buffer storage capacity: adequate to fully register, plot, and accept data from a 4 mph operational run without excessive wait states.

C. Dot matrix mechanism (if applicable): print bar resolution of 100 dots per inch with a row resolution of 200 rows per inch.

2.9 OPERATOR CONTROL PANEL

A. Located within easy access of the operator and in a location on the profilograph that does not hinder other operational functions or line of sight to testing path.

B. Control panel with a digital display, data input keyboard, observable indicators, (video or screen) and operator actuated control switches.

C. Parameters entered, displayed, and printed as follows (all numeric):
1. Time
2. Date
3. Region, route and pavement
4. Pass number
5. Beginning Station
6. Ending Station
7. Odometer
8. Blanking band width
9. Bump height
10. Bump width
11. Event marker

2.10 REPORTING REQUIREMENTS

A. Determine Profile Index, documentation, reports, outputs, or example, as specified. UDOT Materials Manual, 8-995.

B. Set preprogrammed or operator entered scaling or sensitivity factors at a sensitivity level that to correlate with Department profilographs.

C. Include the following documentation supplied with the Profilograph system:
   1. Operator's Manual.
   2. Wiring Diagrams.
   3. Industry standard part number or name and model numbers for complete subsystems.

PART 3 EXECUTION

3.1 HMA AND OGSC

A. Construction Requirements
   1. Construct finished pavement to meet the surface requirements in Table 1.
   2. Identify defects exceeding the limits in Table 1 and correct prior to acceptance testing.
      a. Analyze the profile using 0.2 inch blanking band.
      b. Correct defects across the entire width of the traffic lane or shoulder either by grinding with a device approved by the Engineer, or by milling and filling as directed by the Engineer.
      c. Re-profile for correction verification prior to acceptance testing.
   3. Correct transverse defects where the pavement surface varies more than 1/8 inch from the lower edge of a 10 foot straightedge placed perpendicular to the centerline of the roadway.
   4. Seal ground areas with asphalt tack coat and blotter material.
      a. Use a tack coat application rate between 0.07 and 0.14 gal/yd^2.
      b. Meet blotter material requirements in Section 02748.
   5. The Department inspects acceptance testing prior to the placement of Chip Seal Coat, when applicable.

B. Incentive/Disincentive - HMA
   1. Incentive/Disincentive applies only to Class I surfaces for each pavement section defined in this Section, article 1.4, Acceptance, paragraph B.
      a. Incentive/Disincentive is calculated according to Table 2, with partial sections prorated based on length.
      b. Incentive/Disincentive does not apply to HMA surfaces on projects requiring OGSC.
      c. Any section requiring grinding exceeding 20 yd^2 does not qualify for incentive. Disincentive remains applicable for sections where grinding exceeds 20 yd^2.
   2. Any section still requiring corrective work that is identified at the time of acceptance testing results in loss of incentive for the section. Disincentives remain applicable and are based on PI obtained at the time of acceptance testing.

3. Failure to correct defects, identified at the time of acceptance testing, within 14 calendar days after notification by the Engineer results in liquidated damages assessed at $100.00 per day after 14 calendar days per each section needing corrective work.
    a. Liquidated damages may be waived by the Engineer if it is determined to be in the best interests of the Department to defer corrective work.

C. Incentive/Disincentive - OGSC
1. Incentive/Disincentive applies only to Class I surfaces for each pavement section defined in this Section, article 1.5, Acceptance, paragraph B.
    a. Incentive/Disincentive is calculated according to Table 3, with partial sections prorated based on length.
2. Any section requiring grinding exceeding 20 yd^2 or any section still requiring corrective work that is identified at the time of acceptance testing results in a disincentive of $1000.00 per section.
3. Failure to correct defects, identified at the time of acceptance testing, within 14 calendar days after notification by the Engineer results in liquidated damages assessed at $100.00 per day per each section needing corrective work.
    a. Liquidated damages may be waived by the Engineer if it is determined to be in the best interests of the Department to defer corrective work.

3.2 PORTLAND CEMENT CONCRETE PAVEMENT (PCCP)

A. Construction Requirements
1. Construct finished pavement to meet surface requirements listed in Table 1.
2. Identify defects exceeding the limits in Table 1 and correct prior to acceptance testing.
    a. Analyze the profile using 0.2 inch blanking band.
3. Correct defects across the entire width of the traffic lane or shoulder by grinding with a device approved by the Engineer.
    a. Re-profile for correction verification prior to acceptance testing.
4. Correct transverse defects where the pavement surface varies more than 1/8 inch from the lower edge of a 10 foot straightedge placed perpendicular to the centerline of the roadway.

B. Incentive/Disincentive - PCCP
1. Incentive/Disincentive applies only to Class I surfaces for each pavement section defined in this Section, article 1.5, Acceptance, paragraph B.
    a. Incentive/Disincentive is calculated according to Table 4, with partial sections prorated based on length.

2. Any section requiring grinding exceeding 20 yd^2 does not qualify for incentive.
3. Any section still requiring corrective work that is identified at the time of acceptance testing results in loss of incentive for the section. Disincentives remain applicable and are based on PI obtained at the time of acceptance testing.
4. Failure to correct defects, identified at the time of acceptance testing, within 14 calendar days after notification by the Engineer results in liquidated damages assessed at $100.00 per day per each section needing corrective work.
    a. Liquidated damages may be waived by the Engineer if it is determined to be in the best interests of the Department to defer corrective work.

Table 1 Surface Requirements				
Pavement Category	**Class 1 Surface**		**Class II Surface**	
	Section PI	**Profile Deviation**	**Section PI**	**Profile Deviation**
Category	**in/mi**	**in/25ft**	**in/mi**	**in/25ft**
1	5	0.3	N/A	0.3
2	7	0.3	N/A	0.3
Category 1	National Highway System and Truck Routes (See Section 02741, Table 11) and all other routes with surfaces having three or more opportunities for improving the ride.*			
Category 2	All other routes incorporating single lift overlays with not more than two opportunities for improving the ride.*			
Class I	Surfaces consist of all through traffic and climbing lanes, passing lanes, acceleration and deceleration lanes, shoulders, ramps and turn lanes longer than 1000 ft, including bridges and bridge approach slabs with final riding surfaces placed on the contract. Excluded are horizontal curves having a centerline radius of curvature less than 900 ft and areas within the superelevation transitions to these short radius curves.			
Class II	Surfaces consist of all tapers, road approaches, mainline pavement sections with posted regulatory speeds less than 35 MPH, pavement within 15 ft of bridge decks and approach slabs not paved as part of the project, pavement to a point 50 ft beyond the paving limits of the project and all other surfaces not included in Class 1 and surfaces excluded due to horizontal curves.			

- Each opportunity to improve the ride is one of the following: Placing a gravel or treated base course, OGSC, rotomilling, cold recycling, and each lift of paving. Leveling is not considered as an opportunity to improve the ride.

Table 2 HMA	
Category	**Incentive/Disincentive per Section**
1	**$60 x [(Required in/mi) - (PI)]**
2	**$30 x [(Required in/mi) - (PI)]**

Table 3 OGSC	
Category	**Incentive/Disincentive per Section**
1	**$150 x [(Required in/mi) - (PI)]**
2	**$100 x [(Required in/mi) - (PI)]**

Table 4 PCCP	
Category	**Incentive/Disincentive per Section**
1	**$200 x [(Required in/mi) - (PI)]**
2	**$125 x [(Required in/mi) - (PI)]**

END OF SECTION

SECTION 01455

MATERIALS QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Section 01355: Environmental Protection

1.2 REFERENCES

A. UDOT Materials Manual of Instruction

B. UDOT Minimum Sampling and Testing Requirements Manual

C. U. S. Code of Federal Regulations

1.3 SOURCE OF SUPPLY AND QUALITY REQUIREMENTS

A. Use only materials that meet contract requirements.

B. Notify the Engineer of the proposed source of materials to be used prior to their delivery.

C. Materials can be conditionally approved at the supply source.

D. Correct materials to the satisfaction of the Engineer if materials are conditionally approved but fail to meet contract requirements or remove the materials.

E. Use new materials for the work unless otherwise specified.

1.4 LOCAL OPTIONAL MATERIAL SOURCES - DEPARTMENT FURNISHED SOURCES

A. Possible sources of local optional materials may be designated.
   1. Determine the amount of equipment and work required to produce a material meeting the Specifications using these sources.
   2. Expect variations in both quantity and quality.
   3. Procure material from designated portions of the deposit.

4. Material may be rejected if it is unacceptable or fails to meet contract requirements.

B. Specific information about optional material sites and sources is usually available for inspection at the Region Materials Lab. Sources and sites are those either identified in Contract Documents or within the vicinity of the project, including aggregate quality test or quality control test results from previous projects where the sources or materials sites may have been used or investigated.
   1. This information is made available to prospective bidders upon request for their inspection.
   2. By making this information available, the Department does not represent that a bidder should necessarily expect to produce materials corresponding with those previously produced by others, or that the Contractor may expect to produce based upon the Contractor's interpretation of test data.

C. The Department may acquire the right to take and make materials available from designated sources, including the right to use the property as specified, or for plant site, stockpiles, and haul roads. The Contract defines acquisition and rights provided for this procedure.

1.5 LOCAL OPTIONAL MATERIAL SOURCES - CONTRACTOR FURNISHED SOURCES

A. Obtain Environmental Clearances in accordance with Section 01355.

B. Acquire the rights to take materials from sources other than those designated in the Contract.

C. Locate, where practicable, borrow, gravel, and quarry materials sites where they are not visible from the highway.

D. Pay all related costs including those for increased haul length and for exploring and developing sources.

E. Use material from other than Department-furnished sources only after Department tests indicate that the material is of equal or better value than the Department furnished source, and after its conditional acceptance is received.
   1. Notify the Engineer in writing of the choice of aggregate source.
   2. The Department obtains and processes the additional samples to determine the suitability of the aggregate.
   3. Allow 30 calendar days for sampling and testing after the Engineer has been notified and the number of test sites has been determined.
   4. The Engineer may require additional samples for inspection and testing before authorizing use of the source.

5. Engineer determines the location and necessary number of test sites, with three test sites and samples per aggregate source as a minimum.

F. Pay 50 percent of the Department's sampling and testing cost if the material source is found to be unacceptable for use as a particular contract bid item.

G. Department does not extend time to the original contract time for the time required for Department testing of non-designated sources.

1.6 FINISHING LOCAL MATERIAL SOURCE SITES

A. Finish all (public or private) material source sites to leave a pleasing appearance.

B. Grade to drain without causing excessive erosion and without altering the natural drainage courses.

C. Prepare materials site plans that show in detail the line and grades to which materials are to be removed.
   1. The Engineer evaluates the materials site plans as to their physical, environmental, and ecological effect before materials are removed from that source.
   2. If a property owner requests that the materials site be finished other than stipulated, the change is permitted only with written approval from the Engineer and the property owner.

D. Locate waste sites in areas that are least visible from public view. Spread waste material to obtain a natural appearance.

E. Strip and stockpile topsoil. Spread topsoil that is not used for the highway over the excavated area.

F. Remove trash. Remove, bury or distribute excess materials over the disturbed areas when excavation has been completed.

G. Grade to approved lines and grades, before topsoil is spread.
   1. Avoid vertical cuts and sharp corners.
   2. Grade side slopes to be 3:1 or flatter.
   3. Abandon and obliterate haul roads.

H. Seed all areas disturbed by construction operations, and obliterated haul roads with a grass or grasses adaptable to the area and approved by the Engineer and property owner. Perform seeding under the contract requirements for Seeding, including mulching.

I. Finishing local material source sites, including seeding and mulching, is not measured or paid for separately and is considered incidental to other items of work.

1.7 SAMPLES, TESTS AND REFERENCED CITED SPECIFICATIONS

A. Incorporate into the work only material that the Department has inspected, tested, and accepted. Pay to remove unacceptable materials from the site.

B. Department test methods are the most recent minimum sampling and testing requirements and standard test methods of the Department, AASHTO or ASTM tests in effect at the time the job is advertised.

C. The Department performs testing at its expense, unless otherwise designated.

D. Test method precedence is as follows:
   1. UDOT Minimum Sampling and Testing Requirements Manual
   2. AASHTO
   3. ASTM

E. A Department representative performs or observes sampling and sample splitting of materials.

F. The Department can retest and reject materials conditionally accepted at the source.
   1. Materials designated for use can be inspected, tested, or rejected before or during incorporation into the work.
   2. Copies of any or all test results are available upon request.

G. Pay for retesting of materials made necessary by the Contractor's activities.

H. All Department and Consultant/Contractor materials laboratories, materials test technicians, and construction technician inspectors must be qualified under the requirements of the Manual of Instruction Part 8, to perform material sampling and testing and construction inspection on State, Federal-Aid, local government and maintenance projects.

1.8 CERTIFICATE OF COMPLIANCE

A. The Contract or the Department's current minimum sampling and testing requirements designates manufactured materials and assemblies that can be incorporated in the work, if accompanied by Certificates of Compliance from the manufacturer.
   1. A Certificate of Compliance clearly identifying the materials delivered and the specification requirement satisfied must accompany each lot of materials or assemblies delivered to the work.
   2. The Certificates of Compliance must state that the materials or assemblies provided fully meet the requirements of the Contract, and must be signed by a representative of the manufacturer who is in a position to legally bind the manufacturer.

B. Department may sample and test materials or assemblies used on the basis of Certificates of Compliance and reject or accept if it is determined not to meet contract requirements.

C. The form and distribution of the Certificates of Compliance are as found in the Contract or the Department's Minimum Sampling and Testing Requirements Manual.

1.9 PLANT INSPECTION

A. Department may inspect materials at the acquisition or manufacturing source for compliance with specified manufacturing methods. Department obtains and tests material samples for compliance with quality requirements.

B. Meet the following conditions if inspection is at the plant.
   1. Cooperate fully and assist the Engineer during the inspection.
   2. Allow the Engineer full access to all parts of the plant used to manufacture or produce materials.
   3. Provide and maintain adequate safety measures.
   4. Equip crushing or screening facilities with automatic or semiautomatic mechanical sampling devices.

C. The Department can retest materials conditionally approved at the source prior to incorporation into the work.

D. The Department rejects material not meeting contract requirements.

1.10 STORAGE AND HANDLING OF MATERIALS

A. Store and handle materials to preserve their quality and fitness for the work.

B. Transport bulk materials in a manner to prevent loss or segregation after loading and measuring.

C. Store materials so they can be easily inspected and retested in accordance with this Section.

D. Obtain approval to store materials and Contractor's plant and equipment within the right-of-way.

E. Additional storage space is at the Contractor's expense and option.
   1. Obtain owner's or lessee's written permission before storing material on private property.
   2. Furnish copies of the permission to the Engineer, if requested.

F. Pay to restore storage and plant sites to their original condition.

1.11 UNACCEPTABLE MATERIALS

A. Engineer rejects all materials not meeting the contract requirements.

B. Remove unacceptable materials immediately from the project site unless the defects are corrected and approved by the Engineer or accepted at a reduced price.

1.12 DEPARTMENT FURNISHED MATERIALS

A. Deliver or make available Department-furnished materials at the locations specified in the Contract. Receive, inventory, store, protect, distribute and install Department-furnished material.

B. Include the cost of handling and placing Department-furnished materials in the contract price for the item for which the materials are used.

C. Contractor is responsible for all materials received. The Department deducts from any monies due:
   1. For any shortages, deficiencies, and damage that may occur to the material after delivery.
   2. The demurrage charges resulting from failure to accept the material at the designated time and point of delivery.

1.13 BUY AMERICA

A. Federal-aid projects are subject to Title 23, U. S. Code of Federal Regulations, Section 635.410, Buy America Requirements.
   1. Check the appropriate box on the bid proposal indicating the intent to use steel or iron or both of 100 percent domestic supply, or with some foreign supply.
   2. If neither box is checked, the Department considers the bid a bid for furnishing domestic steel and iron, and uses only domestic steel and iron in the Contract.
   3. The Department awards the Contract to the bidder who submits the lowest total contract bid based on furnishing domestic steel and iron unless the total contract bid exceeds the lowest total contract bid based on foreign steel and iron by more than 25 percent.

B. To be considered domestic, all steel and iron used and all products manufactured from steel and iron must be produced in the United States.
   1. All manufacturing processes, including application of a coating, of these materials must occur in the United States.
   2. Coating includes all processes that protect or enhance the value of the material to which the coating is applied. The material applied, as a coating is not covered under Buy America.

C. If 100 percent steel and iron is furnished, provide a written certification that all contract items using steel and iron are of domestic supply.

D. The above requirement does not preclude a minimal use of foreign material, provided the cost of material used does not exceed one-tenth of one percent (0.1 percent) of the total contract amount or $2,500 whichever is greater.

1.14 CONVICT PRODUCED MATERIALS

A. Federal-aid projects are subject to Title 23, U. S. Code of Federal Regulations, Section 635.417, Convict Produced Materials.

B. Materials produced after July 1, 1991, by convict labor may only be incorporated in a Federal-aid highway construction project if such materials have been:
   1. Produced by convicts who are on parole, supervised release, or probation from a prison, or
   2. Produced in a qualified prison facility and the cumulative annual production amount of such materials for use in Federal-aid highway construction does not exceed the amount of such materials produced in such facilities for use in Federal-aid highway construction during the 12-month period ending July 1, 1987.

PART 2 PRODUCTS Not used

PART 3 EXECUTION Not used

END OF SECTION

SECTION 01554

TRAFFIC CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Traffic Control Plan requirements, and materials and labor necessary for implementation.

B Traffic Control Maintainer, and Flagging.

C. Work zone traffic control devices, advance warning arrow panels, and pilot cars.

1.2 RELATED SECTIONS

A. Section 00555: Prosecution and Progress

B. Section 00725: Scope of Work

C. Section 00727: Control of Work

D. Section 00820: Legal Relations and Responsibility to Public

E. Section 01558: Temporary Pavement Markings

F. Section 02891: Traffic Signs

G. Section 02765: Pavement Marking Paint

1.3 REFERENCES

A. AASHTO Roadside Design Guide, Current Edition

B. ATSSA: American Traffic Safety Services Association.
   1. Quality Standards for Work Zone Traffic Control Devices

C. Manual on Uniform Traffic Control Devices (MUTCD), Current Edition

D. NCHRP- Report 350 Recommended Procedures for the Safety Performance Evaluation of Highway Features

E. UDOT Flagger Training Handbook

F. UDOT Guidelines for Crash Cushions

1.4 BIDDING REQUIREMENTS

A. The apparent low bidder:
   1. Submit three copies of the Traffic Control Plan to the Engineer no later than the fourth Wednesday following bid opening. Submit plans in 11 inches x 17 inches format prepared using CAD software. All plans must be signed and sealed by a professional engineer licensed in the State of Utah. When available, the Department will provide basemap CAD files in Microstation format to the Contractor on a CD-ROM at no cost.
   2. Attend a mandatory meeting at the time and location as directed by the Engineer:
      a. Contractor's Traffic Control Designer
      b. Contractor's Traffic Control Maintainer
      c. Resident Engineer
      d. Region Traffic Engineer or designated representative
   3. Ensure compliance with the plans and specifications. Modify plan if necessary to meet all applicable requirements.
   4. The Department will grant no additional contract time for preparing or modifying the Traffic Control Plan.
   5. Do not begin work until the Traffic Control Plan is implemented for that phase of work. Do not implement traffic control until written authorization is received from the Engineer.

1.5 CERTIFICATIONS

A. After April 1, 2002, use devices and systems that meet NCHRP-350 Report crash test requirements as defined in the four categories by the Federal Highway Administration. Some exceptions will be acceptable as stated below.
   1. Category 1: Cones, tubular marker, delineators, and drums without lights must be certified by the manufacturer as meeting NCHRP-350 Report requirements.
   2. Category 2: Portable sign stands with signs, Type I, II and III barricades, vertical panels, Category 1 devices with light attachments and devices not expected to cause significant vehicle velocity change. These devices and systems must be certified by FHWA as meeting NCHRP-350 Report test requirements.

3. Category 3: Portable/Temporary pre-cast concrete barrier manufactured after October 1, 2002 must be certified as meeting NCHRP-350 Report test requirements.
   a. Manufactured date to be stamped into top of each barrier section using a numeric format (ex: 10/2002) with 2 inch x 2 inch numerals, 1/4 inch deep. See BA series Standard Drawings.
   b. Portable/Temporary pre-cast concrete barrier manufactured prior to October 1, 2002 and meeting NCHRP 230 may be used until they are no longer serviceable.
4. Category 3: Crash Cushions and Truck Mounted Attenuators must be certified by FHWA as meeting NCHRP-350 Report test requirements.
   a. The appropriate GREAT CZ, manufactured by Energy Absorption Systems, may be used until they have completed their normal service life.
5. Category 4: Advanced Warning Arrow Panels and portable variable message signs do not have to meet NCHRP-350 Report test requirements.

1.6 TRAFFIC CONTROL PLAN REQUIREMENTS

A. Design Traffic Control Plan resolving discrepancies between the various standards for traffic control in accordance with Section 00727 and the following:
   1. SN series Standard Drawings for post mounted signs and TC series Standard Drawings.
   2. Manual on Uniform Traffic Control Devices (MUTCD) Current Edition

B. Follow the requirements and limitations identified in the Traffic Control Special Provision (if included), Section 00555, Section 00725, and Section 00820.

C. Consider the safe and efficient movement of traffic when lane closures are proposed.
   1. Open lanes to traffic wherever and whenever practical.
   2. Minimize and restrict lane closures to the locations and times essential for prosecution of work.

D. Provide for concrete barrier and attenuation to satisfy hazard mitigation according to TC series Standard Drawings.

E. Provide for delineation and temporary pavement markings and/or removal as needed for traffic control or as required in accordance with this Section, article 1.6, Traffic Control Plan Requirements, paragraphs H and I.

F. Provide concrete barrier or other positive protection for all hazards (ie: bridge parapets, barrier blunt ends, poles, large equipment to include but not limited to cranes, pile drivers etc.) when hazard is within AASHTO clear zone requirements for approach traffic.

G. Use the following format and provide the following documentation:

1. Section I: Description of each phase
   a. List phases, and corresponding bid items and elements of work to be accomplished in each phase.
   b. Accounting for each contract bid item and element of work, reference the traffic control detail designed to provide for the safe and efficient movement of traffic and safety of workers.
   c. All contract bid items and elements of work must be identified and included in the phasing.
2. Section II: CAD generated drawings showing detailed Traffic Control Plan for each phase:
   a. Adapt Standard Drawings and work zone traffic control examples contained in the MUTCD to reflect actual project conditions such as curves, grades, presence of ramps, intersections and accesses.
   b. Use basemap CAD files when supplied by the Department as a basis for the Traffic Control Plan drawings.
   c. Use the same level of detail as in the MUTCD and UDOT TC series Standard Drawings.
   d. Include the anticipated duration of the traffic control setup used in each phase.
   e. Provide for the safe passage of pedestrians and bicyclists through the work zone in accordance with the Americans with Disabilities Act and the MUTCD.
   f. Clearly indicate the following:
      1) Proposed regulatory speed reductions in accordance with this Section, article 3.6, Construction Zone Speed Limit Requirements.
      2) For all tapers: length of taper, device spacing, lane or shoulder closures, amount of lane shift in accordance with this Section, article 3.3, Traffic Control Signing and Devices, paragraph A.
      3) Length of buffer zone, in accordance with this Section, article.3.3, Traffic Control Signing and Devices, paragraph A.
      4) Device spacing used in tangents in accordance with this Section, article 3.3, Traffic Control Signing and Devices, paragraph B.
      5) Lengths of work zones, lane and shoulder widths and area available for vehicle recovery
      6) Proposed changes to be made to existing traffic signals including: timing changes, phase changes, etc.
      7) Sign locations for required and existing signs.
      8) Existing signs that are to be removed, covered, relocated or otherwise changed from the original configuration.

9) Worker parking, work vehicle and equipment access to and from work area, staging and material sites.

3. Section III: Emergency and Special Situations
   a. Identify procedures for dealing with emergencies and special situations.

H. Provide temporary pavement markings on newly constructed asphalt pavement and refresh as needed until the final surfacing is placed in accordance with Section 01558 as directed by the Engineer.

I. Completely remove all existing traffic markings that conflict with the Traffic Control Plan, in accordance with Section 02765. Do not use paint or other material to cover markings.

1.7 TRAFFIC CONTROL MAINTAINER

A. Certified by the Department or by the American Traffic Safety Services Association (ATSSA) as a Traffic Control Technician. Certifications are available through:

Associated General Contractors
1135 South West Temple
Salt Lake City, Utah
Telephone: 801-363-2753

American Traffic Safety Services Association (ATSSA),
15 Riverside Parkway Suite 100
Fredericksburg, Virginia 22406-1022
Telephone: (800) 272-8772
Internet: Refer to http://www.udot.utah.gov/index.php/m=c/tid=719.

B. Authority:
1. Obtains and uses all labor, equipment, and materials necessary to maintain traffic control.
2. Changes traffic control operations per the traffic control plan.

C. Responsibilities and Duties:
1. Oversees all traffic control operations.
2. Implements the Traffic Control Plan.

3. Remains available 24 hours a day, seven days a week and can be on-site within 30 minutes of notification.

4. Corrects deficiencies immediately upon verbal or written notification from the Engineer or representative.

5. Inspect and document inspections of traffic control on a form acceptable to the Engineer at least four times each day, at least one of which must be conducted during nighttime hours.
    a. Before beginning of shift.
    b. At mid-shift.
    c. Half-hour after shift ends.
    d. At the midpoint of the off-shift period.
6. Coordinates project traffic control with emergency services and local law enforcement agencies.
7. Inspect and document inspections of traffic control twice each day when no construction work is being done.
    a. One during day light hours and one during night time hours
    b. Conduct inspections a minimum of eight hours apart
8. Completes a daily record of traffic control activities using a form acceptable to the Engineer.
9. Submit to the Engineer inspection and activities forms each week on a day and time acceptable to the Engineer.
10. Provide a daily report of all planned traffic control activities to the Engineer by 7:00 a.m. each day. Provide the report each day during the contract.

1.8 MAINTENANCE OF WORK ZONE TRAFFIC CONTROL

A. Implement and maintain traffic control per the Traffic Control Plan. Implement changes to traffic control required in order to meet UDOT Standard Specifications, Drawings and MUTCD at no additional cost to the Department. Coordinate changes to traffic control and the Traffic Control Plan with the Engineer prior to implementation.

B. Meet all requirements of this Section, article 1.7, Traffic Control Maintainer when traffic control devices are required to be in place overnight or on weekends.

C. Meet the acceptable classification as identified by *Quality Standards for Work Zone Traffic Control Devices* published by American Traffic Safety Services Association (ATSSA) for traffic control devices.
    1. Wash devices weekly unless conditions warrant more frequent cleaning.

D. Maintain traffic control devices during and after all snow plowing operations at no additional cost to the Department. Clear snow away from all traffic control devices so that the devices function as intended.

1.9 WAGE RATES FOR TRAFFIC CONTROL PERSONNEL (FEDERAL AID JOBS ONLY)

A. Payment of wages must be as stated below during the time the certified Traffic Control Maintainer, or others involved in setting up or maintaining traffic control devices working under the direction of the certified Traffic Control Maintainer, is on the project site and does any of the following work:

1. Laborer I - for moving traffic control devices by hand; loading or unloading devices on to or off of the truck; and for all hours required to be at the project site except those hours spent in the truck driver classification.
2. Truck Driver - for all hours spent driving on the project site in the performance of the duties required to maintain the traffic control. The rate of pay is determined by the size of vehicle being driven, Pickup Truck being the smallest.

1.10 PAYMENT PROCEDURES

A. Partial Payments - Based on the percentage of the project completed, excluding the cost of traffic control.

B. Price Adjustments:

1. The Department reduces payment when traffic control is not in compliance with the Traffic Control Plan, or when the contractor fails to meet all requirements cited or referenced in this specification.
   a. The amount per day by which the Contractor's compensation will be reduced is calculated using the daily charge for Calendar Day in the Schedule of Liquidated Damages in Table of Section 00555 or the Contract lump sum bid price for Traffic Control divided by the number of contract days, whichever is greater.
2. A Stop Work order issued due to non-compliance with this specification is not considered to be an authorized suspension of contract time. Contract time will continue to accrue as defined Section 00555.

C. Include in the bid item Traffic Control all materials, equipment, labor, flagging, pilot car, temporary pavement markings and/or removal and workmanship required for the design, implementation and maintenance of the Traffic Control Plan.

D. Provide the Engineer in writing with a detailed analysis showing impacts to traffic control caused by extra work that necessitates modification to the Traffic Control Plan. Negotiate and agree to either a lump sum price for additional Traffic Control or agree to unit prices to be used for additional Traffic Control measures or devices required, prior to performing the extra work.

PART 2 PRODUCTS

2.1 PILOT CAR

A. Equip with a reflectorized sign:
   1. Comply with Section 02891
   2. MUTCD sign G20-4

B. Equip with a minimum two rotating lights or strobe lights.
   1. Minimum 4 inch diameter and minimum 6 feet mounting height
   2. Yellow color

2.2 FLAGGER EQUIPMENT AND CLOTHING

A. Comply with to the Department's Flagger Training Handbook.

B. Comply with TC series Standard Drawings.

C. Clothing:
   1. Flagger vest and hard hat: Orange, red-orange, or fluorescent version of these colors:
      a. Safety vest with a minimum of 775 square inches of background material. Night work requires a minimum of 201 square inches of reflective material (100 ½ square inches on the front and 100 ½ square inches on the back). Reflective material will be white and/or strong yellow-green.
      b. Hard hat with 10 square inches of white or strong yellow-green reflective tape placed around the base of the hard hat and visible to traffic from all directions.

2.3 TRAFFIC CONTROL SIGNING AND DEVICES

A. Signs:
   1. Comply with this Section, article 1.5, Certifications
   2. Comply with Section 02891
   3. Comply with TC series Standard Drawing

4. Comply with SN series Standard Drawing when using post mounted signs

B. Channelizing Devices:
1. Comply with this Section, article 1.5, Certifications
2. Comply with TC series Standard Drawing
   a. Comply with Section 02891.
   b. Use construction orange tubular markers and cone during daylight hours only.

C. Precast Concrete Barrier:
1. Comply with this Section, article 1.5, Certifications
2. Comply with TC series Standards Drawings
3. Use an approved construction zone attenuator or permanent style end sections, as listed in UDOT Guidelines for Attenuators and End Section.
   a. Use a construction zone attenuator when approach ends of temporary precast barrier are within AASHTO clear zone.
      1) Use AASHTO Roadside Design Guide to determine proper clear zone distance requirements
      2) Install crash cushions as per CC series Standard Drawings and manufacturer's recommendations.
4. Do not use a truck-mounted attenuator (TMA) to protect temporary precast barrier end for more than 24 hours. Use properly rated TMA as directed in this Section, article 2.3, Traffic Control Signing and Devices, paragraph D.

D. Use properly rated truck-mounted attenuator for the posted speed limit prior to construction.
1. NCHRP-350 Test Level 2 for speeds 45 mph or less
2. NCHRP-350 Test Level 3 for speeds greater than 45 mph.

2.4 ADVANCE WARNING ARROW PANEL

A. Advance Warning Device:
1. Meet all standards as specified in the MUTCD, Section 6F.53 Arrow Panels.
2. Perform all functions as specified in TC series Standard Drawings and the MUTCD

PART 3 EXECUTION

3.1 MODIFICATION OF TRAFFIC CONTROL PLANS

A. Each phase of construction must use an authorized Traffic Control Plan. If a construction phase is proposed that is not covered by the Traffic Control Plan, submit a plan to the Engineer for review.
   1. Submit plans to the Engineer 10 working days before the Traffic Control Plan is to be implemented.
   2. Do not begin work until the Traffic Control plan is authorized for use, and has been fully implemented.
   3. Implement changes required to meet UDOT Standard Specifications, Standard Drawings and MUTCD at no additional cost to the Department.
      a. Comply with this Section, article 1.4, Bidding Requirements, paragraph A, line 1.

3.2 FLAGGING

A. Flaggers must have a current flagging certificate and must present proof of certification upon request by the Department.
   1. Acceptable certifications
      a. UDOT Contractor Certification (Utah Valley State College)
      b. American Traffic Safety Services Association (ATSSA)

3.3 TRAFFIC CONTROL SIGNING AND DEVICES

A. Use posted speed limit prior to construction to compute sign spacing, taper lengths, buffer zones and construction clear zone.
   1. Use plastic drums for lane closure taper devices for speeds 50 mph and greater.
   2. Do not use cones or tubular markers at night

B. Use posted speed during construction to compute the tangent spacing for channelizing devices.

C. Remove all traffic control from site of work when not required within 24 hours.
   1. Remove traffic control devices from the roadway a distance twice that of the Construction Clear Zone, TC series Standard Drawings, if they will be used within 24 hours of the daily work stoppage and are not required for immediate traffic control.
      a. Obtain written permission from property owner prior to storing traffic control devices on private property.

2. Cover post mounted signs when directed by Engineer.
   a. Cover signs completely with an opaque and durable covering.

3.4 ADVANCE WARNING ARROW PANEL

A. May substitute Type C units for Type B units.
   1. Comply with TC series Standard Drawings

B. Do not substitute Type B units for Type C units.

C. Remove Advance Warning Arrow Panel from the site of work when not needed for the control of traffic within a four-hour period.

3.5 TRAFFIC SIGNALS

A. Use uniformed police officer when construction activities are impacting an operating signalized intersection.

B. Use of flaggers at traffic signals permitted when the signals have been turned to red flash mode.
   1. Each approach is to be controlled by a separate flagger(s).
      a. Flaggers can control only two lanes of approach traffic
         1) Third lane control permitted when left or right turn bays present.

C. The Department will make all changes to traffic signal operations.

3.6 CONSTRUCTION ZONE SPEED LIMIT REQUIREMENTS

A. Obtain approval from the Engineer for regulatory speed reductions.
   1. See TC series Standard Drawings.
   2. Use speed reduction only when construction activities impact traffic.
   3. Restore regulatory speed limit at locations where construction activities are not impacting traffic.
   4. See SN series Standard Drawings for post mounted sign requirements.

END OF SECTION

SECTION 01558

TEMPORARY PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installation of temporary pavement markings.

1.2 RELATED SECTIONS

A. Section 01554: Traffic Control

B. Section 02765: Pavement Marking Paint

C. Section 02842: Delineators

1.3 REFERENCES

A. ASTM D 4592: Preformed Plastic Pavement Marking Tape for Limited Service Life.

B. ASTM D 4956: Retroreflective Sheeting for Traffic Control

1.4 PAYMENT PROCEDURES

A. When there is no bid item included in the proposal for Temporary Pavement Markings:
   1. This work is considered incidental to other items of work and no separate measurement or payment will be made.
   2. Include all costs in Traffic Control or other items of work.

PART 2 PRODUCTS

2.1 PAVEMENT MARKING PAINT AND GLASS BEADS

A. Refer to Section 02765.

B. Accepted upon approval of the weights and analysis stated on the containers.

2.2 PAVEMENT MARKING TAPE

A. ASTM D 4592, Type I (Removable)

B. Minimum reflective values:
   1. ASTM D 4592

2.3 RAISED PAVEMENT MARKERS

A. Provide plastic raised pavement markers having reflective material with clear cover(s) as needed for the particular application.
   1. Marker body to be manufactured of polyurethane plastic in color specified for required type.
      a. Width 4 inches, height 2 inches, thickness 0.06 inches.
   2. Reflective sheeting to be a minimum area of 1.50 in^2. Sheeting to meet ASTM D 4956 Type 1 material minimum.
   3. Provide clear polyvinyl chloride covers attached to marker body with heavy duty staples when appropriate for the particular application or work operation.
   4. Marker to be supplied with a method of attaching to pavement surface.

B. Raised Pavement Marker Types
   1. Type Y1, yellow body with yellow reflective sheeting on both sides.
      a. Optional: Type B1, black body with yellow reflective sheeting on both sides.
   2. Type W1, white body with white reflective sheeting on both sides.
      a. Optional: Type B2, black body with white reflective sheeting on both sides.

PART 3 EXECUTION

3.1 GENERAL

A. Apply temporary pavement markings along the entire length of any roadway surfaces opened to traffic.
   1. Apply edge markings when and where delineation is removed or nonexistent. Refer to Section 02842.
   2. Broken line pavement markings are 3 ft long, spaced on a 40 ft cycle length.

B. Follow Preparation requirements in Section 02765.

C. Use channelizing devices or other delineation as directed by the Engineer to indicate road user paths in work zones when it is not possible to provide a clear path with temporary pavement markings.

D. Place transverse marking, using pavement marking tape (4 inches x 24 inches), across exposed longitudinal joint for pavement vertical grade separation greater than 1 inch.
   1. Place markings on a 25 ft spacing.

3.2 PAVEMENT MARKING PAINT AND GLASS BEADS

A. Apply Pavement Marking Paint at the following rates:
   1. 4 inch solid line at 480 to 510 ft/gal.
   2. 4 inch by 3 ft broken line at 6400 to 6800 ft/gal.

B. Apply glass beads at a minimum 6 lbs/gal of paint, over full length and width of lines and pavement markings.

C. Re-apply Pavement Marking Paint at two-week intervals or at a frequency as directed by the Engineer in order to maintain markings that provide a clear path during night and twilight periods and wet pavement conditions.

3.3 PAVEMENT MARKING TAPE

A. Apply Pavement Marking Tape in accordance with manufacturer's directions.

B. Maintain or re-apply Pavement Marking Tape in order to maintain markings that provide a clear path during night and twilight periods and wet pavement conditions.

C. Inspect in accordance with Section 01554 and replace any loose, missing, or damaged pavement markings immediately.

D. Remove the tape immediately before paving.

3.4 RAISED PAVEMENT MARKERS

A. Attach raised pavement marker as per manufactures recommendations.

B. Space raised pavement markers as follows:
   1. Solid line: on 10 ft centers.
   2. Broken line: Two on 3 ft centers spaced on a 40 ft cycle length.

C. Inspect in accordance with Section 01554, and replace any loose, missing, or damaged markers immediately.

D. Remove markers immediately before paving.

END OF SECTION

SECTION 01561

TEMPORARY ENVIRONMENTAL FENCE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing and removing temporary environmental fencing.

1.2 RELATED SECTIONS

A. Section 02936: Vegetation Establishment Period

1.3 REFERENCES

A. AASHTO M 281: Steel Fence Posts and Assemblies, Hot Wrought

1.4 DELIVERY, STORAGE, AND HANDLING

A. The fence and all its components becomes property of the Contractor when construction is complete.

B. When a fence or its components is to remain in place in areas designated for the vegetation establishment period, it becomes the property of the Department. Refer to Section 02936.

1.5 SCHEDULING

A. Install the fence before construction begins.

B. Install fence for vegetation establishment period at the beginning of the establishment period.

PART 2 PRODUCTS

2.1 FENCE FABRIC

A. Polyethylene, high-density, UV stabilized.

B. Width: 4 ft minimum.

C. Tensile Strength: capable of maintaining an upright position through construction.

D. Fabric pattern: sufficient to create a durable visual barrier.

E. Color: orange.

2.2 POSTS

A. Meet AASHTO M 281.

B. Painted or galvanized metal "T" post, 5 ft to 6 ft long.

C. Anchor plates optional.

PART 3 EXECUTION

3.1 INSTALLATION

A. Stake the fence in the required locations.

B. Install posts at a spacing (12 ft maximum) so the fence does not sag more than 2 inches between posts.

C. Weave the fence over the support posts alternating every two loops and secure it to the posts with wire or plastic ties.

3.2 REPAIR AND REMOVAL

A. Maintain the fence during construction.

B. Remove the fence and posts upon completion of construction when required.

END OF SECTION

SECTION 01571

TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for controlling surface environmental conditions at the construction site, and related areas under the Contractor's control.

B. Coordinating temporary erosion control measures.

1.2 RELATED SECTIONS

A. Section 01574: Environmental Control Supervisor

B. Section 02061: Select Aggregate

C. Section 02373: Riprap

D. Section 02610: Pipe Culverts

E. Section 02613: Culvert End Sections

F. Section 02922: Seed, Turf Seed, and Turf Sod

1.3 REFERENCES

A. AASHTO M 288: Geotextile Specifications for Highway Applications.

B. Storm Water Pollution Prevention Plan (SWPPP)

1.4 TYPES

A. Check Dam:
   1. Intercepts and ponds sediment-laden ditch flows.
   2. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle out.

3. Water exits the check dam by flowing over the top.
4. Types:
    a. Straw or Hay Bale
    b. Stone

B. Silt Fence Slope Barrier:
1. Intercepts and ponds sediment-laden sheet flow runoff from slopes.
2. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle out.
3. Water exits by percolating through the silt fence.

C. Slope Drain:
1. Collects and transports storm runoff down the face of a slope.
2. Consists of a berm at the top of the slope, a pipe culvert with end sections and outlet protection.
3. Used until permanent facilities are installed or until vegetation growth is adequate.

D. Drop-inlet Barrier:
1. Intercepts and ponds sediment-laden runoff.
2. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle out.
3. When pond height reaches the top of the barrier, water flows over the bales or stones and into the drop-inlet. If a silt-fence barrier is used, the ponded water percolates through the silt-fence fabric and into the drop-inlet.
4. Types:
    a. Straw or Hay Bale Drop-inlet Barrier
    b. Stone Drop-inlet Barrier
    c. Silt-Fence Drop-Inlet Barrier

E. Sediment Trap:
1. Intercepts and ponds sediment-laden concentrated flows.
2. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle out.

F. Temporary Berm:
1. Diverts storm runoff from a recently constructed slope to a controlled release point.
2. Ridge of compacted soil, with or without shallow ditch.

G. Curb Inlet Barrier:
1. Intercepts Sediment-laden runoff.
2. Minor ponding may occur.

PART 2 PRODUCTS

2.1 MATERIALS

A. Check dams:
   1. Straw or hay bale:
      a. Twine bound hay or straw bales free from weeds declared noxious by the UDA.
      b. Hardwood stakes: 2 inch square (nominal) by 4 feet.
      c. Filter Fabric: AASHTO M 288.
   2. Stone: Well graded within 0.5 inch to 1.5 inch.

B. Silt Fence:
   1. Hardwood Post: 2 inch square (nominal) by 4 feet in length.
   2. Free Draining Granular Backfill Borrow: Refer to Section 02061.
   3. Filter Fabric: Synthetic, pervious sheet of propylene, nylon, polyester, or ethylene yarn. AASHTO M 288.
      a. Allows a flow rate of 0.067 gal/yd^2/min.
      b. Filter efficiency of 97 percent.
      c. With ultraviolet ray inhibitors and stabilizers.
      d. Provide a minimum of 6 months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F.
   4. Fasteners: Staples, wire, zip ties, or nails.

C. Slope Drain:
   1. Pipe Culverts: Refer to Section 02610.
   2. End Section: Refer to Section 02613.
   3. Riprap or Rock Lining: Refer to Section 02373. Fifty percent of the riprap to be between 6 inches and 12 inches with a maximum size of 12 inches and a minimum size of 4 inches.
   4. Hay or straw bales and hardwood stakes: Refer to this Section, article 2.1, Materials, paragraph A, Check Dams.

D. Drop-Inlet Barriers:
   1. Straw or Hay Bale: Refer to this Section, article 2.1, Materials, paragraph A, Check Dams.
   2. Stone: Refer to this Section, article 2.1, Materials, paragraph A2, Check Dams, Stone.
   3. Silt-fence: Refer to this Section, article 2.1, Materials, paragraph B, Silt Fence.

E. Sediment Trap:
   1. Free draining granular backfill borrow: Refer to Section 02061.

2. Riprap or Rock Lining: Refer to Section 02373, and this Section, article 2.1, Materials, paragraph C, Slope Drain.

F. Temporary Berm: Existing Soil.

G. Curb Inlet Barrier:
1. Concrete Building Blocks.
2. Stone: Refer to this Section, article 2.1, Materials, paragraph A2, Check Dams, Stone.
3. Wire Mesh: 0.5 inch by 0.5 inch.

PART 3 EXECUTION

3.1 PREPARATION

A. Follow the Storm Water Pollution Prevention Plan (SWPPP) in the plan.
1. Address in the SWPPP all disturbed areas on a project including staging areas, haul roads, borrow sites, stockpiles, and disposal areas.
2. If SWPPP is not provided in the plans, create and submit a plan to the Engineer for approval.
3. Obtain written approval from the Engineer to change the SWPPP.

B. Designate an Environmental Control Supervisor (ECS) who will:
1. Work directly with the Department SWPPP coordinator designated by the Engineer.
2. Be available as needed to coordinate the SWPPP, inspect and maintain sediment control devices, and resolve other issues.

C. Do not start earth-disturbing work until SWPPP is approved, and appropriate temporary erosion and sediment control measures are in place.

D. Use the most restrictive requirement if a conflict occurs between erosion and sediment control specifications and federal, State, or local agency's laws, rules, or regulations.

3.2 INSTALLATION

A. Provide or construct measures such as check dams, silt fence, slope drains, drop-in inlet barriers, sediment traps, and other erosion control devices or methods to prevent erosion and sedimentation during construction and/or shutdown periods.

B. Follow installation procedures outlined in the Standard Drawings.

3.3 INSPECTIONS

A. Inspect all denuded areas during construction to determine potential erosion problems. Pro-actively apply corrective measures in a timely manner as required.

B. Inspect all sediment retention structures. Refer to Section 01574.

3.4 MAINTENANCE

A. Maintain temporary sediment control devices to ensure they function properly until all disturbed areas draining to them are stabilized.

B. Remove and properly dispose of sediment when it has accumulated half way up the height or it interferes with the performance of the structure.

C. Dispose of sediment removed from erosion control structures in a manner acceptable to the Engineer.

3.5 REMOVAL

A. After all seeding and mulching has been placed and just before final closeout of the project, remove any remaining sediment from behind and around erosion control features and remove all temporary erosion control features unless directed differently by the Engineer.

B. Seed areas where the sediment was removed following Section 02922.

END OF SECTION

SECTION 01572

DUST CONTROL AND WATERING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide and apply water for dust control, and prewetting, mixing, or compacting materials.

1.2 PAYMENT PROCEDURES

A. Reapply water at no additional cost to the Department when material containing natural or applied water is allowed to dry due to the Contractor's inattention or neglect.

B. The Department will not pay separately for furnishing or applying water used in:
1. Hot plant wet collectors.
2. Areas around all HMA and PCC plants, pits, and crusher operations.
3. Roads used to haul materials to and from project site.
4. Rotomilling, sawing, or grinding operations.
5. Maintaining plant life.
6. Lean concrete base and Portland Cement Concrete pavement.
7. Aggregate washing.
8. Wetting foundations before concrete work.
9. Concrete curing.
10. Other items of work for which water is desired as incidental to and included in payment.

PART 2 PRODUCTS

2.1 WATER

A. Free of dirt, silt, or other detrimental matter, and in adequate quantities for dust control and watering requirements.

2.2 EQUIPMENT

A. Water distribution system: self-propelled, pressure distributor with a spray system, equipped with a positive shut-off control. Pressure pump must have the capacity to apply the whole load uniformly.

B. Pressure system must operate at least 75 percent of the time during five successive work days or be removed from the project. In case of pressure system failure, a gravity flow spray system may be used for the remainder of the shift.

C. Water truck: 1000 U.S. gallons minimum capacity, with the capacity clearly and permanently marked on the tank. Engineer may require Contractor to verify capacity.

D. Metered pipeline may be used when prewetting. Apply at a rate and nozzle size to obtain desired results.

PART 3 EXECUTION

3.1 APPLICATION

A. Apply water for dust control in quantities and locations as directed by Engineer. Dust control may be required at any time. Do not waste water.

END OF SECTION

SECTION 01574

ENVIRONMENTAL CONTROL SUPERVISOR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Description of the responsibilities of the Contractor's Environmental Control Supervisor (ECS) to monitor and document environmental mitigation and compliance on the project.

1.2 RELATED SECTIONS

A. Section 01355: Environmental Protection

B. Section 01571: Temporary Environmental Controls

1.3 REFERENCES

A. Storm Water Pollution Prevention Plan (SWPPP)

1.4 SUBMITTALS

A. Submit to the Engineer, certification that the Contractor's proposed ECS has attended and passed the examination for UDOT's Environmental Control Supervisor Training. Contact the UDOT Environmental Section for more information.

B. Submit a NOI and a NOT to the Division of Water Quality at the Department of Environmental Quality (DEQ) as described under Article 3.3.

C. Submit Storm Water Pollution Prevention Plan (SWPPP) inspection reports to the Engineer within 24 hours of the inspection in accordance with Article 3.4.

1.4 ECS QUALIFICATIONS

A. Attend UDOT's Environmental Control Supervisor Training and pass the examination.

B. Knowledge of erosion control principles and best management practices for roadway construction sites.

C. Knowledge of the laws surrounding environmental clearances and how to obtain these clearances required under Section 01355.

D. Be sufficiently knowledgeable to understand the significance and implementation of environmental plans, details, and specifications.

1.5 NON-PERFORMANCE

A. Damages are assessed against the Contractor for non-performance in the amount of $500.00 for each calendar day, or portion thereof, the project is not in compliance with all required permits and regulations. If the Contractor remains not in compliance after three days, the damages assessed are increased to $1,000 per day and increased to $1,500 per day after seven days. Add fines issued by the regulatory agencies against the Department to the damages assessed to the Contractor.

B. No extension of contract time allowed for any project delay resulting directly or indirectly from a violation of project environmental requirements.

PART 2 PRODUCTS **Not used**

PART 3 EXECUTION

3.1 GENERAL RESPONSIBILITIES

A. Successful implementation of all environmental protection commitments and the correct installation of environmental mitigation measures associated with the project.

B. Keep the project in environmental compliance.

C. ECS responsibilities take precedence over any other work commitments.

D. Obtain environmental clearances in accordance with Section 01355 for disturbances, waste sites, staging areas, for example not provided in the Contact.

E. Be available at all times (24-hours a day) during the active project construction to respond as necessary to environmental compliance and to the direction of the Engineer. Be available as needed during seasonal shutdowns.

3.2 REGULATORY AGENCY COORDINATION

A. Work through the Engineer to maintain coordination and communications between the Contractor, Department, and Regulatory Agencies. Process all official communication through the Engineer.

B. Coordinate and conduct on-site meetings on an as-needed basis with Regulatory Agency Inspectors. This could include Regulatory Inspectors from the Utah Division of Water Quality, Utah Division of Water Rights (Stream Alterations), U.S. Army Corps of Engineers (wetlands), and U.S. Fish and Wildlife Service.

C. Notify the Engineer in writing of the results of any agency coordination meeting within 24-hours.

3.3 UTAH POLLUTION DISCHARGE ELIMINATION SYSTEM (UPDES) PERMIT COMPLIANCE

A. Prepare and submit a Notice of Intent (NOI) for Storm Water Discharges with Construction Activity. NOI forms can be completed online at Division of Water Quality website. Refer to http://www.udot.utah.gov/index.php/m=c/tid=719.

B. Do not start earth-disturbing activities until the completed and signed NOI form has been submitted to the Division of Water Quality at the DEQ.

C. Work directly with the Department SWPPP coordinator designated by the Engineer.

D. Place temporary or permanent stabilization measures (for example, mulch, erosion control blankets) as soon as practicable but in no case longer than 14 days unless construction activities resume on that portion of the site within 21 days when activity ceased. If snow cover precludes the mulch placement, apply as soon as practicable. Seasonal shutdowns require that mulch be placed for all disturbed portions of the project.

E. Do not start earth disturbing work until project perimeter temporary erosion measures and those protecting environmentally sensitive areas are in place and approved.

F. Understand that the erosion control measures on the SWPPP are diagrammatic and must be adapted in the field to meet their intended purpose. As the project progresses through the various construction phases, implement the appropriate erosion control measures for that stage. Make necessary changes to the SWPPP to accommodate construction sequencing.

G. Obtain approval from the Engineer to make changes to the SWPPP. Install additional erosion control measures as directed by the Engineer.

H. Be available as needed to coordinate the SWPPP, make necessary changes, inspect, maintain sediment control devices, and resolve other sediment and erosion control issues.

I. Monitor earthwork during construction to detect any evidence of the start of erosion. Pro-actively apply corrective measures.

J. Apply the appropriate maintenance of temporary erosion controls. Refer to Section 01571.

K. At the end of construction, submit a Notice of Termination (NOT) form to the Division of Water Quality to terminate the permit. NOT forms can be obtained at the DEQ or UDOT.

3.4 SWPPP INSPECTIONS

A. At the commencement of earth moving activity, start performing inspections of all temporary erosion control measures a minimum of once every seven calendar days and within 24 hours after any storm event greater than 0.5 inch. Conduct inspections a minimum of once per month when construction site activities are temporarily or seasonally shut down

B. Invite UDOT's SWPPP coordinator appointed by the Engineer to the inspections.

C. After each inspection, complete an inspection report and submit it to the Engineer within 24 hours. Include the following information:
   1. Names of personnel attending the inspection.
   2. Date of inspection
   3. List of problems identified in the previous inspection and document if corrections have been made.
   4. List by station, earth-disturbing activities since previous inspection.

5. List by station, erosion and sediment control measures installed since previous inspection.
6. List by station, new and unresolved problems encountered with specific erosion control measures and describe solutions to be implemented.

END OF SECTION

SECTION 01721

SURVEY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Schedule, coordinate, and provide all construction surveying, staking, calculations essential to complete the project and properly control the entire work.

B. Directed surveying as requested by the Engineer.

1.2 RELATED SECTIONS

A. Section 00727: Control of Work

1.3 MEASUREMENT PROCEDURES

A. Directed Survey: If extra survey work is needed, a 2-Person Crew measured by the hour authorized. Department makes no additional payment for travel time to and from the project.

B. Directed Survey: If extra survey work is needed a 3-Person Crew measured by the hour authorized. Department makes no additional payment for travel time to and from the project.

1.4 PAYMENT PROCEDURES

A. If needed and approved, directed survey work paid for in the accepted quantities at the following rates:

Two person survey crew	$130.00 per hour
Three person survey crew	$155.00 per hour
One person computation and /or CAD	$ 65.00 per hour

B. The number of hours required for computations and/or drafting in total cannot exceed 33 percent of actual survey hours, established on a percent basis prior to directed survey work starts.

1.5 SUBMITTALS

A. The Department requires that a Professional Engineer or Professional Land Surveyor registered in the State of Utah sign and seal all submittals.

B. Resubmittals may be required depending on completeness and correctness of the work.

C. Prior to beginning work, submit a statement indicating all Department-provided horizontal and vertical control have been field checked and the control has been determined to be accurate within the tolerances specified in this Section, article 3.5, Control Point and Survey Tolerances. Attach field survey information used to verify control. If discrepancies are found, notify the Engineer verbally and in writing.

D. Prior to beginning work, provide a written description of the equipment, manpower, methods, and data storage format proposed for use to complete all survey activities.

E. Record keeping: Keep all field notes, diaries, and books according to standard surveying practice.
   1. Loose leaf books not acceptable.
   2. Make available at any time all survey records including field notebooks and forms used for the work to the Engineer upon verbal or written request.
   3. During construction, keep all documentation at a location approved by the Engineer.

F. After project completion, return to the Engineer all surveying and design data and "as staked/constructed" drawings in Microstation format clearly showing all final dimensions, lines, grades, tie-ins and deviations from contract plans.

G. Provide a red-lined hard copy plan set showing as-constructed features denoting changes from the original design.

1.6 QUALITY ASSURANCE

A. Responsible for survey and control of the work, and for correcting Contractor errors, whether the errors are discovered during the actual survey work or in subsequent phases of the project. Bear any cost overruns resulting from Contractor errors.

B. Perform all work in accordance with the plans and specifications and standard Engineering and Surveying practices under the responsible charge of a Professional Engineer or Professional Land Surveyor duly and properly registered in Utah.

C. The Engineer may spot check the work for accuracy and may reject unacceptable portions of work. Resurvey rejected work and correct work that is not within the specified tolerances at no additional expense to the Department.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Furnish tools, supplies, and stakes suitable for use in highway survey work.

B. Furnish stakes and hubs of sufficient length to provide a solid set in the ground with sufficient surface area above ground for necessary legible markings.

C. Furnish survey instruments and supporting equipment capable of achieving the specified tolerances. Calibrate survey equipment for accuracy prior to beginning survey work and as required.

PART 3 EXECUTION

3.1 PREPARATION

A. Discuss and coordinate the following with the Engineer before survey work begins:
1. Required submittals
2. Survey and staking methods
3. Stake markings
4. Grade control
5. Referencing
6. Structure control
7. Any other procedures and control necessary for the work
8. Documentation procedures

B. Establish construction survey points, elevations and grades as necessary to control layout and complete the work. Verify all control surveying and staking meets specified tolerances for prior to beginning work.

C. Calculate all grades, elevations, offsets and alignment data necessary for staking and/or setting items of work. Obtain approval from the Engineer for alternate methods of establishing grade control with wire lines, computer or laser controlled grading or other suitable methods.

D. Provide appropriate traffic control for all survey activities.

E. The Department furnishes:
   1. Plans showing locations of control points
   2. Plans showing locations of Bench Marks
   3. Cross sections developed during design, if any
   4. Electronic project data, if any
   5. Digital Terrain Model used for design, if any

CONTRACT PROVISION DISCLAIMER

RELEASE OF UDOT DATA: Contractor may obtain an electronic copy of the Data Points prepared by UDOT. UDOT provides data points in Microstation and/or Inroads format only. Contractor responsible for translation into other formats. This data does not include the commercial software needed to read the points. In order to obtain an electronic copy, Contractor makes a written request to the Engineer. Contractor agrees and understands that the data points are prepared by UDOT for its own purposes and not for the benefit of private individuals or businesses. Contractor waives any and all claims that may result from the use of or reliance upon the data points. Contractor indemnifies UDOT and holds it harmless for any damages, costs, attorneys' fees, or other liabilities that might be incurred as a result of the Department's use and reliance on the data.

3.2 DIRECTED SURVEY

A. Conduct directed surveying if requested by the Engineer.
   1. Includes work needed for changes and extra work. Provide all labor, materials, and equipment including global positioning satellite equipment.
   2. Obtain prior written authorization from the Engineer documenting the affected work and requirements before performing work under these items.

3.3 COMPUTATIONS AND PLOTS

A. Use cross-sections to calculate volume measurements.

   1. Superimpose final cross sections with original cross sections and calculate final quantities using the average end area method.

2. Develop cross-sections from field measurements.
    a. Take cross section measurements both before and after excavation and prior to backfill.
    b. When the centerline curve radius is less than or equal to 500 ft, take cross sections at a maximum centerline spacing of 25 ft.
    c. When the centerline curve radius is greater than 500 ft, take cross sections at a maximum spacing of 50 ft.
    d. Take additional cross sections at breaks in terrain and at changes in typical sections.
    e. For each cross section, measure and record points at breaks in terrain, but at least every 25 ft unless otherwise approved by the Engineer.
    f. Measure and record points to at least the anticipated slopes and reference locations.
    g. Reduce all cross section distances to horizontal distances from centerline.
    h. Take cross sections at right angles to tangents and normal to curves.
    i. Include in cross sections all grades, locations, and existing ground line profiles.
3. May develop cross sections from digital terrain models provided that:
    a. The ground survey locations do not exceed 100 ft in any direction
    b. Major breaks in terrain are also included.
    c. The horizontal and vertical control for the project is used
    d. The DTM is verified accurate to require tolerances by spot checking throughout the length of the project.

B. Engineer may approve alternate methods of calculating quantities.

3.4 STAKE MAINTENANCE AND MARKING

A. Maintain ALL staking necessary for the work until the construction has been completed and accepted by the Engineer.
    1. Legibly mark all survey stakes with station and offset referenced to their respective control line.
    2. Mark slope, reference and guard stakes with station.
    3. Renew illegible stakes at no additional cost to the Department.

B. Provide and maintain reference stakes that identify stationing at least every 150 ft until all work has been completed and accepted by the Engineer.

3.5 CONTROL POINT AND SURVEY TOLERANCES

A. Relocate initial horizontal and vertical control points in conflict with construction to areas that will not be disturbed by construction operations. Furnish the coordinates and elevations for the relocated points before the initial points are disturbed.

B. Protect bench marks from construction activities. Position all bench marks to allow a level rod to stand vertically and squarely on the mark. Reference bench marks to centerline and horizontal measurements.

C. Survey and establish control within the following tolerances:

Description	Horizontal	Vertical
	Decimals of a foot	
Control points	" 0.01	" 0.01
Centerline points	" 0.04	" 0.04
Cross sections and slope stakes	" 0.10	" 0.10
Slope stake references	" 0.10	" 0.10
Culverts and Ditches	" 0.10	" 0.10
Minor drainage structures	" 0.10	" 0.04
Curb and gutter	" 0.02	" 0.02
Guardrail and concrete barrier	" 0.05	-----
Retaining walls	" 0.05	" 0.01
Bridge substructure and overall	" 0.01	" 0.01
Bridge superstructure and overall	" 0.01	" 0.01
Environmental Control Limits	" 1.00	-----
Clearing and grubbing limits	" 1.00	-----
Right of Way Limits	" 0.02	-----
Roadway subgrade finish stakes	" 0.10	" 0.10
Roadway finish grade stakes	" 0.04	" 0.04
Signals and electrical	" 0.08	" 0.04
Striping	" 0.08	-----
Paving reference line	" 0.04	" 0.01

Coordinate the survey tolerances of any items not listed above with the Engineer.

D. Staking limits:
   1. Stake clearing limits on both sides of centerline at each established station. Locate the clearing limit on the ground as shown by the cut and fill limits on the plans.
   2. Stake right of way limits every 50 ft maximum on tangents, every 25 ft maximum on curves and at all right of way breaks. If staking distance affects line of sight, reduce the distance.
   3. Stake environmental control limits both sides of centerline at each established station. Locate the environmental control limits on the ground as shown by the slope rounding contours and environmental and silt fence locations as shown on the Plans. Stake environmental control limits every 50 ft and every 25 ft where environmental or silt fence is required.

E. Furnish reference stakes for all slope stakes and stakes used for setting items for work.
   1. Maintain the reference stakes for the duration of the project until the Engineer approves removal.
   2. Establish and set slope stakes and references on both sides of centerline at cross section locations.
      a. When the centerline curve radius is less than or equal to 500 ft, place slope stakes at a maximum centerline spacing of 25 ft.
      b. When the centerline curve radius is greater than 500 ft, place slope stakes at a maximum spacing of 50 ft.
   3. Establish slope stakes in the field as the actual point of intersection of the design slope with the natural ground line.
   4. Set slope stake references outside the clearing limits.
   5. Include all reference point and slope stake information on the reference stakes.

F. After the slope staking is completed, record on the cross section guard stakes the vertical distance from the reference point (RP) to the construction grade, at a minimum horizontal distance of 10 ft outside the clearing limits or at right of way.

G. Setting grade finishing stakes:
   1. For grade elevations and horizontal alignment:
      a. On centerline.
      b. On each shoulder at roadway cross section locations and between centerline and shoulder with a maximum spacing of 15 ft.
      c. At the top of subgrade and the top of each aggregate course.
   2. Locations:
      a. Where turnouts are constructed, set stakes on centerline, on each normal shoulder, and on the shoulder of the turnout.
      b. In parking areas, set hubs at the center and along the edges of the parking area.
      c. Set stakes in all ditches to be paved.

3. Maximum spacing between stakes along the alignment: 50 ft.
4. Use guard stakes, etc. at each grade finishing stake.
5. Reset grade finishing stakes as many times as necessary to construct the subgrade and each aggregate course.

3.6 CONCRETE PAVING

A. Develop a method of horizontal and vertical control for the placement of concrete pavement.
   1. Utilize laser, wire, or string line, for example, to maintain horizontal and vertical control.
   2. Maximum spacing: 50 ft.
   3. Set control on both sides of roadway.

B. Profile surface at each edge of placement and adjust grades for smoothness as approved by the Engineer.

C. Measure pavement thickness every 25 ft and adjust as needed.

D. Stake concrete joint and station stamp locations.

3.7 DRAINAGE STRUCTURES

A. Stake drainage structures to fit field conditions and in coordination with the Engineer. The location of the structures may differ from the plans.
   1. Survey and record the ground profile along centerline of structure
   2. Determine the slope catch points at inlets and outlets.
   3. Set reference points and record information necessary to determine structure length and end treatments.
   4. Stake ditches or grade to make the structure functional.
   5. Plot the profile along centerline of the structure to show the natural ground, the flow line, the roadway section, and the structure.
   6. Mark guard stakes with the following, when applicable:
      a. Diameter, length and type of culvert (for example 18 inch x 35 ft corrugated metal pipe (cmp))
      b. The vertical and horizontal distance from the hub to the invert at the end of the culvert or any intermediate point as needed or directed
      c. Flow line grade of the pipe
      d. Station
   7. For storm sewers and waterlines provide a reference at a maximum spacing of 50 ft. Reference inverts of pipe at all manholes.

3.8 BRIDGES

A. Set a minimum of three horizontal and vertical control reference points to be used for surveying all bridge substructure and superstructure components, including but not limited to; pile locations and cutoffs, line and grade for abutments and bents, beam seats, anchor bolts and screed grades.

B. Set intermediate slope stakes at bridge abutments to establish transitions. Place finish grade stakes on the centerline of abutment bearing and at the top of slope of all bridge berms. Place finish grade stakes on each side at top, mid-point or slope and toe of fill.

3.9 BOX CULVERTS

A. Set horizontal and vertical control and reference points. Establish and reference the centerline, back of parapet, skew, and flow line elevations at inlet, outlet and breaks.

3.10 CURB AND GUTTER

A. Set curb and gutter staking at 25 ft intervals on tangent and 10 ft intervals on curve radii. Set line and grade for curb and gutter within 0.02 ft. of the proposed or established grade line.

3.11 GUARDRAIL

A. Stake guardrail vertical and horizontal control at a maximum spacing of 25 ft on tangent sections and 10 ft on curved sections unless otherwise approved.

3.12 EXISTING SURVEY MONUMENTS

A. Under the direction of a surveyor licensed in the State of Utah, locate and reference all private and public land survey monuments that may be destroyed by project construction activities prior to disturbing those existing monuments.

B. Complete referencing and reestablishing those existing monuments at no cost to the Department and before project completion.

C. In some counties the county surveyor references and reestablishes the monuments.
   1. Notify the county surveyor at least 30 days prior to the destruction of any monument.

2. Coordinate the reestablishment of section corner and quarter corner monuments with the county surveyor.
3. Submit drawings and notes showing references to section corners and quarter corners to the Engineer.

D. If a monument is found during construction but is not shown on the contract plans and must be reset, the Department pays for the additional work under the Directed Survey item.

3.13 RETAINING WALLS

A. Set horizontal and vertical control and reference points. Establish and reference the centerline offsets for the walls, radius points, and the beginning and ending wall locations as shown on the plans.

B. Set grade stakes as required for each lift of select material used on the MSE walls.

C. Stake retaining wall vertical and horizontal control at a maximum spacing of 25 ft on tangent sections and 10 ft on curved sections unless otherwise approved.

3.14 CLEANUP

A. Remove and dispose of all flagging, lath, stakes and other staking material after the project is complete.

3.15 UTILITIES

A. As part of cooperating with the utility companies listed in Section 00727, stake control lines as needed so their facilities can be relocated to their proper final position. Also, stake crossings or potential points of conflict between facilities to give proper horizontal and vertical control for the relocation. Schedule this survey work with the utility companies to minimize delays and disruption of survey stakes. Replace all disturbed stakes as necessary to facilitate the relocations. The Contractor is responsible for costs incurred to relocate any utility more than once due to inaccurate or incomplete staking.

END OF SECTION

SECTION 01741

FINAL CLEANUP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Finish and clean all areas disturbed by construction.

1.2 RELATED SECTIONS

A. Section 01455: Materials Quality Requirements.

1.3 PAYMENT PROCEDURES

A. All costs associated with Final Cleanup are incidental to other items of work and no separate measurement or payment will be made.

B. When the Engineer directs clean up work outside the area disturbed by the Contractor, this will be paid as extra work.

1.4 REFERENCES

A. AASHTO Roadside Design Guide.

PART 2 PRODUCTS **Not used**

PART 3 EXECUTION

3.1 CLEANING PROCEDURES

A. Do not drag, push, or scrape along or across the final pavement surface.

B. Only use equipment with pneumatic tires on the final pavement surface.

C. Determine the Safety Zone using the current AASHTO Roadside Design Guide.
   1. No protrusions or depressions greater than 3 inches are allowed within the clear zone (rocks, boulders, ridges, stumps, etc.).
   2. Remove trees and provide proper sight distance.

D. Within drainage ditches: clean all debris and obstructions and dispose of material removed.

E. On fill slopes: cover large rocks or boulders with fine material from roadway excavation or borrow. On slopes steeper than 3:1 beyond the clear zone, clean up of large rocks and boulders may not be required.

F. On cut slopes: do not undercut the slope. Remove all overhanging rocks. On slopes steeper than 4:1 beyond the clear zone, solid ledge rock or partially buried boulders 0.33 yd^3 or more may be left in place.

G. Within borrow and local material source sites: Refer to Section 01455.

H. Within right-of-way limits:
   1. Remove all dead trees and shrubs.
   2. Prune trees and shrubs as required.
   3. Trim and shape trees to provide horizontal sight distance and 20 ft vertical clearances above the roadway.
   4. Remove undesirable live trees, shrubs, and all fruit trees to a depth of 18 inches below natural ground.
   5. Dispose of trash and debris.

I. For staging and office sites:
   1. Clean up and finish in accordance with the requirements as described for the finishing of local material source sites under Section 01455, including seeding and mulching.

END OF SECTION

SECTION 01891

MOVE STREET SIGNS AND MAIL BOX ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Move or reset street signs.

B. Move or reconstruct existing mailbox supports.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 06055: Timber and Timber Treatment

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. ASTM A 36: Carbon Structural Steel

PART 2 PRODUCTS

2.1 CONCRETE

A. Class B. Refer to Section 03055

B. Substitute higher class of concrete if desired.

2.2 WOOD POSTS FOR MAILBOX AND SIGN

A. Refer to Section 06055

2.3 MAILBOX MOUNTING HARDWARE

A. Shelf, platform, and bracket.

B. Zinc plated bolts, washers, and nuts.

C. ASTM A 36M, and AASHTO M 111. Follow GW series Standard Drawings.

PART 3 EXECUTION

3.1 MOVE STREET SIGN

A. Maintain existing signs until construction requires removal. Coordinate with Engineer 24 hours in advance of removing any sign.

B. Relocate existing street signs as indicated or as directed by the Engineer.

C. Remove concrete from existing posts where posts are to be reused.

D. Reset post in 8.0-inch diameter concrete base. Keep the box within 1/8 inch of the finished grade.

E. Fill and compact hole left by removing sign post. Compact to density of adjacent material.

3.2 MOVE MAIL BOX

A. Furnish and install new posts, shelf, and brace, firmly attaching boxes to the support. Refer to GW series Standard Drawings.

B. Repair or replace mailboxes damaged during construction.

C. Install temporary posts and mailboxes if required, then remove.

END OF SECTION

SECTION 01892

RECONSTRUCT CATCH BASIN, CLEANOUT, METER, VALVE, MANHOLE, AND MONUMENT BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reconstruct catch basin, cleanout, meter, valve, manhole, and monument boxes to meet the grade of the adjacent surfaces.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

1.3 REFERENCES

A. AASHTO M 105: Grey Iron Castings.

PART 2 PRODUCTS

2.1 CONCRETE

A. Class AA(AE). Refer to Section 03055.

2.2 EXTENSION RINGS

A. Cast iron. AASHTO M 105

PART 3 EXECUTION

3.1 RAISE BOXES

A. Contractor options:
   1. Remove the cover and frame and raise the box using concrete.
   2. Raise the box using precast concrete manhole sections.
   3. Raise the frame and cover using adjustable extension rings.

B. Set box so that all corners are within 1/8 inch lower than finished grade of roadway.

3.2 LOWER BOXES

A. Remove the frame and break off the existing walls.

B. Use concrete to provide a new seat for the frame.

C. Set box so that all corners are within 1/8 inch lower than finished grade of roadway.

3.3 PAVEMENT REPAIR

A. Place and compact approved material below the pavement structure.

B. Place and consolidate Portland Cement Concrete the full depth of the pavement to match the existing pavement surface.

END OF SECTION

SECTION 02056

COMMON FILL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Common Fill materials and procedures.

1.2 RELATED SECTIONS

A. Section 01455: Material Quality Requirements

B. Section 01741: Final Cleanup

C. Section 02332: Embankment for Bridge

D. Section 02912: Topsoil

1.3 REFERENCES

A. AASHTO M 145: Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

B. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates.

1.4 DEFINITIONS

A. Common Fill: Topsoil and fill materials meeting requirements of this Section.

1.5 SUBMITTALS

A. Prior to delivering Common Fill to site, submit:
   1. Name of supplier and source of imported materials and materials analysis of each Common Fill to be used.
   2. Gradation analysis of Common Fill material.

B. If a change in source of material is required, submit name of supplier, source and gradation analysis of Common Fill prior to delivery to site.

1.6 QUALITY ASSURANCE

A. Reject Common Fill products that do not meet requirements of this Section.

B. Remove any product found defective and install acceptable product at no additional cost to the Department.

1.7 ACCEPTANCE

A. Acceptance of Common Fill product placed in construction is based upon lot size and the gradation of Common Fill samples collected from the lot.

B. Lot Size is one day's production with 5000 ton sub-lots.

C. Engineer reserves the right to select and test Common Fill randomly from any location at the construction site, or from the Common Fill source.

PART 2 PRODUCTS

2.1 BORROW

A. Classifications A-1-a through A-4. Meet AASHTO 145.

2.2 GRANULAR BORROW

A. Classification A-1-a. Meet AASHTO 145.

B. Non-plastic, passing a 3 inch sieve (maximum size).

2.3 GRANULAR BACKFILL BORROW

A. Classification A-1-a. Meet AASHTO 145.

B. Non-plastic, uniformly graded with a particle size of 2 inch maximum.

2.4 SAND

A. Friable natural river or bank aggregate, free of loam, detrimental, or soluble or organic matter.

B. Comply with gradation in Table 1.

Table 1

Sand		
Sieve Size	**Percent Passing (by weight)**	
	Min	**Max**
3/8 inch	100	--
No. 100	--	10

2.5 CLAY (As fill material, or channel or pond liner)

A. Classification CL or CL-ML, as defined by AASHTO M 145.

B. Free of organic matter, frozen material, debris, rocks, and deleterious materials.

C. Homogeneous, relatively uniform.

2.6 TOPSOIL

A. Refer to Section 02912.

2.7 EMBANKMENT FOR BRIDGE

A. Refer to Section 02332.

2.8 SOURCE QUALITY CONTROL

A. Verify gradation following AASHTO T 27 requirements. Select samples uniformly on a random basis.

B. If tests indicate materials do not meet specified requirements, change materials and retest at no additional cost to Department.

C. Contractor-furnished borrow may be used and excavation wasted provided there is no additional cost to Department. Provide borrow that is equal to or better quality than the wasted excavation.

PART 3 EXECUTION

3.1 STOCKPILING

A. Separate differing materials, and prevent mixing.

B. Prevent erosion or deterioration of stockpiles.

3.2 INSTALLING

A. Give Engineer 30 days notice to collect an existing topography, sample, and test materials before opening borrow areas.

B. Give Engineer five working days notice to collect an existing topography, and test materials before enlarging borrow areas.

C. Clear, strip, remove overburden, and blend material at no additional cost to the Department.

D. Place the best quality material in the top portion of the embankment.

E. Finishing Materials Sources: Refer to Section 01455.

3.3 CLEANUP

A. Refer to Section 01741.

END OF SECTION

SECTION 02061

SELECT AGGREGATE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Select fill materials and procedures.

1.2 RELATED SECTIONS

A. Section 02324: Compaction

1.3 DEFINITIONS

A. Select fill: Aggregate materials meeting requirements of this Section.

1.4 QUALITY ASSURANCE

A. Remove products found defective after installation and install acceptable products at no additional cost to the Department.

PART 2 PRODUCTS

2.1 FREE DRAINING GRANULAR BACKFILL BORROW

A. Natural aggregate or crushed slag to meet the following gradation:

Table 1

Free Draining Granular Backfill Borrow Gradation	
Sieve Size	**Percent Passing**
1-1/2 inch	100
1 inch	95 to 100
1/2 inch	25 to 60
No. 4	0 to 10

2.2 UNDERDRAIN GRANULAR BACKFILL

A. Use the following gradations:

Table 2

Underdrain Granular Backfill Gradation		
Sieve Size	Type A Percent passing	Type B Percent passing
2-1/2 inches	100	
1-1/2 inch	80 - 100	100
1/2 inch	55 - 75	50 - 80
No. 4	30 - 60	30 - 65
No. 40	10 - 25	10 - 30
No. 200	0 - 3	0 - 3

PART 3 EXECUTION

3.1 INSTALLATION

A. Underdrain: Refer to Section 02324.
   1. Excavate a trench 3 inches below the underdrain pipe flow-line. Widen to 2 feet plus the outside diameter of the underdrain pipe.
   2. Place underdrain granular backfill in the trench and compact the bottom 3 inches with two passes of a vibratory roller.
   3. Back fill to 12 inches above top of pipe with underdrain granular backfill.
   4. Compact backfill material in 6 inch layers to a 96 percent density when placing the underdrain under a roadway.

END OF SECTION

SECTION 02075

GEOTEXTILES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing geotextiles of the type(s) shown on the drawings, and at other locations as directed by the Engineer.

1.2 RELATED SECTIONS

A. Section 01571: Temporary Environmental Controls.

1.3 REFERENCES

A. AASHTO M 288: Geotextile Specifications for Highway Applications

B. ASTM D 4791: Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

C. UDOT Minimum Sampling and Testing Guide

1.4 SUBMITTALS

A. Submit prior to use: Manufacturer's certificate that each fabric complies with requirements of this Section.

1.5 SAMPLING AND TESTING

A. Follow UDOT Minimum Sampling and Testing Guide requirements.

B. Prior to shipment, test each individual shipment and lot of geotextile, and send testing reports with the shipment to the job site. Clearly label all rolls as being part of the same production run certified as meeting all material requirements.

1.6 PACKAGING, SHIPPING, AND STORING

A. Protect the geotextile from direct sunlight, chemicals, mud, dirt and debris during shipment and storage. Replace at the Contractor's sole expense, any geotextile damaged or deteriorated during shipping, storage or construction.

B. Labeling and Tagging:
   1. Identify each package by a tag or label securely affixed to the outside of the roll on at least one end.
   2. Provide the following required information on the tag:
      a. Name of the geotextile manufacturer
      b. Brand name of the product, width, length, and package weight of geotextile
      c. Orange UDOT Certification sticker

1.7 ACCEPTANCE

A. Department rejects geotextile at installation if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transport, handling or storage.

B. Non-compliance with UDOT Minimum Sampling and Testing Guide requirements will be a basis for rejection.

PART 2 PRODUCTS

2.1 SILT FENCE GEOTEXTILE

A. Refer to Section 01571.

2.2 EROSION CONTROL GEOTEXTILE

A. Furnish as specified in AASHTO M 288.

2.3 DRAINAGE GEOTEXTILE

A. Furnish non-woven drainage geotextile as specified in AASHTO M 288 with in-situ soil designations as shown on the drawings or as indicated by the Engineer.

B. Notify Engineer if soil conditions are different than shown on the drawings.

2.4 SEPARATION GEOTEXTILE

A. Furnish Class II fabric as specified in AASHTO M 288, with Apparent Opening Size of 0.22 mm maximum average roll value.

2.5 STABILIZATION GEOTEXTILE

A. Furnish Class II fabric as specified in AASHTO M 288, with Apparent Opening Size of 0.25 mm maximum average roll value.

2.6 WEED BARRIER GEOTEXTILE

A. Furnish non-woven weed barrier geotextile with elongation less than 50 percent for all weed barrier applications as specified in AASHTO M 288.

2.7 POSTS FOR SILT FENCE

A. Refer to Section 01571.

PART 3 EXECUTION

3.1 GENERAL

A. Place geotextile on areas that are smooth, and free of projections or depressions. Do not drag the geotextile across the subgrade. Roll geotextile out as smoothly as possible in the direction of vehicle travel.

B. Do not operate construction equipment or traffic directly on geotextile.

C. When placed for construction, cover the geotextile with indicated cover material as soon as possible. Do not leave uncovered for more than five days.

D. Place cover material on the geotextile in a manner that the geotextile is not torn, punctured, or shifted. Use a minimum 6 inches thick cover layer, or twice the maximum aggregate size, whichever is thicker. Do not end-dump cover material directly on the geotextile, except as a starter course.

E. Limit construction vehicles in size and mass so rutting in the initial layer above the geotextile is not more than 3 inches deep, or half the layer thickness, whichever is the lesser. Turning of vehicles on the first layer is not permitted.

3.2 INSTALLING SILT FENCE GEOTEXTILE

A. Refer to Section 01571.

3.3 INSTALLING EROSION CONTROL GEOTEXTILE

A. Install at locations shown on the drawings.

B. Unless otherwise specified, overlap the geotextile a minimum of 2 feet at all longitudinal and transverse joints, or sew the geotextile. For sewing requirements, refer to this Section, article 3.8, Sewing.

C. If overlapped, place the geotextile so that the upstream sheet overlaps the downstream sheets.

D. For placement on slopes, overlap each sheet over the next downhill sheet.

E. Anchor the geotextile using key trenches or aprons at the crests and toes of the slope.

F. Pins, usually 18 inches in length may be helpful in securing the geotextile during installation.

G. Repair: Place patch over damaged area and extend 3 feet beyond the perimeter of the tear or damage.

3.4 INSTALLING DRAINAGE GEOTEXTILE FOR SUBSURFACE DRAINAGE

A. Excavate trench to size and depth indicated.

B. Cut geotextile to width required and place in trench. Prevent damage to geotextile.

C. Overlap geotextile 12 inches or the full width of the trench, whichever is less, at the top of the trench.

D. Overlap successive sheets of geotextile a minimum of 12 inches in the direction of flow.

E. Place fill beginning with the sheet(s) overlapped above subsequent sheet(s), to hold geotextile in place.

F. Repair any damage to geotextile by placing patches extending 3 feet in all directions beyond the damaged area.

3.5 INSTALLING SEPARATION GEOTEXTILE

A. Install for pavement sections or other applications at locations shown on the drawings.

B. Unless otherwise specified, overlap the geotextile a minimum of 1 foot at all longitudinal and transverse joints, or sew the geotextile. For sewing requirements, refer to this Section, article 3.8, Sewing.

C. Repair: Place patch over damaged area and extend 3 feet beyond the perimeter of the tear or damage.

D. Place fill, beginning with the sheet(s) overlapped above subsequent sheet(s), to hold geotextile in place.

E. Pins, usually 18 inches in length, may be helpful in securing the geotextile during installation.

3.6 INSTALLING STABILIZATION GEOTEXTILE

A. Install Stabilization Geotextile at locations shown on the drawings, or as designated by the Engineer.

B. Unless otherwise specified, overlap the geotextile a minimum of 2 feet at all longitudinal and transverse joints, or sew the geotextile. For sewing requirements, refer to this Section, article 3.8, Sewing.

C. For placement on slopes, overlap each sheet over the next downhill sheet.

D. Repair: Place patch over damaged area and extend 3 feet beyond the perimeter of the tear or damage.

E. Place fill, beginning with the sheet(s) overlapped above subsequent sheet(s), to hold geotextile in place.

F. Pins, usually 18 inches long, may be helpful in securing the geotextile during installation.

3.7 INSTALLING WEED BARRIER GEOTEXTILE

A. Preparation:
   1. Remove sharp objects, large stones and undesirable vegetation.
   2. If placing geotextile over an existing bed, cut an "X" over each plant and push geotextile under plant base. If placing over a new bed, roll geotextile over soil and cut an "X" for each plant hole. Fold excess geotextile under and cover with specified landscaping materials.

B. Surface Cover: Provide a minimum of 4 inches of cover on all areas on the geotextile unless otherwise specified by Engineer. If using large landscape rock, increase thickness of cover material over geotextile up to three times the diameter of the largest rock material based on Engineer's recommendations. Do not leave any portion of geotextile exposed to direct sunlight.

C. Repair: Repair immediately if damaged. Remove the damaged area plus an additional 3 feet and apply geotextile patch.

D. Maintenance: Maintain surfaces and supply additional landscape materials where necessary, including areas affected by erosion.

3.8 SEWING

A. Perform sewing (seaming) as specified in AASHTO M 288, Section A1-4.

END OF SECTION

SECTION 02078

ASPHALT OVERLAY FABRIC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for preparing asphalt pavement surface, and installing asphalt overlay fabric.

1.2 RELATED SECTIONS

A. Section 02748: Prime Coat/Tack Coat

1.3 REFERENCES

A. AASHTO M 288: Geotextile Specification for Highway Applications

B. UDOT Minimum Sampling and Testing Guide

1.4 PACKAGING, SHIPPING, HANDLING, AND STORING

A. Identify each roll by a tag or label securely fastened to the outside. List the following required information on the tag or label:
   1. Name of the fabric manufacturer.
   2. Brand name of the product.
   3. Width, length, and package weight of fabric.
   4. UDOT Certification Sticker.

1.5 PROTECTION

A. Protect the fabric from direct sunlight, chemicals, moisture, mud, dirt and debris during shipment and storage.

B. Replace at the Contractor's expense, fabric damaged or deteriorated during shipping, storage or construction.

PART 2 PRODUCTS

2.1 ASPHALT OVERLAY FABRIC

A. Use needle-punched non-woven fabric constructed exclusively of manmade polymeric fibers.
   1. Resistant to rotting, mildew, insects, chemicals and ultraviolet (UV) light.
   2. Meet the following additional minimum average roll requirements when sampled and tested with the methods specified.
   3. Refer to AASHTO M 288, Table 7.

2.2 SOURCE QUALITY CONTROL

A. Meet UDOT Minimum Sampling and Testing Requirements.

B. Perform tests prior to shipment for each individual shipment and lot of fabric.

C. Include testing reports and Certificate of Compliance with the shipment to the job- site.

D. Basis for Rejection: In accordance with UDOT Minimum Sampling and Testing Guide requirements.

PART 3 EXECUTION

3.1 PREPARATION

A. Prepare pavement surface:
   1. Remove all dirt, water, oil, and foreign materials.
   2. Clean out and fill cracks wider than 0.25 inch with a sand and asphalt emulsion filler material.

B. Apply tack coat to the prepared surface at a rate of 0.25 gallon to 0.30 gallon per square yard as approved by the Engineer. Refer to Section 02748.
   1. Additional tack coat is required on overlapped areas.
   2. The Engineer considers manufacturer recommendations and the following performance requirements:
      a. Satisfy asphalt retention properties of fabric.
      b. Bond the fabric and overlay to the underlying surface.
      c. Do not create a slippage potential for the overlay.
   3. Uniformly spread excess tack coat before it cools.

3.2 INSTALL FABRIC

A. Place fabric over tack coat with a mechanical unit that produces a wrinkle-free placement.
   1. Remove small wrinkles by hand brooming.
   2. For wrinkles in excess of 1 inch wide, cut the fabric overlapping in the direction of paving.

B. Overlap transverse joints 6 inches in the direction of paving and bond with additional tack coat.

C. Overlap longitudinal joints 4 inches and bond with additional tack coat.

END OF SECTION

SECTION 02082

WATER METER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing water meters as indicated on the plans.

1.2 RELATED SECTIONS

A. Section 02061: Select Aggregate

1.3 REFERENCES

A. ASTM D 1784: Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

B. American Water Works Association's specifications.

PART 2 PRODUCTS

2.1 WATER METERS AND ACCESSORIES

A. Meet the American Water Works Association's specifications.

B. Meter Yoke: 21 inches high (minimum) copper setter as manufactured by Ford or equal.

C. Meter Box:
   1. Rigid PVC pipe meeting ASTM D 1784.
   2. 18 inches in diameter by 3 feet long.
   3. Free standing crush factor of 3000 pounds.

D. Meter Box Cover:
   1. 12 inch minimum diameter lid with lock.
   2. 20 inch minimum diameter ring constructed of cast iron.

E. Pipe and Fittings:
   1. Type K copper for sizes 2 inches and smaller.
   2. Ductile iron class 51 for sizes larger than 2 inches.

F. Aggregate: meet specifications for Free Draining Granular Backfill Borrow. Refer to Section 02061.

G. Corporation Stop and Service Saddle Clamp: Supplied by the water system authority unless otherwise noted on plans.

H. Joint Seal Tape (Teflon).

PART 3 EXECUTION

3.1 PREPARATION

A. Obtain all permits associated with the connection and installation.

B. Coordinate with the water system authority the installation of items not performed by own forces.

C. Before trenching:
   1. Stake water meter.
   2. Have utility companies locate and mark their lines.

D. Coordinate all water main shutdowns with the water system authority and notify the Engineer 72 hours before the shutdown.

3.2 INSTALLING CONTRACTOR FURNISHED WATER METERS

A. Water system authority products and installation specifications supercede those listed below.

B. Excavate a trench from the main supply line to the water meter location at the depth determined by local authorities.

C. Install water meter according to manufacturer's specifications.
   1. Place a 6 inches deep free draining granular backfill borrow sump in the bottom of the meter box.

D. Bed all pipe 2 inches minimum surrounding the pipe with sand.

E. After bedding material is placed, backfill and compact the trenches to the same density as the ground adjacent to the trench.

3.3 INSTALLING FURNISHED WATER METERS AND RELOCATED WATER METERS

A. Unless otherwise noted, replace all existing water service lines with new pipe from the main supply line to the water meter.

B. Coordinate the relocation of existing water meters with the water system authority.

C. For relocated water meters, use existing water meter, yoke, box, and cover. Furnish pipe and fittings as necessary.

D. Complete all work that is not completed by the water system authority.

END OF SECTION

SECTION 02221

REMOVE STRUCTURE AND OBSTRUCTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Remove and dispose of structures and utility items or other obstructions that interfere with construction on or off the site including, but not limited to, foundations, bridges, culverts, fences, guardrail, concrete work, septic tanks, trees.

B. Salvage as specified, or dispose of in an approved manner.

1.2 RELATED SECTIONS

A. Section 01355: Environmental Protection

B. Section 02056: Common Fill

C. Section 02231: Site Clearing and Grubbing

D. Section 03055: Portland Cement Concrete

1.3 PROJECT/SITE CONDITIONS

A. Protect adjacent structures and utilities and their contents that are designated to remain.

PART 2 PRODUCTS

2.1 CONCRETE

A. Use Class A Concrete. Refer to Section 03055.

2.2 COMMON FILL

A. Refer to Section 02056.

PART 3 EXECUTION

3.1 PREPARATION

A. Review all work procedures with Engineer.

B. Coordinate utility location.
   1. Locate and protect all active utilities.
   2. Before beginning work:
      a. Notify Engineer
      b. Notify all affected utilities
      c. Blue Stake the area

C. Restore utility services disturbed by construction operations.

D. Disconnect water service by excavating to the corporation stop and turning it off. Disconnect the service line from the corporation stop.

E. Plug disconnected storm drains or sewer lines near the right-of-way line with a watertight concrete plug extending at least 2.0 ft into the remaining pipe.

F. Remove existing septic tanks, cesspools, leach lines, etc.

G. All materials not designated for use or salvage becomes the property of the Contractor unless owned by a utility company.

H. Excavate all material necessary to permit removal of structure.

3.2 BACKFILL AND COMPACTION GUIDELINES

A. Fill all holes or pits resulting from removal operations with suitable material.

B. Compact the backfilled areas to the density of the surrounding ground, or as specified.

C. Department will pay separately for material used for backfilling as “Roadway Excavation,” or “Borrow.” If no appropriate material item is included in the bid

proposal, it will be considered incidental to the work.

3.3 REMOVAL AND DISPOSAL GUIDELINES

A. Remove and dispose of all material in a manner acceptable to the Engineer.

B. Repair any damage to adjacent area at no additional cost to Department.

C. Remove all concrete to at least 2.0 ft below the finished grade, or 2.0 ft below the natural ground surface, whichever is lower.

D. Obtain all required permits and provide an environmentally safe area for disposal of removed items. Refer to Section 01355.

E. Dispose of removed obstructions at a site secured by the Contractor. Furnish a copy of the disposal permits or agreements in accordance with Section 02231.

3.4 BUILDING, BASEMENT, AND FOUNDATION DEMOLITION

A. Move or demolish designated buildings including basements, foundations, sidewalks, pavement slabs, porches, fences and outbuildings on each parcel.

B. The Department is not responsible for any vandalism or theft that occurs to the building or its contents that reduces the value of the salvage or increases the cost of removal after the award of the Contract.

C. Break the floor into pieces not over 3.0 ft^2 in areas to remain in place. Remove and dispose of pieces over 3.0 ft^2.

D. Include in other items of work, payment for obstructions shown on the plans for removal but not having a bid item included in the proposal.

3.5 BRIDGE, BOX CULVERT DEMOLITION

A. Arrange detours for traffic flow according to traffic control plans.

B. Excavate all material necessary to permit removing structure.

C. Remove structure so that no remaining portion is closer than 3.0 ft to any watercourse or closer than 2.0 ft to the subgrade and embankment surface or within 2.0 ft of the natural ground surface.

D. Remove all structures that will interfere with proposed construction.

E. Complete blasting or other removal operations of existing structure that may damage new construction before placing the new work.

3.6 MANHOLE, CLEANOUT, DIVERSION, AND CATCH BASIN REMOVAL

A. Maintain satisfactory by-pass service during construction operations.

B. Plug unused sewers with a 2.0 ft long concrete plug.

3.7 CATTLE GUARD REMOVAL

A. Remove the cattle guard to at least 2.0 ft below the subgrade surface.

B. Excess materials become the Contractor's property, unless otherwise designated.

3.8 SEPTIC TANK, UNDERGROUND TANK REMOVAL

A. Empty and dispose of tank contents in accordance with Section 01355.

B. Break down and remove tank and appurtenances to at least 2.0 ft below the subgrade surface or finished ground lines.

C. Break the floor into pieces not over 3 ft^2 in area.

3.9 BURIED FUEL TANK DEMOLITION

A. Remove buried fuel storage tanks and dispose of tank contents in accordance with all applicable Laws and Regulations.

B. Do not spill fuel on subgrade.

C. Comply with the State and local authorities having jurisdiction over fuel tank removals.

3.10 GUARDRAIL REMOVAL

A. Remove and dispose of guardrail, posts, hardware, anchor assemblies, terminal assemblies, and attached posts, signs, and delineators.

B. For steel posts, remove to a minimum of 8.0 inches below the subgrade surface or finished ground lines.

3.11 FENCE REMOVAL

A. Prevent people or livestock from entering work site from adjacent properties during removal and installation procedures.

B. Remove fence, posts, and foundations to at least 2.0 ft below subgrade or finished ground lines.

C. Do not damage vegetation and ground cover during removal operations.

3.12 RAILROAD TRACK REMOVAL

A. Remove all rails, ties, paving, track encasement, and other appurtenances.

B. Leave crushed stone or gravel ballast. Grade as necessary.

3.13 TREE REMOVAL

A. Remove all trees with a circumference larger than 20 inches measured at a point 2.0 ft above existing ground.
   1. A tree consists of stump, root, trunk, branches, and foliage.
   2. Multiple leaders rising from a common root will not be counted separately.
   3. Remove the root system to a minimum depth of 2.0 ft below the finished ground level and within a 2.0 ft radius of the stump.
   4. When there is no bid item included in the proposal for "Tree Removal:"
      a. This work is considered incidental to other items of work and no separate measurement or payment will be made.
      b. Include all costs in other items of work.

B. Trees removed with a circumference 20 inches or less, measured at 2.0 ft above existing ground are considered incidental construction.

3.14 CONCRETE HEADWALL REMOVAL

A. Remove headwalls where designated.

B. Replace pipes or structural plate pipes damaged while removing headwall at no additional cost to the Department.

3.15 UTILITY POLE REMOVAL

A. Remove pole and all appurtenances.

B. Remove foundation to at least 2.0 ft below subgrade or natural ground.

3.16 PIPE CULVERT REMOVAL

A. Excavate all material necessary to permit removing pipe culvert, end sections, headwalls, etc.

B. Plugs:
   1. Cut existing pipe culvert 2.0 ft inside the Department's right-of-way, and abandon culvert located on private property.
   2. Plug disconnected pipelines near the right-of-way line with a water-tight concrete plug extending into the remaining pipe at least 2.0 ft.

C. Seal openings in walls of remaining manholes or catch basins with watertight concrete plug.

3.17 SALVAGE

A. Salvage designated equipment and materials.

B. All other materials become the property of the Contractor unless otherwise noted.

END OF SECTION

SECTION 02222

SITE DEMOLITION - CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Demolish, remove, and dispose of concrete pavement, curb, gutter, sidewalk, concrete driveway approach, waterway, and similar hard surfaces.

1.2 RELATED SECTIONS

A. Section 00727: Control of Work

B. Section 02705: Pavement Cutting

PART 2 PRODUCTS **Not used**

PART 3 EXECUTION

3.1 PREPARATION

A. Review all work procedures with Engineer.

B. Coordinate utility location in accordance with Section 00727.

C. Preserve all active utilities.

D. Detours according to traffic control plan.

3.2 CONCRETE PAVEMENT REMOVAL

A. Saw cut existing pavement on the designated with straight vertical edges free from irregularities when joining new construction to existing pavement. Refer to Section 02705.

B. Completely remove pavement down to the underlying base course or subgrade.

3.3 OBLITERATION

A. Break up concrete into pieces not over 1 ft^2 in area. Scarify and cover broken concrete with at least 1 ft of suitable backfill material.

B. Fill depressions and blend with the surrounding contours.

C. Grade materials either along the toe of an embankment or into a depression or borrow pit. Cover with at least 1 ft of suitable backfill material.

3.4 CONCRETE SIDEWALK, CONCRETE DRIVEWAY REMOVAL

A. Remove concrete to the nearest expansion joint or saw cut to provide proper grades and connections.

B. Make concrete cuts straight, vertical to the surface, full depth, and free from irregularities. Refer to Section 02705.

C. Thoroughly clean all adhering materials from existing reinforcement.

D. Do not damage concrete designated to remain.

3.5 CONCRETE CURB, CONCRETE CURB AND GUTTER, RAISED ISLAND, BITUMINOUS CURB REMOVAL

A. Remove curb, curb and gutter, gutters, raised island, bituminous curb, and parts of such improvements to an existing joint or joint sawed with a vertical face.

B. Remove material to provide proper grades and connections.

END OF SECTION

SECTION 02224

DISPOSE OF ASPHALT PAVEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Dispose of all asphalt pavement and material, using methods acceptable to the Engineer and in accordance with all applicable laws and regulations.

1.2 RELATED SECTIONS

A. Section 01355: Environmental Protection

B. Section 02316: Roadway Excavation

C. Section 02330: Embankment

1.3 PAYMENT PROCEDURES

A. Include the excavation and removal of asphalt pavement in Roadway Excavation. Refer to Section 02316.

B. When there is no bid item included in the proposal for "Dispose of Asphalt Pavement:"
   1. This work is considered incidental to other items of work and no separate measurement or payment will be made.
   2. Include all costs in other items of work.

PART 2 PRODUCTS **Not Used**

PART 3 EXECUTION

3.1 DISPOSAL

A. Inside the right-of-way
   1. Use as embankment. Refer to Section 02330.

B. Outside the right-of-way: Refer to Section 01355.
   1. Acceptable when done according to prevailing laws (including environmental laws), ordinances, regulations, and rules.
   2. Furnish the Engineer with copies of the disposal permits or agreements.

END OF SECTION

SECTION 02225

ASPHALT SURFACING REMOVAL (STRUCTURES)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Remove existing asphalt surfacing materials from deck and approach slabs.

PART 2 PRODUCTS

2.1 REMOVAL EQUIPMENT

A. Use removal equipment capable of removing a uniform thickness of asphalt on the deck and the approach slabs without damaging the underlying asphalt, waterproofing membrane, and concrete surfaces.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove any existing waterproofing membrane from the deck and/or concrete approach slabs.

3.2 PARTIAL DEPTH REMOVAL

A. Remove a uniform thickness of asphalt from the deck and approach slabs without damaging the underlying asphalt, waterproofing membrane, or concrete surfaces.
   1. Refer to the plans for the asphalt surfacing removal depth.
   2. Allow no traffic on the asphalt surface after partial depth removal. Return traffic only after placing the final surfacing.

B. Use equipment that weighs less than 22 tons.

END OF SECTION

SECTION 02226

REMOVE CONCRETE SLOPE PROTECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Remove portions of the existing slope protection and the cutoff wall where required.

PART 2 PRODUCTS **Not used**

PART 3 EXECUTION

3.1 PREPARATION

A. The Engineer approved flow limits of the concrete slope protection removal.

3.2 REMOVAL

A. At the designated areas, saw cut the existing slope protection to full depth where necessary.

B. Do not damage or affect in any way the portions of concrete slope protection that are to remain.

3.3 DISPOSAL

A. Dispose of the removed material in an environmentally safe area.

END OF SECTION

SECTION 02231

SITE CLEARING AND GRUBBING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Clear, grub, remove and dispose of trees, stumps, and debris within the designated limits of the roadways, channels, easements, and other designated areas.

1.2 DEFINITIONS

A. Clear: remove and dispose of trees, stumps, logs, limbs, sticks, vegetation, debris, and other material on the natural ground surface.

B. Grub: remove and dispose of roots, buried logs, debris, and other material under the ground surface.

1.3 RELATED SECTIONS

A. Section 01355: Environmental Protection

B. Section 01571: Temporary Environmental Controls

C. Section 02221: Remove Structure and Obstruction

1.4 PAYMENT PROCEDURES

A. When there is no bid item included in the proposal for "Site Clearing and Grubbing:"
   1. This work is considered incidental to other items of work and no separate measurement or payment will be made.
   2. Include all costs in other items of work.

PART 2 PRODUCTS **Not used**

PART 3 EXECUTION

3.1 PREPARATION

A. Verify with Engineer the vegetation or objects to be removed.

B. Review work procedures with Engineer.

C. Schedule work carefully with consideration for property owners and general public.

D. Refer to Section 01571 for temporary environmental measures.

3.2 VEGETATION REMOVAL

A. Grub the areas 2 feet below natural ground within the limits of clearing of all stumps, roots, buried logs, and all other underground obstructions.

B. Stumps, roots, and non-perishable solid objects may remain in cleared areas where the embankment is:
   1. 2.0 feet or more above the natural ground.
   2. At least 2.0 feet away outside the slope stake lines.

C. Completely grub stumps and roots where a structure is to be constructed, piles are to be driven, or unsuitable material is to be removed.

3.3 BACKFILLING

A. Backfill all stump holes, cuts, depressions, and other holes resulting from clearing and grubbing within areas to receive embankment. Compact backfilled areas to the density of the surrounding ground.

B. Measure and pay separately for materials used for backfilling under “Roadway Excavation” or “Borrow.”

C. Consider “Roadway Excavation” and “Borrow” as incidental to the work when these items are not included in the bid proposal. No separate measurement or payment made in this case.

3.4 DISPOSAL

A. Dispose of material in accordance with Section 01355.

B. Do not dispose of material within the designated roadbed.

C. Outside of the right-of-way:
   1. Acceptable when done according to prevailing laws (including environmental laws), ordinances, regulations, and rules, and at no additional cost to the Department.
   2. Furnish the Engineer with copies of the disposal permits or agreements.

D. Inside the right-of-way:
   1. Bury material at locations specified by or acceptable to the Engineer.
   2. Use material to widen embankments and flatten embankment side slopes as approved by the Engineer.
   3. Cover disposed material with a minimum of 2.0 ft of earth and grade to drain properly at no additional cost to the Department.
   4. Reduce wood to chips a maximum of ½ inch thick for mulching cut and fill slopes. Chips may be buried or distributed uniformly on the ground surface and mixed with the underlying earth so the mixtures will not sustain burning.

3.5 TREE REMOVAL

A. Refer to Section 02221.

3.6 PROTECTION

A. Land monuments, property markers, or official datum points:
   1. Protect until their removal is approved.
   2. Reference for re-establishment before removing.

B. Protect trees from damage to roots and branches if they are designated to remain.

C. Protect other vegetation and/or objects designated to remain.

END OF SECTION

SECTION 02312

GRADING FOR LANDSCAPES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for landscape grading.

1.2 RELATED WORK

A. Section 02056: Common Fill

B. Section 02912: Topsoil

1.3 QUALITY ASSURANCE

A. Landscape grading is aesthetic by nature and subject to continual monitoring and modification during backfilling. Work closely with Engineer particularly when grading and constructing berms, channels, or other aesthetic structures.

1.4 PAYMENT PROCEDURES

A. When there is no bid item included in the proposal for "Grading for Landscapes:"
   1. This work is considered incidental to other items of work and no separate measurement or payment will be made.
   2. Include all costs in other items of work.

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS

A. For fill areas that are to be landscaped, provide soils that comply with Section 02056.

B. Topsoil: Refer to Section 02912.

PART 3 EXECUTION

3.1 PREPARATION

A. Identify required line, levels, contours, and datum.

3.2 PROTECTION

A. Protect existing trees, shrubs, lawns, existing structures, fences, roads, sidewalks, paving, curb and gutter, and other features.

3.3 CLEANING

A. Remove stockpiles from the site. Grade site surface to prevent freestanding surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 02316

ROADWAY EXCAVATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavate all material within designated areas, including channels with a bottom width of 12.0 ft or greater. Widen cuts as directed.

B. Rock excavation and removal.

C. Dispose of excavated material; place in embankment and/or other areas.

D. Dispose of Asphalt Pavement per Section 02224.

1.2 RELATED SECTIONS

A. Section 00820: Legal Relations and Responsibility to Public

B. Section 01571: Temporary Environmental Controls

C. Section 01721: Survey

D. Section 02056: Common Fill

E. Section 02061: Select Aggregate

F. Section 02075: Geotextiles

G Section 02224: Dispose of Asphalt Pavement

H. Section 02231: Site Clearing and Grubbing

I. Section 02324: Compaction

J. Section 02705: Pavement Cutting

K. Section 02912: Topsoil

1.3 REFERENCES

A. National Fire Protection Association (NFPA) Standards

B. UOSH Construction Standards

1.4 DEFINITIONS

A. Rock: Solid mineral material that cannot be removed with equipment reasonably expected to be used in the work without cutting, drilling or blasting.

1.5 SUBMITTALS

A. Submit proposed method of blasting, delay pattern, explosive types, and type of blasting mat cover.

1.6 ACCEPTANCE AND PAYMENT PROCEDURES

A. Grading Tolerance: Top surface of subgrade = " 0.1 ft of line and grade.

B. Payment is plan quantity by the cubic yard. If staked quantities differ by 5 percent or less make no adjustment to plan quantities.

C. Notify the Engineer in writing before beginning excavation in any area or balances of excavation if the Contractor determines that the staked quantities differ from the plan quantities by more than 5 percent. The following procedures then apply:
   1. Provide calculations and plots in accordance with Section 01721.
   2. Evaluate the “plan quantities” to “staked quantities” by individual cuts or balances as determined by the Engineer to provide the necessary accuracy.
   3. Do not begin excavation of any cut sections that the Contractor determines to differ from plan quantities by more than 5 percent until the calculations and plots have been submitted, reviewed, and approved adjusted quantities are determined by the Engineer. No payments, partial or final will be made until submissions are provided and approved.

D. When the Engineer determines the staked quantities differ from plan quantities by more than 5 percent, the approved quantities become the adjusted plan quantities and are paid at the original unit bid price.

1.7 STOCKPILING AND HANDLING

A. Stockpile excavated material at approved locations.

B. Waste excess excavation as required.

PART 2 PRODUCTS

2.1 MATERIALS FOR OVER-EXCAVATED AREAS

A. Common Fill: Refer to Section 02056

B. Select Aggregate: Refer to Section 02061

C. Geotextile Fabric: Refer to Section 02075

2.2 EXPLOSIVES

A. Use explosives, delay fuses, and all blasting materials as recommended by the explosives firm. Refer to NFPA 495: Code for the Manufacture, Transportation, Storage, and Use of Explosive Materials.

PART 3 EXECUTION

3.1 PREPARATION AND PROTECTION

A. Refer to Sections 00820 and 01571.

B. Pothole, expose, or otherwise locate buried utilities as necessary.

C. Finish clearing and grubbing within the designated area before starting excavation. Refer to Section 02231.

3.2 STORAGE OF BLASTING MATERIALS

A. Store all explosives securely in compliance with Laws and Regulations. Refer to Section 00820. Refer to NFPA 495: Code for the Manufacture, Transportation, Storage, and Use of Explosive Materials.

B. Mark all storage places clearly.

3.3 TOPSOIL

A. Remove topsoil in accordance with Section 02912.

3.4 DEWATERING

A. Keep excavation free from surface and ground water through all stages of construction.
   1. Maintain adequate drainage during all stages of construction through pumping, pipe culverts and drainage ditches.
   2. Provide temporary facilities when interrupting irrigation systems, sewer, underdrainage, etc.

3.5 EXCAVATION - STANDARD PROCEDURES

A. Finish excavation to reasonably smooth and uniform surface.

B. Provide and maintain satisfactory access to roads, streets, and adjacent property during all phases of construction according to the Traffic Control Plan.

C. Remove material in all cut sections to the depth shown. Scarify to an 8 inch depth and compact to at least 96 percent of maximum laboratory density when necessary to obtain compaction. Refer to Section 02324.

D. Excavate and waste unsuitable material.

E. Material for backfilling or finishing.
   1. Use suitable granular material encountered in excavation to construct the top layers of embankment, for finishing the roadbed, or for backfill when directed by the Engineer.
   2. Haul the granular material directly from excavation to the final position on the roadbed when practical.

F. Use Contractor-furnished borrow and waste roadway excavation if there is no additional cost to the Department and borrow is equal to, or better quality than, the wasted roadway excavation.

3.6 ROCK REMOVAL - NONEXPLOSIVE METHOD

A. Excavate solid rock 6 inches to 1 ft below subgrade and backfill with acceptable material.
   1. Rock removed more than 1 ft below subgrade will not be measured or paid for.
   2. Backfilling of depth greater than 1 ft below subgrade will not be measured or paid for.

3.7 ROCK REMOVAL- EXPLOSIVE METHOD

A. Comply with UOSH Constructions Standards Chapter U rules and regulations.

B. Comply with NFPA 495: Code for the Manufacture, Transportation, Storage, and Use of Explosive Materials.

C. Provide a qualified explosives expert to act as an advisor and consultant during drilling and blasting operations.

D. Do not blast beyond designated areas.

3.8 ROCK FACES

A. Scale rock cuts of all loose rocks and fragments and leave in a neat and safe condition.

3.9 ASPHALT PAVEMENT

A. Cut existing asphalt pavement on the designated line with straight vertical edges free from irregularities when joining new construction to existing pavement. Refer to Section 02705.

B. Excavate all asphalt pavement according to plans.

END OF SECTION

SECTION 02317

STRUCTURAL EXCAVATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavate, backfill, and dispose of all material for constructing bridges, foundations, box culverts, pipe culverts, drains, and other structures.

1.2 RELATED SECTIONS

A. Section 00820: Legal Relations and Responsibility to Public

B. Section 02056: Common Fill

C. Section 02324: Compaction

1.3 PAYMENT PROCEDURES

A. This work is considered incidental to other items and no separate measurement or payment will be made.

PART 2 PRODUCTS Not used

PART 3 EXECUTION

3.1 PREPARATION

A. The designated bottom elevation of the structure reflects information used for design and the Engineer may order changes in writing. Subsurface information shown in the plans reflects the information used for design.

B. Verify conditions in the field.

C. Provide a cofferdam for underwater work, so the excavation can be dewatered.
   1. Use inside dimensions sufficient to provide access to all parts of the foundation forms.
   2. Remove all cofferdams, sheeting, and bracing when no longer needed.

3.2 EXCAVATION

A. Comply with all applicable regulations when excavating and trenching. Refer to Section 00820.

B. Excavate to the established elevations and dimensions.

C. Excavate and waste unsuitable material to the depth directed.

D. Excavate rock, hardpan, or other material unsuitable for the structure foundation to at least 1 ft below the designated elevation.

E. Rock and other hard strata for concrete and masonry foundations:
   1. Clean and cut to a firm surface (level, stepped, or serrated as shown). Foundation cannot contain loose material.
   2. Clean out seams and fill with concrete, mortar, or grout.

F. Dispose of all unused excavation material that impairs the appearance and use of the roadway or waterway.
   1. Clean the space under structures, in channels, and adjacent areas affected by operations to prevent drift and scour.

3.3 BACKFILL AND COMPACTION

A. Refer to Sections 02056 and 02324.

B. Moisten all areas of backfill inaccessible to roller equipment. Compact in successive 6-inch (loose measurement) layers.

C. Do not use excessive water in backfill material.

D. Do not jet backfill.

E. Use a hand-operated vibratory compactor or small vibratory roller in a transverse direction in areas directly adjacent to abutments, backwalls, approach slabs, wing walls, retaining walls, and other structures.

F. Coordinate the rate of placing backfill materials with compaction operations.

G. Unsuitable excavation areas:
   1. Use granular backfill borrow or other suitable material.
   2. Compact to the density of surrounding ground.

END OF SECTION

SECTION 02318

DITCH EXCAVATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for small ditch and surface ditch excavation.

1.2 RELATED SECTIONS

A. Section 02324: Compaction

1.3 DEFINITIONS

A. Small ditch: Ditch or channel with a bottom width less than 12.0 feet.

B. Surface ditch: V-shaped, 1.0 foot deep minimum, and 3.0 feet wide across the top, or as shown in the plans.

PART 2 PRODUCTS **Not used**

PART 3 EXECUTION

3.1 SMALL DITCH EXCAVATION

A. Form the ditch as shown in the plans.

B. Place and compact excavated material in embankments as defined in Section 02324.

3.2 SURFACE DITCH EXCAVATION

A. Construct the ditch along the contour of the ground.

B. Place excavated material to form a berm on the downhill side of the ditch.

C. Shape the ditch and berm so that power-driven mowers can operate on the graded surface.

END OF SECTION

SECTION 02324

COMPACTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Compaction of fill material for embankment foundations, areas through cuts, embankments, dikes, backfill, and other materials.

1.2 REFERENCES

A. AASHTO T 99: Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop. (Method D)

B. AASHTO T 180: Moisture-Density Relations of Soils Using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop. (Method D)

C. AASHTO T 310: In-place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.3 ACCEPTANCE TESTING (BY DEPARTMENT)

A. Density Requirement: The Engineer accepts a test lot following the standard for average density - not less than 96 percent of maximum laboratory density, and when no single determination is lower than 92 percent of maximum laboratory density.

B. Test Lot for Embankment and Subgrade:
   1. Number of tons or cubic yards of embankment placed and compacted during each production day.
   2. Divide test lots into sublots of approximately 3000 tons or 2000 yd^3 and 6000 yd^2 in cut sections, and take one random density test within each sublot.

C. Test Lot for Backfill:
   1. Engineer accepts backfill at pipe culverts, small structures, concrete box culverts, and bridges based on acceptance of the average of four density determinations in a test area.

2. A test lot will not exceed 200 yd^3 of material or be more than one pipe culvert or small structure.

D. Test Lot for Embankment for Bridge:
1. Take at least six random density tests at both ends of the bridge in each 12-inch layer.
   a. Conform to AASHTO T 180, Method D.
   b. Randomly select four of the tests.
   c. Select two of the test within 2.0 feet of the outside perimeter of each layer.
2. Engineer takes density tests:
   a. In the backfill material replacing sub-excavated areas.
   b. In the lower layers of required surcharge as shown.

1.4 PAYMENT PROCEDURES

A. This work is considered incidental to other items and no separate measurement or payment will be made.

PART 2 PRODUCTS Not used

PART 3 EXECUTION

3.1 COMPACTION

A. Moisten or de-water backfill material to obtain optimum moisture for compaction operations.

B. Use a hand-operated vibratory compactor or a vibratory roller adjacent to backwalls of structure abutments and approach slabs.

C. Conform to:
1. AASHTO T 180, Method D for A-1 soils.
2. AASHTO T 99, Method D for all other soils.
3. AASHTO T 310 for in-place field density.

END OF SECTION

SECTION 02330

EMBANKMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Place excavated materials in embankments.

B. Shape and maintain embankments.

C. Fill holes, pits, and other depressions left by removing unsuitable materials.

1.2 RELATED SECTIONS

A. Section 02056: Common Fill

B. Section 02231: Site Clearing and Grubbing

C. Section 02324: Compaction

D. Section 02912: Topsoil

1.3 SUBMITTALS

A. Written approval to disturb areas outside the slope-stake limits. Submit request to the Engineer.

PART 2 PRODUCTS **Not used**

PART 3 EXECUTION

3.1 PREPARATION

A. Finish clearing and grubbing, and topsoil stripping before starting embankment. Refer to Sections 02231 and 02912.

B. Provide and maintain satisfactory access to roads, streets, and adjacent property during all phases of construction according to the traffic control plan.

3.2 STANDARD PROCEDURES

A. Contractor-furnished borrow may be used and excavation wasted provided there is no additional cost to the Department. Provide borrow that is equal to or better quality than the wasted excavation. Refer to Section 02056.

B. Maintain drainage
   1. Grade and maintain the roadway to ensure adequate drainage.
   2. Maintain pipe culverts and drainage ditches, or provide temporary facilities when interrupting irrigation systems, sewer, underdrainage, etc.

3.3 EXECUTION

A. For compaction process, follow Section 02324.

B. Scarify and compact the top 8.0 inches of the ground to at least 90 percent of maximum laboratory density when the embankment height is 6.0 feet or less and the underlying ground consists of loose material.

C. Remove and waste unsuitable material.

D. Break and scarify all underlying road surfaces in pieces not exceeding 3.0 ft^2 in area.

E. Place an initial layer to act as a working platform over soft, wet ground when approved by the Engineer without meeting density specifications. Conform to density specifications when placing embankment above the working platform.

F. Complete preparation of area. The Engineer inspects and accepts the foundation before the embankment is placed.

G. Uniformly spread embankment materials in layers not exceeding 1.0 ft (noncompacted depth) and compact to at least 96 percent maximum laboratory density before placing the next layer. Reduce the uncompacted lift thickness if tests show unsatisfactory density.

H. Finish subgrade surface within 0.1 ft " of line and grade.

I. Do not use rock or pavement materials over 3.0 ft in the largest dimension. Distribute so space exists for placing and compacting embankment material between large rocks or pavement materials.

J. Do not place large rock within 1.0 ft below subgrade surface. Do not allow rocks to protrude above the subgrade surface.

K. Construct embankments placed against a hillside or an existing embankment as specified in DD series Standard Drawings.

L. Route construction equipment uniformly over the layers to assist compaction.

M. Do not use compacting equipment that causes shear failure in the embankment.

N. Requirements for freezing or snowy conditions:
   1. Do not place embankment on frozen or snow-covered areas.
   2. Do not deliver or use frozen material in embankments.
   3. The Contractor may remove snow and frozen material from embankments, foundations, and borrow areas, and furnish unfrozen, embankment material that can be compacted to the specified density. Remove, waste, and replace frozen embankment material at no additional cost to the Department.
   4. Provide the Engineer time to measure wasted material.

O. Excess material, including rock, may be placed on fill slopes outside the clear zone provided it does not create an unsightly appearance. Meet density specifications for materials placed on fill slopes.

END OF SECTION

SECTION 02332

EMBANKMENT FOR BRIDGE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for placing bridge approach embankments.

1.2 RELATED SECTIONS

A. Section 02324: Compaction

1.3 REFERENCES

A. AASHTO M 145: The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

PART 2 PRODUCTS

2.1 MATERIALS

A. A-1 Material.
   1. AASHTO M 145. Conform with 4.0 inch maximum size.
   2. Use 3.0 inch maximum size where piles are to be driven through the embankment.

PART 3 EXECUTION

3.1 INSTALLATION

A. Construct approach embankments within 300 feet of the toe of the bridge approaches from the original existing ground up with designated material.

B. Subexcavate unsuitable material (soft, springy, organic, or yielding material) at natural ground level as directed by the Engineer.

3.2 COMPACTION

A. Refer to Section 02324.

END OF SECTION

SECTION 02338

REFINISH SUBGRADE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reshape and recompact existing subgrade constructed under a previous contract.

1.2 RELATED SECTIONS

A. Section 02056: Common Fill

B. Section 02324: Compaction

1.3 PAYMENT PROCEDURES

A. When there is no bid item included in the proposal for "Refinish Subgrade:"
   1. This work is considered incidental to other items of work and no separate measurement or payment will be made.
   2. Include all costs in other items of work.

PART 2 PRODUCTS Not used

PART 3 EXECUTION

3.1 CONSTRUCTION

A. Scarify the upper 4 inches and compact in accordance with Section 02324.

B. Bring the subgrade to within "0.10 ft of line and grade.

C. Rework or remove material in soft and yielding spots as directed.
   1. Replace with granular borrow and compact to the specified density.
   2. For Granular Borrow: Refer to Section 02056.

D. Maintain the subgrade until the pavement has been placed.

1. Protect the finished subgrade from damage by construction operations or public traffic.
2. Repair all cuts, ruts, and breaks in the surface before placing successive surfacing materials at no additional cost to the Department.

END OF SECTION

SECTION 02372

WIRE ENCLOSED RIPRAP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for wire enclosed riprap.

1.2 DEFINITIONS

A. Connecting wires: Internal galvanized wires used to prevent the walls of the deeper basket units from bulging.

B. Diaphragms: The internal galvanized wire mesh partitions that divide the baskets into smaller cells.

C. Hop Rigs: Heavy wire elements. Precut and performed to fit application tools and serve a similar function to lacing or binding wire.

D. Lacing or binding wire: The galvanized wire used to assemble and join the individual basket modules to each other to form a monolithic structural unit.

E. Reinforcing wires: The thicker galvanized wires incorporated into the wire mesh faces during fabrication of the baskets.

F. Selvedges of the basket structures: The thicker perimeter and edge galvanized wires to which the wire mesh faces of the baskets are securely tied.

G. Wire enclosed riprap: Modular galvanized steel wire mesh box-shaped baskets of varying sizes. Baskets filled with stone on site.

1.3 RELATED SECTIONS

A. Section 02056: Common Fill

B. Section 02075: Geotextiles

C. Section 02316: Roadway Excavation

D. Section 02324: Compaction

E. Section 03211: Reinforcing Steel and Welded Wire

1.4 REFERENCES

A. AASHTO M 288: Geotextile Specification for Highway Applications

B. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

C. ASTM A 116: Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric

D. ASTM A 641: Zinc Coated (Galvanized) Carbon Steel Wire

E. ASTM C 535: Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

1.5 SUBMITTALS

A. Manufacturer's product data including typical construction details and procedures.

1.6 QUALITY ASSURANCE

A. Construct to the line and grade as shown in the plans.

PART 2 PRODUCTS

2.1 MATERIALS

A. Stone:
   1. Sound, clean, angular, well-graded rock, free of seams or cracks.
   2. No stone greater than 10 inches in size.
   3. Retain 95 percent or more of the stone on a square screen having openings whose areas are equivalent to those areas presented by the unstretched or deformed wire mesh from which the basket modules are fabricated.
   4. Maximum 40 percent wear. ASTM C 535.
   5. Maximum 16 percent weighted loss when subjected to five cycles of sodium sulfate. AASHTO T 104.

B. Wire:
1. Use not less than the following minimum gauges.
2. Use wire that meets ASTM A 641, Class 3.
3. Selvage wires: 9 gauge
4. Lacing wire: 13 gauge
5. Hog rings: 9 gauge
6. Connecting wires: 13 gauge
7. Reinforcing wires: 13 gauge
8. Finish a wire coated with polyvinyl chloride (PVC) with a nominal thickness of 0.022 inches and nowhere less than 0.015 inches over the required galvanization when the pH of the liquid or of the native soil in contact is greater than 10.

C. Wire Mesh:
1. Use not less than 11 gauge wire.
2. Furnish non-raveling wire mesh that maintains its overall support function when a single wire in a section of mesh is damaged or cut.
3. Protect the wire elements with a galvanized coating of not less than 0.85 ounces per square foot of wire surface. ASTM A 116, type A (ASTM A 641, class 3).
4. Openings in the wire mesh are not to exceed 4 inches.
5. Must be capable of stretching in length a minimum of 10 percent without reducing the tensile strength of the individual wire strands making up the mesh to values less than those for similar wire, one gauge smaller in diameter.

D. Anchor Rods:
1. Provide 3/4 inch minimum diameter steel rods; reinforcing bars allowed following Section 03211.
2. Use 3 foot long anchor rods with a 3 inch hook bend or a 6 inch "T" welded to the top of the rod.

E. Accessories
1. When required in the plans, furnish Stabilization/Separation Geotextile as specified in AASHTO M 288 and as approved by the Engineer.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove all brush, trees, stumps, and other objectionable materials.

B. Remove unacceptable material to a 1-foot depth. Refer to Section 02316.

C. Replace with granular borrow material bringing the grade to the base of the wire enclosed riprap structure. Refer to Section 02056.

D. Provide a firm foundation by excavating to a dressed uniform surface conforming to the lines and grades shown in the plans and the finished depth of the wire baskets.

E. Compact with two passes of a vibratory roller on 3:1 or flatter slopes. Refer to Section 02324.

F. Do not over excavate or disturb compacted foundations or undisturbed soils outside of the required lines and grades shown on the plans. Secure approval from the Engineer before backfilling or installing geotextiles.

G. When indicated on the plans, install required geotextile fabric. Refer to Section 02075.

3.2 PLACING WIRE ENCLOSED RIPRAP

A. Install all proprietary materials according to manufacturer's recommendations.

B. Assemble individual baskets for all revetment designs in such a manner that the failure and loss of stone fill from any single basket will not cause the failure and loss of stone fill in the adjoining baskets.

C. Assemble the wire mesh bases, lid, ends, and sides into a single units.
   1. Securely selvedge all discontinuous perimeter edges with continuous lacing wire.
   2. Tie all untied edges with binding wire. Tightly loop binding wire around every other mesh opening along the seams in such a manner that single and double loops are alternated.
   3. Connect all common edges of face elements so that the strength and flexibility at the connecting edge is at least equal to that of the mesh faces of the boxes.
   4. The joints formed by tying must have the same strength as the body mesh.

D. Place a diaphragm of the same mesh and gauge as the body of the wire basket module when the length of the basket exceeds one and one-half items its horizontal width. Divide the diaphragms into cells whose lengths do not exceed the horizontal width of the basket. Secure the diaphragm in the proper position to the base section so that no additional tying will be required at this point in assembly.

E. Stretch the baskets if needed only after the empty baskets have been placed into position as indicated in the contract drawings and each empty wire basket module is complete and securely tied to the adjoining basket modules along with vertical reinforced edges and the top selvedges.

F. Place the stone in the wire baskets according to the manufacturer's recommendations.
   1. Protect wire from being broken.
   2. Protect sides and ends from being crushed and kinked. If necessary use a loading frame to support the wire fabric while placing rocks.
   3. Hand place stone fill on exposed vertical faces so that a satisfactory face graduation and loss of smaller stone fill through mesh openings.

G. Insert connecting wires in the cells of baskets deeper than one foot in the following manner:
   1. For baskets of three feet in depth: uniformly fill adjacent cells first with stone to a height of 12 inches.
   2. Place one connecting wire in each direction along the center and secure it to the opposite faces of each cell by looping it around two mesh openings. Twist the ends to the wire to prevent opening.
   3. Fill the baskets with a further depth of 12 inches of stone and tie the two connecting wires at this level.
   4. Fill the basket uniformly to the top and bend the lid over by hand until it meets the front and ends of the basket module. Tightly bind the lid to the edges of the basket with lacing wire along all edges and also along internal cell diaphragm top edges with binding wire. Tightly loop the binding wire around every other mesh opening along the seams in such a manner that single and double loops are alternated.
   5. Connecting wires are not required in wire enclosed riprap baskets of 18 inches or less in depth unless they are being used to build vertical structures; in this case, two connecting wires, one in each direction, at 9 inches from the base will be placed and the lid secured in the same manner as described above.
   6. Connecting wires are not required in wire enclosed riprap baskets of 12 inches or less in depth.

H. Begin assembly and stone placement at the lowest layer or row of wire structures.

I. Tie each subsequent layer or row to the one below and tie adjoining structures.

J. Use wire equal to that required for selvage wire.

K. Install anchors according to manufacturer's recommendation.

END OF SECTION

SECTION 02373

RIPRAP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for placing loose riprap, hand-placed riprap, compacted riprap, and plated riprap.

1.2 RELATED SECTIONS

A. Section 02075: Geotextiles

1.3 REFERENCES

A. AASHTO M 288: Geotextile Specification for Highway Applications

B. AASHTO T 96: Resistance to Degradation of Small Size Coarse Aggregate by Abrasion by Impact in the Los Angeles Machine

C. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

1.4 SUBMITTALS

A. Submit data showing riprap source gradation, wear and soundness, and placement technique 10 working days before use.

B. Submit samples for Quality Assurance testing before use.

PART 2 PRODUCTS

2.1 AGGREGATE

A. Durable, angular, hard, stone that is free from seams, cracks, or other structural defects.

B. Maximum wear not greater than 40 percent when tested. AASHTO T 96.

C. Maximum 16 percent weighted loss. AASHTO T 104.

D. Loose Riprap: Stones graded in size so as to produce a dense mass. The greatest dimension of fifty percent of the stone to be at least two-thirds times, but not more than one and one-half times, the specified thickness of the riprap layer. Not more than ten percent of the rock will have a dimension of less than one-tenth the indicated thickness of the riprap.

E. Hand-placed riprap: Stones of not less than 3 inches in thickness, with seventy-five percent of stones being at least one-third of a cubic foot in volume.

2.2 ACCESSORIES

A. When required in the plans, furnish stabilization/separation Geotextile specified in AASHTO M 288 and as approved by the Region Materials Engineer.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove all brush, trees, stumps, and other objectionable materials.

B. Provide a firm foundation by excavating to a dressed uniform surface conforming to the lines and grades shown in the plans.

C. Do not over-excavate and disturb compacted foundations or undisturbed soils outside of the required lines and grades shown on the plans. Secure approval from Engineer before backfilling or installing geotextiles.

D. Install required geotextile following Section 02075 and plans.

3.2 LOOSE RIPRAP

A. Place stones to secure a rock mass, conforming to the grades and dimensions shown on the plans. Distribute and manipulate the stones in a manner that the larger rock fragments are uniformly distributed and the smaller rock fragments serve to fill the spaces between the larger fragments. Place in a manner that results in unsegregated, densely placed, uniform layers of riprap of the thickness indicated on the plans.

B. Excavate at the toe of the slope and embed riprap as shown in the plans to protect against undercutting.

3.3 HAND-PLACED RIPRAP

A. Place and bed the stones, one against the other, and key together. Fill irregularities between stones with suitable size stones rammed tightly into place.

B. Provide an even, tight finished surface, true to the dimensions shown in the plans.

C. Embed riprap below the ground surface as shown on plans.

3.4 COMPACTED RIPRAP

A. Place loose riprap conforming to this Section, article 3.2, Loose Riprap where indicated on the plans.

B. Compact properly placed loose riprap in a manner that results in the development of an unsegregated dense regular tight surface of graded interlocking sizes, true to the dimensions shown in the plans and free from any irregular surface protrusions over 3 inches in height.

3.5 PLATED RIPRAP

A. Place loose riprap conforming to Section, article 3.2, Loose Riprap where indicated on the plans.

B. Compact properly placed loose riprap by repeatedly striking the riprap surface with a steel (armor) plate, approximately 5 ft by 5 ft and weighing 6,000 lbs, dropped from a height of 3 to5 ft.

C. Compaction is complete when plating action has resulted in a reasonably uniform surface, true to the dimensions shown in the plans and free from any irregular surface protrusions over 4 inches in height.

END OF SECTION

SECTION 02376

EROSION CONTROL BLANKETS/CHANNEL LINERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Approved erosion control products for slopes and channels.

B. Installation requirements.

1.2 DEFINITIONS

A. Erosion Control Blanket: Fabric applied on slopes to prevent soil erosion and protect the seedbed.
   1. Machine-produced fabric consisting of elongated wood or coconut fibers or straw that are bonded together.
   2. Hydraulically applied bonded fiber matrix.

B. Flexible Channel Liner: A machine-produced mat consisting of elongated materials that are bonded together and used to line channels.

1.3 SUBMITTALS

A. A sample of the blanket or liner, staples and other materials used, manufacturer's specifications, and recommended installation requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in original wrapping showing the name of the manufacturer and product description.

PART 2 PRODUCTS

2.1 EROSION CONTROL BLANKETS

A. Contact Engineer for Approved List of Erosion Control Blankets. Approved list is updated annually.

2.2 FLEXIBLE CHANNEL LINERS

A. Contact Engineer for Approved List of Channel Liners. Approved list is updated annually.

PART 3 EXECUTION

3.1 PREPARATION

A. All required grading and seeding in areas to receive erosion control blanket or channel liner should be completed and approved before placing the product.

B. Apply the blanket or liner within 24 hours after seeding or before precipitation falls.

C. If the blanket is not installed and a precipitation event occurs creating soil erosion, replace eroded material, rework the soil, and reseed before installing the blanket or liner.

3.2 INSTALLATION

A. Install the erosion control blanket or channel liner strictly following manufacturer's specifications.

B. Minimize disturbance of the prepared seedbed.

C. Allow the blanket or liner to lay loosely on the soil to achieve maximum soil contact. Remove roots, branches, or other loose objects that cause the blanket or channel liner to "tent." Place roots and branches on areas already blanketed. Do not stretch the blanket during installation.

D. Staple the blanket or liner using manufacturer's specifications. Staple requirements vary according to the steepness and length of the slope.

E. Place additional staples in areas such as: swales, base of humps, against rock outcrops and as required to achieve maximum contact between the blanket and the soil.

END OF SECTION

SECTION 02455

DRIVEN PILES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials, equipment and procedures for driving steel piles.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 03211: Reinforcing Steel and Welded Wire

1.3 REFERENCES

A. AASHTO M 31: Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

B. ASTM A 252: Welded and Seamless Steel Pipe Piles

C. ANSI/AASHTO/AWS D 1.1

1.4 SUBMITTALS

A. Complete and submit the "Pile and Driving Equipment Data" form located at the end of this Section.
   1. The Department uses this information to perform a pile driving wave equation analysis.
   2. Within 14 calendar days after submitting the form, the Engineer provides either:
      a. Approval to continue
      b. Notification of inadequate equipment

3. Mobilize pile driver to the site only after the Engineer indicates that acceptable results of the wave equation analysis have been obtained.
4. Remove pile hammer and other related equipment found to be inadequate for the project pile driving conditions and re-mobilize another hammer at no cost to the Department.
5. Provide accurate test information regarding the yield stress values for each batch (heat) of piles to be used on the project.

1.5 ACCEPTANCE

A. Driven piles may be accepted at a reduced price when the concrete strength is below that specified.
1. Price adjustment pay factor following Section 03055.
2. Sixty-five dollars per cubic yard will be used in the price reduction determination.
3. The computed lump sum pay reduction will be subtracted from the payment for this item.

PART 2 PRODUCTS

2.1 PIPE PILE SHELLS

A. Use new pipe pile shells having wall thickness as shown on plans.

B. Meet requirements for ASTM A 252 steel, for either Grade 2 (normal strength) or Grade 3 (high strength) steel, or for other minimum yield stress values shown on the plans.

2.2 "H" PILES

A. As specified on the plans.

2.3 PORTLAND CEMENT CONCRETE

A. Class A Concrete following Section 03055.

2.4 REINFORCING STEEL

A. Meet AASHTO M 31, Grade 60.

B. Refer to Section 03211.

2.5 PILE DRIVER

A. Equip pile driver following manufacturer's recommendations.

B. Leads:
   1. Used with all types of hammers.
   2. Free moving.
   3. Hold in the required position with guys, stiff braces, or both. Hold the pile parallel to the leads.
   4. Accommodate the maximum length of the pile segment, and extend to the lowest point that the hammer must reach. Obtain approval from the Engineer before using followers.

C. Driving Head: Fits the top of pile and provides full bearing.

D. Hammer:
   1. With fully-operable adjustable settings.
   2. Rated energy as much or greater than the value indicated on the foundation plans.
   3. Install a new hammer cushion before beginning pile driving.
      a. Inspect the hammer cushion with the Engineer present after completing 100 hours of pile driving.
      b. Replace the cushion when it loses 25 percent or more of its original thickness.

PART 3 EXECUTION

3.1 PREPARATION

A. Complete all foundation excavation before driving piles. Dewater excavation a minimum of 3 feet below bottom of footing at all times during pile driving.

B. Compare designated position of piles with the locations of existing piles from previous construction, existing utilities, old foundations, and other potential conflicts. Notify the Engineer of any conflicts. The Engineer designates new pile locations as required to resolve conflicts with locations of existing piles or other conflicts.

3.2 DYNAMIC ANALYSIS

A. Notify the Engineer at least two working days before pile driving is to commence on the project, and at least two working days before piles are to be driven on all subsequent abutment, bent, or pier foundations.

B. The Department performs dynamic testing using a Pile Driving Analyzer (PDA), during the driving of the initial pile at each abutment and bent location. Additional piles may be monitored by the Department if driving conditions warrant.

C. Cooperate fully with the Department in the conducting of PDA including, but not limited to, the following:

1. Provide adequate space and conditions for the PDA rig and equipment.
2. Climb the driver leads as necessary to attach, check and remove PDA gauges; or provide a platform at least 4 feet square with a 4 feet high safety rail, equipped to be raised to the top of the pile located in the leads, to allow Department personnel to safely attach and remove the gauges.
3. Begin installation of instrumentation after placing the pile in the leads. Allow approximately one hour per pile for installation of dynamic measuring equipment. Allow one additional hour for installation of measuring equipment after splicing, if splicing is performed.
4. Reduce the energy of the hammer and/or make other adjustments as necessary, if the stress exceeds the specified limit.
5. Drive piles to the required resistance as determined by the Department to obtain the specified ultimate loads, unless otherwise indicated by the Department.
6. Where required by the Department, re-strike the PDA-tested pile after a sufficient time period (at least 24 hours or more after the initial driving of the pile). Do not perform re-strikes using a cold hammer. If a re-strike is to be performed after the hammer has not been used for over two hours, operate the hammer first on another pile for at least 200 blows before performing the PDA re-strike.

D. The Department must approve the PDA results before pile driving proceeds for the remaining piles. The Department may revise the pile driving criteria during the dynamic test pile driving period, including re-establishing required pile tip elevations.

E. Allow for the Department or PDA firm to conduct one analysis per foundation (abutment or bent), of the Case Pile Wave Analysis Program (CAPWAP) from the PDA testing. Suspend pile driving on the foundation until the CAPWAP results are presented and the Engineer gives notice that results indicate sufficient capacity has been obtained.

3.3 INSTALLATION

A. Pre-drill/pre-auger if the designated pile tip elevation cannot be reached by the approved pile driver. Do not drill holes greater in diameter than the diameter or other maximum dimension of the pile.

B. Pile Splicing:
   1. Butt weld the entire pile cross section using full penetration welds as per ANSI/AASHTO/AWS D.1.1.
   2. Use no more than one spliced section less than 6 ft, and splice no other section less than 30 ft for any pile.
   3. Inspect the driven pile section before splicing any pile section to determine if it has been distorted from its original shape, or otherwise damaged from pile driving operations. Remove the damaged portion where distortion/damage has occurred, before splicing the next segment.

C. Keep driven piles within 6 inches of the designated position and keep exposed portion of the pile within 1/4 inch/feet from vertical (or from direction otherwise shown for battered piles). Before proceeding with backfilling or other associated foundation work, verify that the criteria have been met at the ground surface at the end of pile driving. If either requirement is not met, contact the Engineer to determine the appropriate resolution. The Contractor bears all costs for any measures required to resolve the non-conformance.

D. Drive additional piles at locations designated by the Engineer when replacing damaged piles and/or piles driven out of position and/or alignment as specified above.

E. Drive down piles that were raised because of driving adjacent piles.

F. Engineer evaluates the possible damage to piles from water collecting in open pipe piles. Drive additional piles as determined by the Engineer to resolve concerns with any such pile damage.

G. Remove all loose, displaced, and foreign materials from around the completed piles leaving clean, solid surfaces to receive the concrete.

H. Cutting and capping piles:
   1. Remove all damaged material from the top of the pile.
   2. Keep the sides of piles at least 9 inches away from the nearest edge of footing.
   3. Cut off piles with clean, straight-line cuts to the designated elevation at a right angle to the pile axis. Level all irregularities before placing concrete pile cap.

I. Receive approval from Engineer prior to concrete placement.

J. Embed the tops of piles in the concrete pile cap as shown on the plans.

3.4 CONCRETE FILLING OF PIPE PILES

A. Fill pipe piles with specified concrete shown on drawings, after compliance with all tolerances and required criteria have been established.

B. Prior to filling pipe shell, fill any annular space between the pipe shell and the surrounding soil with grout or clean sand washed down to reestablish lateral support.

C. Avoid segregation of the concrete ingredients.

D. Slump at the time of placement: between 4 and 6 inches.

E. Arrange chutes, pipes, etc. used as aids in placing concrete so concrete does not separate (i.e. flows freely without having to be pushed or shoveled).

F. Place concrete in pipe shell either by free fall or through a tremie or concrete pump.

G. Concrete placed by free-fall falls directly to the base without contacting either the rebar cage or the pipe wall. Use drop chutes or tremie as necessary to achieve this.

H. Do not chute concrete directly into hole.

I. If a hopper or concrete bucket is used, do not discharge concrete directly from the mixer into the hopper or bucket; discharge concrete into a funnel-type downpipe centered over the hopper or bucket.

J. Use high frequency internal vibrators to densify concrete to at least 3 feet below the bottom of the rebar cage, or to at least 12 feet below the pile cutoff level, whichever is deeper.

K. Do not allow vibrators to penetrate concrete that has taken initial set.

L. If concrete placement is to occur after daylight hours, light the work site so all operations are plainly visible.

END OF SECTION
A “Pile and Driving Equipment Data” form follows

Sheet # _____

Pile and Driving Equipment Data

Project No: _____
Project Name: _____ County: _____
Drawing No: _____
General Contractor: _____
Pile Driving Contractor/Subcontractor: _____
Phone: _____ FAX: _____
(Piles driven by, foreman): _____
Date Submitted: _____

Hammer Components		**Hammer**	Manufacturer: _____ Model: _____ Type: _____ Serial No: _____ Manufacturer's Maximum Rated Energy: _____(ft-lb) Stroke at Maximum Rated Energy: _____(ft) Range in Operating Energy: ____ to ____(ft-lb) Range in Operating Stroke: ____ to ____(ft) Modifications: _____ _____
		Ram	Ram Weight: _____ (lb) Ram Length: _____(ft) (for diesel hammers)
		Anvil	Ram Cross Sectional Area: _____(in^2) (With diesel hammers) Anvil Weight: _____(lb)
		Hammer Cushion	Material #1 / Material #2 Name: _____ _____ Area: _____ _____ (in^2) No. of Plates: _____ _____ Thickness: _____ _____ (in) Mod. of Elasticity - E: _____ _____ (psi) Coeff. of Restitution - e: _____ _____
		Pile Cap	Helmet Bonnet Anvil Block Weight: _____(lb) Drive Head
		Pile Cushion (Only for Concrete or Timber Piles)	Material: _____ Area: _____ (in^2) No. of Sheets: _____ Thickness/Sheet: _____ (in) Total Thickness of Pile Cushion: _____ (in) Mod. of Elasticity - E: _____ (psi) Coeff. of Restitution - e: _____
Pile		**Pile**	Diameter: _____ (in) Wall Thickness: _____ (in) Taper (if any): _____ Length in Leads: _____ (ft) Ordered Length: _____(ft) Required Ultimate Capacity: _____ (lb) Description of Splice: _____ Tip Treatment/Plate Description: _____

Use Separate Data Sheet for Each Proposed Hammer and Unique Driving Condition

SECTION 02466

DRILLED CAISSON

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Material, equipment, and procedures for constructing drilled caissons.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete.

B. Section 03211: Reinforcing Steel and Welded Wire.

1.3 QUALITY ASSURANCE

A. If caisson installation is unsatisfactory:
1. Immediately remove the reinforcing steel cage and the concrete.
2. Replace the reinforcing cage and place concrete in a satisfactory manner.
3. Submit proposed remedial action for approval if the reinforcing steel and concrete cannot be removed.

1.4 ACCEPTANCE

A. Drilled caissons may be accepted at a reduced price when the concrete strength is below that specified.
1. Price adjustment pay factor following Section 03055.
2. The Department applies the pay factor to the total length of any caisson containing concrete with strength tests falling below that specified.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT CONCRETE

A. Class A. Follow Section 03055.

B. Modify as follows when placed under water:
   1. Maintain the same minimum compressive strength at 28 days.
   2. Add at least one bag of additional cement per cubic yard of concrete for a minimum of seven bags of cement per cubic yard.
   3. Proportion concrete to facilitate pumping.
   4. Use water reducers or plasticizers per Section 03055.
   5. Keep slump between 4 inches and 8 inches when tested at the truck.

2.2 REINFORCING STEEL

A. Refer to Section 03211.

2.3 CAISSON DRILLING EQUIPMENT

A. Capable of:
   1. Drilling holes of the required diameter and depth in the type of materials located at the footings.
   2. Installing and removing casing.

PART 3 EXECUTION

3.1 PREPARATION

A. Drilling holes:
   1. Drill straight, vertical holes to the tip elevations on plans or as determined by Engineer.
   2. Remove all loose material from the bottom of the drilled holes before placing concrete.
   3. Do not use water for drilling operations.

B. Casing:
   1. Furnish and place casing when required to prevent the drilled hole from caving in and remove casing as the concrete is placed.
   2. Keep the bottom of the casing between 2 feet and 5 feet below the top of the concrete surface when withdrawing.
   3. Prevent concrete separation when withdrawing the casing.

3.2 PLACING CONCRETE

A. Fill drilled holes within 24 hours after drilling.

B. Prevent concrete from striking the steel-reinforcing cage during free-fall. Do not allow the free-fall of concrete to exceed 5 feet without the use of a tremie or a flexible metal spout.

C. Do not vibrate concrete during initial placement. Remove all muck laitance and degraded concrete from the caisson.

D. Vibrate the concrete during placement to at least 10 feet below top of casing.

3.3 PLACING CONCRETE UNDER WATER

A. Submit procedure to Engineer and secure Engineer's written approval to place concrete under water.

B. Use concrete pumping equipment capable of pumping at least 50 yd^3/hr against a minimum 20 feet head of concrete measured from the discharge end of the pump hose extension.

C. Use a rigid, steel pipe pump hose extension with tight couplings straight to within ½ inch in 10 feet.
   1. Length of extension must be greater than or equal to the depth of the caisson.
   2. Inside diameter must be greater than or equal to the concrete pump discharge hose, but not more than one-half of the inside diameter of the reinforcing cage.

D. Purge the pipe of water.
   1. Insert a sturdy plastic ball or equivalent into the top of the pump hose extension before connecting the hose from the concrete pump.
   2. The ball must fit snugly into the pump hose extension when the hose is filled. The hose must be strong enough to resist rupture.
   3. Prime the hose and pipe with Portland Cement slurry.

E. Lower a small diameter pole with an attached flat plate into the hole to determine the top surface of concrete.
   1. Both pole and pipe should be marked so that the length of penetration can be determined immediately.
   2. Prevent the end of the pipe from becoming plugged with soil from the bottom of the hole.

F. Begin pumping the concrete immediately after setting the reinforcing cage and pipe in the hole. Do not begin raising the pipe until the concrete surface is 10 feet above the bottom of the pipe.

G. Keep the bottom of the pipe at least 5 feet below the top of the concrete until the pour is complete and all muck, laitance, and all unsuitable concrete is removed. Provide a positive hold down if the pipe floats to ensure that the minimum 5 feet penetration is maintained.

3.4 FIELD QUALITY CONTROL

A. If plugging of the pipe, equipment breakdown, or loss of the seal at the end of the pipe occurs:
   1. Pull the pipe, reset it 2 feet below the top of the concrete, and purge it.
   2. Lower the pipe to at least 5 feet below the top of the placement, and continue pumping concrete until all degraded concrete has lifted to the top of the caisson.
   3. Remove all muck laitance and degraded concrete.

END OF SECTION

SECTION 02610

PIPE CULVERTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing pipe culvert.

B. Class, type, size, and thickness designations.

C. Asphalt coating for pipe culvert.

1.2 RELATED SECTIONS

A. Section 00820: Legal Relations and Responsibility to Public

B. Section 02317: Structural Excavation

C. Section 02330: Embankment

D. Section 03055: Portland Cement Concrete

E. Section 03310: Structural Concrete

1.3 REFERENCES

A. AASHTO M 36: Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains

B. AASHTO M 55: Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

C. AASHTO M 86: Concrete Sewer, Storm Drain, and Culvert Pipe

D. AASHTO M 167: Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches

E. AASHTO M 170: Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

F. AASHTO M 190: Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches

G. AASHTO M 196: Corrugated Aluminum Pipe for Sewers and Drains

H. AASHTO M 197: Aluminum Alloy Sheet for Corrugated Aluminum Pipe

I. AASHTO M 198: Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

J. AASHTO M 207: Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe

K. AASHTO M 219: Corrugated Aluminum Alloy Structural Plate for Field-Bolted Pipe, Pipe-Arches, and Arches

L. AASHTO M 243: Field Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe Arches, and Arches

M. AASHTO M 245: Corrugated Steel Pipe, Polymer Precoated, for Sewers and Drains

N. AASHTO M 246: Steel Sheet, Metallic-Coated and Polymer Precoated for Corrugated Steel Pipe

O. AASHTO M 294: Corrugated Polyethylene Pipe, 300- to 1200-mm Diameter

P. AASHTO M 304: Polyvinyl Chloride (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter

Q. AASHTO Standard Specifications for Bridge Construction

R. ASTM A 849: Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe

S. ASTM C 443: Standard Specification for Joints for Concrete Pipe and Manholds, Using Rubber Gaskets

T. ASTM D 1784: Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

U. ASTM D 3212: Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

V. ASTM D 3350: Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

W. ASTM F 477: Elastomeric Seals (Gaskets) for Joining Plastic Pipe

X. Utah Occupation Safety and Health Regulations

PART 2 PRODUCTS

2.1 PIPE CULVERT CLASSES

A. Pipe Culvert Classes:
   1. Class A: Pipe used in mostly non-reactive soils, and that require no special materials, treatment, or coating.
   2. Class B: Pipe used in moderately reactive and corrosive soils.
   3. Class C: Pipe used in soils which are highly reactive and corrosive.
   4. Class D: Untreated structural plate pipe used in mostly non-reactive and non-corrosive soils.
   5. Class E: Structural plate pipe used in highly reactive and corrosive soils.

B. Pipe Culvert Class Substitutions: May be made at no additional cost to the Department.
   1. Class B and C may be substituted for Class A.
   2. Class C may be substituted for Class B or A.
   3. Class E may be substituted for Class D.

C. Refer to Table 1.

Table 1: AASHTO Reference Specifications for Pipe Culverts

Pipe Culvert Type		Pipe Culvert Class				
		A	B	C	D	E
Substitutions: Class B and C may be substituted for Class A, Class C may be substituted for Class B or A, Class E may be substituted for Class C.						
1.0	**Corrugated Pipe Culverts and Pipe Arch Culverts:**					
1.1 1.1(a)	Corrugated steel pipe. Corrugated steel pipe arch. **(1)**	M 36	M 36 Asphalt Coating (Type A) M 190 OR Polymeric Coating 0 Fm (inside) / 250 Fm (outside) M 245 & M 246 ASTM A 849 or Aluminized Type II Steel M 274 (2)	M 36 Asphalt Coating (Type A) M 190 OR Polymeric Coating 250 Fm (inside)/250 Fm (outside) M 245 & M 246 ASTM A 849	N/A	N/A
1.2 1.2 (a)	Corrugated aluminum pipe. Corrugated aluminum pipe arch. **(1)**	M 196 M 197	M 196 M 197	M 196 M 197	N/A	N/A
1.3	Corrugated polyethelene (HDPE) pipe	M 294 Cell class # 335420C ASTM D 3350	M 294 Cell class # 335420C ASTM D 3350	M 294 Cell class # 335420C ASTM D 3350	N/A	N/A
2.0	**Smooth-Lined Pipe Culverts and Pipe Arch Culverts:**					
2.1	Concrete lined corrugated steel pipe (Use Type V cement. Refer to Section 03055)	M 36	M 36 Asphalt Coating (Type A) M 190 OR Polymeric Coating 250 Fm (inside) /250 Fm (outside) M 245 & M 246 ASTM A 849	M 36 Asphalt Coating (Type A) M 190 OR Polymeric Coating 250 Fm (inside) /250 Fm (outside) M 245 & M 246 ASTM A 849	N/A	N/A
2.2	Smooth lined polyethylene pipe.	M 294 Cell Class # 334433C and 335434C ASTM D3350	M 294 Cell Class # 334433C and 335434C ASTM D3350	M 294 Cell Class # 334433C and 335434C ASTM D3350	N/A	N/A
2.3	Smooth lined Poly Vinyl Chloride (PVC) pipe	M 304 Cell Class # 12454C ASTM D 1784	M 304 Cell Class # 1245C ASTM D 1784	M 304 Cell Class # 1245C ASTM D 1784	N/A	N/A

Pipe Culvert Type		Pipe Culvert Class				
		A	B	C	D	E
Substitutions: Class B and C may be substituted for Class A, Class C may be substituted for Class B or A, Class E may be substituted for Class C.						
2.4 2.4 A	Asphalt smooth lined corrugated steel pipe Pipe arch	M 36	M 36 Asphalt Coating (Type D) M 190	M 36 Asphalt Coating (Type D) M 190	N/A	N/A
2.5 2.5 a	Spiral rib steel pipe Spiral rib steel pipe arch	M 36	M 36 Asphalt Coating (Type A) M 190 OR Polymeric Coating 0Fm (inside) / 250 Fm (outside) M 245 and M 246, ASTM A 849 or Aluminized Type II Steel M 274 (2)	M 36 Asphalt Coating (Type A) M 190 OR Polymeric Coating 250 Fm (inside)/250 Fm (outside) M 245 and M 246 ASTM A 849	N/A	N/A
2.6	Spiral rib aluminum pipe and pipe arch	M 196 and M 197	M 196 and M 197	M 196 and M 197	N/A	N/A
2.7	Reinforced concrete pipe	M 170 Type II Cement	M 170 Type II Cement	M 170 Type V Cement	N/A	N/A
2.8	Non-reinforced concrete pipe	M 170 Type II Cement	M 170 Type II Cement	M 86 Type V Cement	N/A	N/A
2.9	Elliptical reinforced concrete pipe	M 207 Type II Cement	M 207 Type II Cement	M 207 Type V Cement	N/A	N/A
3.0	**Structural Plate Pipe and Pipe Arch Culverts**					
3.1	Structural steel plate pipe culverts and pipe arch	N/A	N/A	N/A	M 167	M 167 M 243
3.2	Aluminum alloy structural plate pipe culverts and pipe arch	N/A	N/A	N/A	M 219	M 219

Footnotes:
(1) Minimum corner radii conforming to the details shown on the standard drawings.
(2) Acceptable Soil Conditions, Class B, Aluminized Type II Steel are: 1.6mm minimum thickness of metal acceptable where pH is greater than 7 and less than 8.5, and soil resistivity is greater than 1500 ohm-centimeters.

2.2 PIPE CULVERT TYPES

A. Pipe, Pipe Arch, Structural Plate Pipe and Structural Plate Pipe Arch Culvert Types: Refer to Table 1.

2.3 RELATED PRODUCTS

A. Asphalt Coating: Furnish Material Class M-Mastic, either asphalt or tar base, cold applied. ASTM A 849.
   1. Asphalt base mastic design criteria:
      a. Functions as a cool-applied waterproofing membrane.
      b. Provides a protective coating to aluminum or steel highly resistant to corrosion and chemical fumes.
      c. Is not affected by freezing temperatures and does not flow in hot weather.
      d. Has high cohesive strength and readily hardens in to a tough elastic seal after application.
      e. Is mixed until the mineral stabilizers and fillers are uniformly dispersed. Follow AASHTO M 243.

2.4 PIPE SELECTION

A. At the preconstruction conference, declare choice of pipe, type, diameter and thickness to be used.

B. Use the same type and strength of concrete pipe or thickness of steel, aluminum, polyethelene or polyvinyl chloride (PVC) pipe for the entire run of pipe.

C. Use the maximum height of cover to determine the strength or thickness. Refer to DG series Standard Drawings.

D. Do not use aluminum pipe culvert when a paved invert is required, unless protective measure are taken. Follow this Section, article 3.7, Structural Plate Pipe and Plate Pipe Arch Culverts, paragraph C.

E. Corrugated and smooth-lined polyethylene pipes and PVC pipes: Use only 12 inch to 36 inch diameter.

F. Precast, non-reinforced concrete pipe: Use only 18 inch to 36 inch diameter.

G. Do not allow pipes of different types of metal to contact each other. Use matching materials to make direct extensions of existing pipes.

H. Do not use pipe containing longitudinal lap seams if watertight pipe or watertight joints are called for.

I. Do not use thermoplastic pipe manufactured without UV inhibitors approved by the Materials Engineer in applications subject to direct sunlight.

PART 3 EXECUTION

3.1 PREPARATION

A. Excavating, Trenching, Bedding and Backfill:
   1. Refer to Section 02317.
   2. Refer to DG series Standard Drawings.
   3. Comply with Utah Occupation Safety and Health regulations when excavating and trenching. Note safety restrictions for trenches deeper than 4 feet. Follow Section 00820.
   4. Use Type I bedding unless Type II or Type III is required due to foundation conditions.

3.2 INSTALLATION

A. Lay culvert starting at the downstream end.

B. Keep the bottom of the culvert in contact with the bedding throughout its length.

C. When indicated on the drawings, camber pipe culverts upward from a chord through the inlet and outlet inverts an ordinate amount equal to one percent of the pipe length. Develop camber on a parabolic curve. If the mid-point elevation on the parabolic curve as designed exceeds the elevation of the inlet invert, reduce the amount of camber or increase the pipe culvert gradient.

D. Place bell or socket end of culvert facing upstream.

E. Place culverts fabricated with longitudinal laps or seams so that such seams are located approximately 45 degrees away from the invert or crown.

F. Place paved invert or partially lined culvert so that the centerline of the paved segment matches the flow line.

G. Place elliptical culvert with the major axis within five degrees of a vertical plane through the longitudinal axis of the culverts.

H. Place outside circumferential laps of flexible corrugated (annular corrugations) culvert facing upstream.

I. Close the joints to meet the specified joint integrity in accordance with manufacturer's recommendations.

J. Install pipe to conform to AASHTO Standard Specifications for Highway Bridges:
   1. Section 26 for Corrugated Metal Pipe
   2. Section 27 for Concrete Pipe
   3. Section 30 for Thermoplastic Pipe

3.3 JOINTS OR COUPLING BANDS FOR CULVERTS

A. General:
   1. All joints must sustain 3 psi minimum pressure.
   2. Connection of culvert to concrete headwalls, catch basins, etc. must also comply with manufacturer's recommended installation practices.

B. Concrete Culverts:
   1. Meet AASHTO M 198.

C. Metal Pipe:
   1. Use standard joints or coupling bands unless special joints or special coupling bands are called for on the plans. Refer to DG series Standard Drawings.
   2. Conform to AASHTO Standard Specifications for Highway Bridges and AASHTO M 36 or AASHTO M 245 with the following modifications:
      a. Use connecting bands of the same class as the pipe. Maintain a minimum thickness of 0.06 inch for the connecting bands.
      b. Use bands with projections (dimple bands) only in extension of the existing pipes where annular corrugations do not exist.
      c. The ends of helically corrugated pipe must be re-rolled to form at least two full annular corrugations each before being joined.
      d. Use flat bands only when approved in writing by the Engineer.
      e. Follow DG series Standard Drawings.

D. Joints for Polyethylene (HDPE) Pipe Culverts: Unless otherwise specified, use standard joints conforming to Section 7, Requirements, and Section 9, Test Methods of AASHTO M 294.

E. Joints for PVC Pipe Culverts: Show no leakage when tested in accordance with ASTM D 3212.
   1. Meet ASTM F 477 for gaskets.

3.4 WATERTIGHT CULVERTS AND JOINTS

A. Provide watertight joints as follows:
   1. Pass AASHTO M 86 paragraph 10.6 test requirements by sustaining a 10 psi minimum pressure for a 10 minute period with no leakage observed.

B. Use one of the following water tight culverts:
   1. Reinforced and non-reinforced concrete pipe. Meet AASHTO M 198 for watertight rubber gaskets. Do not use elliptical pipe. Meet ASTM C 443.
   2. Corrugated metal pipe culvert (O-ring gasket placed in lock seam).
   3. Helical rib metal pipe (O-ring gasket placed in lock seam).

3.5 SMOOTH LINING FOR CORRUGATED STEEL PIPE AND PIPE ARCH CULVERTS

A. Clean all surfaces to be lined including removal of all oil and grease from the metal. Allow the surface to dry before proceeding.

B. Concrete Lining: Follow ASTM A 849, Subsections 5 and 9.

C. Asphalt Lining: Follow Table 1.

3.6 PIPE AND PIPE ARCH CULVERTS

A. Use materials described in Table 1.

B. Remove moisture, dirt, oil, un-bonded or incompatible paint, grease residual oil, alkalies, or other foreign matter from the surface to be coated.

C. Spray or brush-coat all aluminum culvert contacting concrete with an asphalt mastic or tar base material to a minimum thickness of 0.05 inch.

3.7 STRUCTURAL PLATE PIPE AND PLATE PIPE ARCH CULVERTS

A. Use materials described in Table 1.

B. Repair or replace all damaged plates or coatings before installation.

C. Installation: Follow DG series Standard Drawings. Embankment: Refer to Section 02330.

D. Assembly:
   1. Give the Engineer a copy of the detail plan showing the position of each plate and the assembly order.
   2. Follow the manufacturer's instructions.
   3. Clearly mark each modified plate, designating its position in the finished structure.
   4. Place outside circumferential pipe-laps facing upstream.
   5. Attain approved seam fit-up. All bolts must be in place and have a torque ranging from 5 lb/ft to 10 lb/ft for aluminum pipe and 10 lb/ft to 28 lb/ft for steel pipe.
   6. Form structural plates so that the finished pipe is elliptical with the vertical diameter approximately 5 percent greater than the nominal diameter.

E. Asphalt Coating (structural plate pipe, and plate pipe arch, and arches):
   1. Thoroughly clean all plates to be coated. Remove any oil or grease from the surface of the plates. Keep plates clean and dry prior to coating.
   2. Apply coating to dry plates:
      a. Spray or brush-coat the entire exterior surface of the culverts with an approved post-applied mastic coating to a minimum 0.08 inch wet thickness. Follow AASHTO M 243.
      b. Spray or brush-coat the inside invert for 1/4 of the circumference of round pipe and the full span width of pipe arch with the same compound.
      c. Spray or brush coat all metal surfaces in contact with the ground at the time of erection before assembly. The remaining surfaces may be treated after erection.
   3. Apply uniformly to a minimum thickness of 0.6 inch dry thickness to structural plate for pipe, pipe arches, or arches on inside and outside surfaces measured on the crest of the corrugations.
   4. Furnish as follows, according to the application used:
      a. Spraying consistency: Spray with an air gun without the use of additional thinners when temperatures are 39 degrees F and above.
      b. Troweling consistency: Apply with a knife or trowel.
      c. Brushing consistency: Apply with an ordinary roofing brush.

3.8 INVERT PROTECTION

A. Paved Invert:
   1. Use corrugated steel pipe or pipe arch and structural steel plate pipe or pipe arch culverts.
   2. Complete backfill and embankment over the pipe before placing paved invert material.
   3. Use 10-gage wire fabric with wire spaced at 6 inch centers. Refer to AASHTO M 55.

4. Arc-weld the wire mesh reinforcement to the corrugation at not more than 2 ft centers.
5. Place concrete at least 2 inches above the crest of the corrugations, at least 1/4 the width of the circumference of round pipe, or the span width of arch pipe. Refer to Section 03055.
6. Finish the concrete to a floated surface finish. Follow Section 03310.
7. After curing, coat the joint between the culvert and concrete with liquid asphalt at a rate 0.9 gal/yd^2 of residual asphalt. Coat 6 inches above and below the joints.

3.9 QUALITY CONTROL

A. Provide adequate cover or protection for all culverts to protect them during project construction. Replace all damaged culverts before acceptance by the Department.

B. The following constitute poor workmanship and any one is cause for rejection:
1. Irregular or distorted shape (not as provided or designed)
2. Dents or bends
3. Damaged, broken, or scaled coating
4. Loose bolts or nuts
5. Uneven laps
6. Improper fitting joints
7. Any damage which compromises the functionality and design life of the pipe.

C. Coatings:
1. Furnish a Certification of Compliance from the manufacturer.
2. Department will take a representative sample from each lot furnished to conduct verification testing.

D. Joints: Furnish a Certificate of Compliance from the manufacturer of the type specified.

END OF SECTION

SECTION 02611

DIVERSION BOX GATE AND FRAME

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing gate and frame for hand slide gates or for screw gates and frames.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 03211: Reinforcing Steel and Welded Wire

C. Section 03310: Structural Concrete

1.3 REFERENCES

A. AASHTO M 218: Steel Sheet, Zinc-Coated (Galvanized) for Corrugated Steel Pipe

B. ASTM A 36: Carbon Structural Steel

C. ASTM A 123: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

D. ASTM A 307: Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

E. ASTM A 575: Steel Bars, Carbon, Merchant Quality, M-Grades

F. ASTM D 2000: Rubber Products in Automotive Applications

1.4 SUBMITTALS

A. Submit for approval two weeks in advance of fabrication:
   1. Diversion box screw gate and frame shop drawings
   2. Installation procedures
   3. Fabrication methods

PART 2 PRODUCTS

2.1 BLADES AND METAL FRAMES FOR HAND-SLIDE GATES

A. Zinc coated steel. Comply with AASHTO M 218, as specified.

2.2 CONCRETE

A. Class AA(AE) concrete per Section 03055.

2.3 REINFORCING STEEL

A. Refer to Section 03211, Part 2.

2.4 FRAME AND FLUSH BOTTOM CLOSURE

A. Carbon steel for frame and flush bottom meeting ASTM A 36, as specified.

B. Galvanizing frame and flush bottom meeting ASTM A 123, as specified.

C. Galvanized fastener meeting ASTM A 307, as specified.

D. Threaded carbon steel meeting ASTM A 575, as specified.

E. Rubber seal for flush bottom: as specified, ASTM D 2000, Grade AA 625 or BC 610 to 615.

PART 3 EXECUTION

3.1 INSTALLATION

A. Hand-Slide Gate: Finish the concrete frame following Section 03310.

B. Install the screw gate and frame conforming with shop drawings, and such that the gate opens and closes smoothly.

END OF SECTION

SECTION 02613

CULVERT END SECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing culvert end sections.

1.2 RELATED SECTIONS

A. Section 02610: Pipe Culverts

1.3 REFERENCES

A. AASHTO M 294: Corrugated Polyethylene Pipe, 305 to 915 mm (12- to 36-in.) Diameter

PART 2 PRODUCTS

2.1 END SECTION

A. Polyethylene end section as specified AASHTO M 294.

B. Refer to Pipe Class Definitions, Section 02610.

C. Coat metal end section identically to pipe material.

PART 3 EXECUTION

3.1 INSTALLATION

A. Use end section made of the same materials as the pipe or pipe arch to which it is connected.
   1. **Exception: Use a metal end section with concrete.**

B. Place end section according to construction methods specified for the type and class of pipe to which they connect. Refer to DG series Standard Drawings and Section 02610.

END OF SECTION

SECTION 02614

SALVAGE AND/OR RELAY PIPE CULVERT AND END SECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Salvage and/or relay existing pipe, and re-lay culvert end section.

1.2 RELATED SECTIONS

A. Section 02610: Pipe Culverts

B. Section 02613: Culvert End Section

PART 2 PRODUCTS **Not used**

PART 3 EXECUTION

3.1 REMOVE, RELAY, OR SALVAGE PIPE

A. Remove pipe from existing location.

B. Replace pipe damaged during operations at no additional cost to the Department.

C. Clean pipe.

D. Relay according to Section 02610.

E. Salvage as directed.

3.2 RE-LAY CULVERT END SECTION

A. Relay the culvert end sections according to Section 02613.

B. Replace culvert end sections damaged by operations at no additional cost to the Department.

END OF SECTION

SECTION 02622

UNDERDRAIN

PART1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for placing pipe underdrains.

1.2 RELATED SECTIONS

A. Section 02061: Select Aggregate

B. Section 02075: Geotextile

C. Section 02610: Pipe Culverts

1.3 REFERENCES

A. AASHTO M 252: Corrugated Polyethylene Drainage Pipe

B. AASHTO T 99: Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305-mm (12 in.) drop

PART 2 PRODUCTS

2.1 PIPE

A. Corrugated Polyethylene Drainage Pipe: ASHTO M 252.

B. Corrugated Steel Pipe and Pipe Arch: Refer to Section 02610.

C. Concrete Pipe: Refer to Section 02610.

2.2 DRAINAGE GEOTEXTILES

A. When required refer to Section 02075.

2.3 UNDERDRAIN GRANULAR BACKFILL

A. Refer to Section 02061.

PART 3 EXECUTION

3.1 PLACEMENT

A. Excavate a trench to a depth of 3 inches below the underdrain pipe flow-line and to a width of the outside diameter of the pipe plus 2 feet.

B. If required, place drainage geotextiles to plan requirements, and following Section 02075.

C. Place underdrain granular backfill in the trench, compacting the bottom 3 inches. Follow Sections 02061.

D. Place pipe with slots or perforations down, or as specified in the plans.

E. Lay an open joint concrete underdrain pipe with the bell or groove end up stream and the spigot end fully entered into the bell.

F. Compact backfill material in 6 inch layers to 96 percent of maximum laboratory density. Follow AASHTO T 99, Method C.

END OF SECTION

SECTION 02624

APPROACH SLAB CATCH BASIN

PART I GENERAL

1.1 SECTION INCLUDES

A. Construct a drainage catch basin at the approach of an existing structure.

1.2 RELATED SECTIONS

A. Section 02610: Pipe Culvert

B. Section 03055: Portland Cement Concrete

C. Section 03211: Reinforcing Steel and Welded Wire

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 270: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement Concrete: Class AA(AE). Refer to Section 03055.

B. Cement: Refer to Section 03055.

C. Reinforcing Steel (Coated): Refer to Section 03211.

D. Structural Steel: Galvanize after fabrication.
   1. AASHTO M 270, Grade 36.
   2. AASHTO M 111.

E. Precast Concrete Catch Basin: Avoid when the plans indicate that the catch basins are to be constructed within an existing concrete approach slab.

PART 3 EXECUTION

3.1 PREPARATION

A. Concrete Removal:
   1. Make saw cuts 1 inch deep to define the work areas.
   2. Remove concrete using 90 pound class hand-operated jackhammers or smaller.

B. Reinforcing Steel:
   1. Cut steel encountered during concrete removal operations so that the final catch basin opening is unencumbered as shown on the plans.
   2. To tie the new facility into the existing approach slab: Expose a minimum of 10 inches of reinforcing steel in both the bottom and upper mats of approach slab steel on at least three sides of the catch basin.

C. Excavation:
   1. Excavate sufficient material to construct the catch basin to the required size and depth.

3.2 CONSTRUCTION

A. Construct catch basin according to plan dimensions and details.

B. Adjust catch basin location for better drainage performance where necessary as directed by the Engineer.

C. Provide for proper outlet connection to the pipe in the side of the box. Refer to Section 02610.

END OF SECTION

SECTION 02625

APPROACH SLAB DRAIN FRAME MODIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide a frame riser to raise the existing drain grate to match the grade of the asphalt surfacing.

1.2 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 270: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

A. Structural steel plates. AASHTO M 270, Grade 250.

B. Galvanize the frame riser after fabrication as specified. AASHTO M 111.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify plan dimension for the existing grate system before fabrication of the new frame riser.

3.2 INSTALLATION

A. Construct the frame riser according to the plan design.

B. Place a new frame riser before placing asphalt surfacing. Hand compact the asphalt in the areas surrounding the frame of the drain.

C. Position the grate properly to receive the water flow. For square frames, line up grate ribs with water flow.

3.3 CLEANING

A. Clean any existing or construction debris and trash from the drain basin and grate ribs.

END OF SECTION

SECTION 02626

DECK DRAIN MODIFICATION OR CLOSURE

PART I GENERAL

1.1 SECTION INCLUDES

A. Modify and/or close existing drains, and install new drains at specified locations.

1.2 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 270: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched and Tempered Alloy Structural Steel Plates for Bridges

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

A. Galvanize the frame riser after fabrication as specified. AASHTO M 270, Grade 36. AASHTO M 111.

B. Structural steel plates: AASHTO M270, Grade 36.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify plan dimension for the existing grate system before fabrication of the new frame riser.

3.2 INSTALLATION

A. Deck Drain Modification:
   1. Construct the frame riser according to the plan design.
   2. Close the deck drains as shown in the plans under the Deck Drain Closure Detail prior to placing new asphalt surfacing.
   3. Place a new frame riser before placing Hot Mix Asphalt. Hand compact the asphalt in the areas surrounding the frame of the drain.
   4. Position the grate properly to receive the water flow. For square frames, line up grate ribs with water flow.
   5. Properly secure the extended pipes to the satisfaction of the Engineer.

B. Deck Drain Closure: Close the deck drains as shown in the plans under the Deck Drain Closure Detail prior to placing new asphalt surfacing.

3.3 CLEANING

A. Clean any asphalt concrete from between the grate ribs, when necessary.

B. Clean any existing or construction debris and trash from the drain basin.

END OF SECTION

SECTION 02635

GRATES, SOLID COVERS, FRAMES, AND MANHOLE STEPS

PART I GENERAL

1.1 SECTION INCLUDES

A. Furnish and install grates, solid covers, frames, and manhole steps.

1.2 RELATED SECTIONS

A. Section 03310: Structural Concrete

B. Section 05120: Structural Steel

1.3 REFERENCES

A. AASHTO M 105: Grey Iron Castings

B. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

C. AASHTO M 199: Precast Reinforced Concrete Manhole Sections

D. AASHTO M 270: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges

E. ASTM A 536: Ductile Iron Castings

PART 2 PRODUCTS

2.1 MATERIALS

A. Structural Steel: Refer to Section 05120.
   1. As specified in AASHTO M 270.
   2. Hot-dip galvanize structural steel after fabrication. AASHTO M 111.

B. Cast Grey Iron: As specified in AASHTO M 105.

C. Ductile Iron: As specified in ASTM A 536.

D. Precast Grade Ring: As specified in AASHTO M 199.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install as specified by the manufacturer and the following standard specifications:

Item To Be Installed	Standard Drawing
Standard Diversion Box Hinged Lid (Solid Cover Plate) Type A Details Type I Plan and Type II Plan	DB 2E, 2F
Standard Diversion Box Hinged Lid Solid Cover Type B and C	DB 2G, 2H
Standard Diversion Box Hinged Lid Solid Cover Type C	DB 2H
Solid Cover and Frame	CB 4
Manhole Frame and Grated Cover	GF 1
Manhole Frame and Solid Cover	GF 2
Rectangular Grate and Frame (Standard Grating)	GF 3
Directional Grate and Frame (Bicycle-Safe Grating)	GF 4
Solid Cover and Frame	GF 5
Manhole Steps	GF 6

END OF SECTION

SECTION 02643

CONCRETE-LINED DITCH

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing concrete-lined ditch.

1.2 RELATED SECTIONS

A. Section 02324: Compaction.

B. Section 03055: Portland Cement Concrete.

C. Section 03152: Concrete Joint Control.

1.3 ACCEPTANCE

B. Concrete lined ditch may be accepted at a reduced price when the concrete strength is below that specified.
   1. Price adjustment pay factor following Section 03055.

PART 2 PRODUCTS

2.1 CONCRETE

A. Class A(AE). Refer to Section 03055.

PART 3 EXECUTION

3.1 CONSTRUCTION

A. Construct concrete-lined ditch placing contraction joints at 10 ft intervals, and expansion joints at 30 ft intervals. Refer to Section 03152.

B. Finish inside of ditch with a moist, wooden float to remove projections and honeycomb.

C. Slip-form pavers may be used.

D. When placing ditch on a raised berm, compact berm following Section 02324.

END OF SECTION

SECTION 02645

PRECAST CONCRETE BOX CULVERT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Material and procedures for fabricating and installing single cell precast concrete box culverts.

1.2 RELATED SECTIONS

A. Section 02056: Common Fill

B. Section 02317: Structural Excavation

C. Section 02324: Compaction

D. Section 03055: Portland Cement Concrete

E. Section 03211: Reinforcing Steel and Welded Wire

F. Section 03390: Concrete Curing

1.3 REFERENCES

A. AASHTO M 198: Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets.

B. AASHTO M 259: Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers.

C. AASHTO M 273: Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less Than 2 Feet Of Cover Subjected to Highway Loadings.

D. UDOT Quality Management Plan

1.4 SUBMITTALS

A. Shop Drawings: Furnish to the Engineer.
   1. Shop drawings: 1 full-size 24 inch by 36 inch, and 4 half-size 11½ inch by 17 inch sheets with a 1½ inch blank margin on the left-hand edge.
   2. Place the State project designation data in the lower right-hand corner of each sheet.
   3. Prepare shop drawings under seal of a Professional Engineer.

B. Department rejects units fabricated prior to written approval.

1.5 ACCEPTANCE

C. Precast concrete box culverts may be accepted at a reduced price when the concrete strength is below that specified.
   1. Price adjustment pay factor following Section 03310.

PART 2 PRODUCTS

2.1 CONCRETE

A. Wet Cast Concrete: Class 4A(AE). Follow Section 03055.

B. Dry Cast Concrete:

1.	Minimum cement content:	564 lb/yd^3 of concrete
2.	Maximum Water/cement Ratio:	0.15 gal/lb
3.	Mix Design:	Submit for approval

2.2 REINFORCING STEEL AND WELDED WIRE

A. Refer to Section 03211.

B. Meet AASHTO M 259, and AASHTO M 273.

2.3 FLEXIBLE GASKET

A. Meet AASHTO M 198.

B. 1 inch minimum initial thickness.

C. 2 square inches minimum in cross section.

2.4 QUALITY ASSURANCE

A. Department pre-qualifies manufacturers of pre-cast concrete box culvert sections as a supplier of pre-cast concrete products in accordance with Quality Management Plan: Pre-cast/Prestressed Concrete Structures.

B. Permanently mark each precast unit with date of casting and identification number supplied by the inspector. Stamp markings in fresh concrete.

C. Prevent cracking or damage during handling and storage of precast units.

D. Replace cracked or damaged precast units at no additional cost to the Department.

PART 3 EXECUTION

3.1 MANUFACTURE

A. Meet AASHTO M 259, and AASHTO M 273.
   1. Multiply steel reinforcement requirements shown in table by 1.25.
   2. Minimum reinforcing steel spacing 4 inches around circumference and 8 inches longitudinal.
   3. 1 inch minimum concrete cover to reinforcing steel.

B. Portland Cement Concrete: Follow Section 03055.

C. Concrete Curing: Follow Section 03390.

3.2 INSTALLATION

A. Installation with 2 ft or less cover, follow AASHTO M 273.

B. Installation with greater than 2 ft of cover, follow AASHTO M 259.

3.3 STEEL REINFORCEMENT

A. Follow Section 03211.

3.4 JOINTS

A. Make joint opening between box sections less than 1 inch measured face to face of the concrete.
   1. Reject box sections when the installation tolerance cannot be met due to casting variations.
   2. Prevent soil from being forced into the joint as the box sections are placed.

B. Provide shear transfer devices for box culvert sections with less than 2 feet of cover. Device or method must be capable of transferring a minimum shear load of 3,000 lbs/ft of joint width through top slab of adjacent units. When using individual devices, space closer than 2.5 ft center to center with a minimum of two per joint.

3.5 LIFTING HOLES

A. Provide a maximum of four lifting holes in the top slab, each having a maximum diameter of 3 inches.

B. Locate holes to avoid interference with the reinforcing steel.

C. Plug holes with a 1/1 sand to cement grout.

3.6 CONNECTION TO CAST-IN-PLACE CONCRETE

A. Where precast box sections join cast-in-place concrete, project the reinforcing steel a minimum of 12 inches out of the precast box section and square off the concrete face.

3.7 REPAIRS

A. Box sections may be repaired as allowed in the referenced specification only when approved in advance by the Engineer.

B. Making repairs in advance of approval will be cause for rejection.

3.8 MINIMUM LENGTH

A. Individual standard box segment: None less than 5 feet.

3.9 BEDDING AND BACKFILL

A. Excavate the material under the box location in compliance with Section 02317 to a minimum depth of 4 inches.

B. Backfill with granular backfill borrow as specified in Section 02056.

C. Compact following Section 02324.

END OF SECTION

SECTION 02705

PAVEMENT CUTTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Saw or cut pavements, curb and gutter, sidewalk, and/or any appurtenances as required to provide a smooth surface to match.

1.2 RELATED SECTIONS

A. Section 02748: Prime Coat/Tack Coat

1.3 PAYMENT PROCEDURES

A. Department makes no separate payment for Pavement Cutting. Include in associated bid items.

PART 2 PRODUCTS **Not used**

PART 3 EXECUTION

3.1 PROCEDURE – CONCRETE SURFACES

A. Saw cut vertically in a straight line through the full depth of the surface.

B. Where the edge of the existing surface is cracked, broken, or deteriorated, make the cut so the defective surface can be removed.

C. Do not allow traffic or construction equipment to cross the cut edge.

3.2 PROCEDURE – ASPHALT SURFACES

A. Use any method that provides a vertical cut in a straight line through the full depth of the surface.
   1. Should the method of cutting not produce a smooth, non-broken edge, saw cutting will be required at no additional cost to the Department.

B. Where the edge of the existing surface is cracked, broken, or deteriorated, make the cut so the defective surface can be removed.

C. Do not allow traffic or construction equipment to cross the cut edge.

D. When appropriate, apply a tack coat to the cut edge before placing hot mix asphalt surfacing. Refer to Section 02748.

END OF SECTION

SECTION 02712

LEAN CONCRETE BASE COURSE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing a Lean Concrete Base Course.

1.2 RELATED SECTIONS

A. Section 02752: Portland Cement Concrete Pavement.

1.3 REFERENCES

A. AASHTO M 85: Portland Cement.

B. AASHTO M 148: Liquid Membrane-Forming Compounds for Curing Concrete.

C. AASHTO M 154: Air-Entraining Admixtures for Concrete.

D. AASHTO M 194: Chemical Admixtures for Concrete.

E. AASHTO T 11: Materials Finer Than 75 Fm (No. 200) Sieve in Mineral Aggregates by Washing.

F. AASHTO T 19: Unit Weight and Voids in Aggregate.

G. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates.

H. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils.

I. AASHTO T 96: Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine.

1.4 ACCEPTANCE

A. Refer to Section 02752 with the following modifications:

1. No strength tests are required for acceptance.
2. Engineer takes cores to determine thickness-acceptance criteria at random locations with one core representing 12,000 ft^2 (a sublot).
3. The Engineer takes three measurements (using a tape measure) on each core. The average of these measurements will be used as the length of x.

   x = Average length of core
   n = Number of cores (1 per sublot)
   0 = Average length for entire project (lot)

$$0 = \frac{3x}{n}$$

4. Department will assess reductions for thickness and cement content separately. Any core less than 3.5 inches will be included in 0 determination and also have a price adjustment under sub lot. Refer to Table 02712-1 for Payment Reductions for Thickness.

Table 02712-1
Payment Reductions for Thickness

Thickness	**Pay Factor (Project)**
0 ≥ 3.75 inch	1.00
3.50 inch < 0 < 3.75 inch-	0.90
3.00 inch < 0 < 3.50 inch	0.75
	Pay Factor (Sub lot)
Sub lot, 3.00 inch < x < 3.50 inch	0.75
Sub lots, x < 3 inch	0.50 or replace as directed by the Engineer.

5. Price adjustment for cement content under, 98 percent of mix design requirements will be assessed at 1.5 times the FOB Batch Plant price for cement.

1.5 QUALITY ASSURANCE - STOCKPILES

A. Department requires new trial batches and tests if the stockpile gradation changes from the job-mix gradation by more than the allowable variation as shown in Table 1.

B. Provide adequate supplies of aggregate and stockpiles for sampling and testing seven days before construction.

C. Make sufficient quantity of material available in the stockpiles to supply the mixing plant at full capacity and to provide continuous placing.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT

A. Type I or Type II following AASHTO M 85.
   1. The Department may retest cement that has been stored over 60 days.
   2. Do not use cement containing lumps or cement that has partially set.

2.2 AGGREGATE

A. Portion of aggregate passing the No. 40 sieve: non-plastic. AASHTO T 90

B. Wear: Cannot exceed 50 percent. AASHTO T 96

C. Dry-rodded unit weight: Greater than 75 lb/ft^3 AASHTO T 19

D. Aggregate Job-Mix Gradation: AASHTO T 11, and AASHTO T 27

E. Meet Table 1

Table 1

Aggregate - Lean Concrete Base Course		
	Job-Mix Gradation Band	**Allowable Variation From Job-Mix Gradation**
Sieve Size	**Percent Passing**	**Percent**
1 ½ inch	100	-
1 inch	85 - 100	-
3/4 inch	50 - 100	"8
3/8 inch	30 - 75	"8
No. 4	25 - 60	"8
No. 40	8 - 25	"4
No. 200	0 - 9	"3

2.3 WATER

A. Refer to Section 02752.

2.4 ADMIXTURES

A. Air-entraining agents. AASHTO M 154

B. Water-reducing admixtures: AASHTO M 194, Type A, except:
   1. Relative durability factor: at least 90.
   2. Chlorides content (as Cl^-): not exceeding one percent by weight of the admixtures.

C. Do not use calcium chloride.

2.5 CURING COMPOUND

A. As specified for white, pigmented material with wax base.

B. Meet AASHTO M 148, Type II.

2.6 BOND BREAKER

A. Use curing compound following article 2.5 above.

2.7 EQUIPMENT

A. Refer to Section 02752.

2.8 JOB-MIX DESIGN

A. Provide the Engineer with a written job-mix design for approval before placing lean concrete base course.
   1. Base the job-mix design on trial batch results that verify the concrete mix design strength.
   2. Do not change the job-mix design without written approval.
   3. Meet the requirements in Table 2.

Table 2

Job-Mix Design Requirements		
Slump	Air Content	Minimum Design Compressive Strength
Inches	Percent	psi, 7 days
2-1/2 " 1-1/2	4.5 "1.5	750

4. Use a minimum of 255 lbs. of cement per cubic yard of concrete.
5. Do not exceed the water-cement ratio determined by the trial batches.

PART 3 EXECUTION

3.1 CONSTRUCTION METHODS

A. Line and Grade Control: Refer to Section 02752.

B. Pre-Wetting Base Course:
1. Moisten the subbase prior to placement.
2. If the subbase dries, sprinkle it without forming puddles or mud.
3. Keep at least 500 ft of subbase prepared ahead of the paver.

C. Formed paving option: Refer to Section 02752.

D. Batching materials: Refer to Section 02752.

E. Placing lean concrete base: Refer to Section 02752.

F. Finishing:
1. Screed the lean concrete base course to maintain line and grade within 3/8 inch in 10 ft.
2. Hand methods of strike-off and consolidation are permitted when the base width is less than 10 ft or where machine screeding is impractical.
3. Fill porous areas.

3.2 CURING

A. Curing Compound:
1. Warm curing compound (to a temperature not exceeding 100 degrees F) when it is too viscous for application.
2. Do not dilute or alter the compound.

3. Thoroughly mix the compound before application, and agitate the compound continuously during application.

B. Application:
1. Immediately following finishing operations, spray entire exposed area of lean concrete base course (top and sides) with curing compound at a rate of 1 gallon per 160 ft^2 of surface.
2. Apply compound with fully atomizing mechanical sprayers equipped with wind-protective hoods.
3. Hand spraying will be permitted on small areas and areas inaccessible to mechanical spraying equipment.
4. Amply cover edges, corners, sides, and rough spots with curing compound.

C. Immediately repair damage to the film of curing compound occurring within 72 hours of application.

3.3 BOND BREAKER

A. Apply a second application of curing compound (at 1 gallon per 160 ft^2 of surface) within 48 hours before placing Portland cement concrete pavement.

3.4 TRAFFIC CONTROL

A. Do not allow traffic or construction equipment until 72 hours after placing.

B. After 72 hours, trucks hauling Portland cement concrete for pavement will be permitted to maneuver (for only the minimum length necessary to back into paver).

C. After the lean concrete base has cured for seven days, legal loads may be hauled provided that:
1. Hauling is limited to the lane adjacent to the median.
2. Hauling does not cause damage.

D. Reduce the load or refrain from hauling if damage occurs.

E. Repair all damage at no additional cost to the Department.

END OF SECTION

SECTION 02715

HYDRATED LIME TREATED ROADBED

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing a compacted hydrated lime treated roadbed.

1.2 RELATED SECTIONS

A. Section 02745: Asphalt Material.

B. Section 02746: Hydrated Lime

1.3 REFERENCES

A. AASHTO T 26: Quality of Water to be Used in Concrete

B. AASHTO T 99: The Moisture-Density Relations of Soils Using a 5.5 lb (2.5 kg) Rammer and a 12 inch (305 mm) Drop

C. AASHTO T 310: In-place Density and Moisture Content of Soil and Soil-aggregate by Nuclear Methods (Shallow Depth)

1.4 ACCEPTANCE

A. The Department conducts random sample tests on the grade.

B. Acceptance Criteria for Density:
   1. Lot-by-lot basis where a lot consists of a single layer of not more than 8000 yd^2 placed.
   2. A lot is divided into five approximately equal-sized sublots (1600 yd^2).
   3. The Department conducts one random moisture and density test within each sublot. AASHTO T 310.
   4. Department accepts a lot when the results of the five density tests indicate that the average of 96 percent of maximum laboratory density has been met, with no test less than 92 percent. AASHTO T 99, Method D.

C. Rework unacceptable lot layer at no additional cost to the Department.

PART 2 PRODUCTS

2.1 HYDRATED LIME

A. Refer to Section 02746.

2.2 WATER

A. Potable water or water that meets the specified test standard. AASHTO T 26.

B. Screen out extraneous material when pumping water from streams, ponds, lakes, etc., by enclosing and positioning the water intake.

2.3 ASPHALTIC MATERIAL

A. Refer to Section 02745.

PART 3 EXECUTION

3.1 PREPARATION

A. Compact and finish the roadbed to the lines and grades shown.

B. Scarify the surface over the entire width to the depth shown.

C. Mechanically pulverize the material until all soil lumps are broken up.

D. Remove all unacceptable material and stones greater than 3 inches.

E. Windrow scarified/pulverized material to facilitate compaction.

F. Firmly compact the subgrade below the scarified soil to 90 percent of maximum density. AASHTO T 99, Method B.

G. Correct soft or yielding areas before adding hydrated lime.

3.2 LIMITATIONS

A. Do not mix and place lime-treated roadbed when the material is frozen.

B. Begin work when the air temperature is at least 40 degrees F in the shade and rising.

3.3 PROPORTION AND MIX

A. Uniformly spread the material to be treated over the full width of the roadbed to obtain the compacted thickness shown.

B. Combine hydrated lime and water for the slurry.
   1. Measure water with a calibrated meter and weigh hydrated lime on approved scales.
   2. Mix at a ratio of approximately 1 ton of hydrated lime to 500 gallons of water in a central mixing tank or in the tanks used for distribution.
   3. The mixing tank must agitate the slurry, providing uniform moisture and preventing settlement of the lime after mixing.

C. Apply the water-lime slurry with distributors that agitate the slurry during hauling and spreading.

D. Adjust the number and rate of applications to achieve the required quantity of residual lime without runoff.

E. Lightly scarify the surface to facilitate absorption of the slurry and to prevent runoff.

F. Maintain the moisture content of the material during processing within two percent of the optimum. AASHTO T 99, Method D.

G. Thoroughly blend the material and lime slurry with a traveling mixer until the mixture is uniform in appearance, texture, and moisture content, and is free from pockets of segregated material.

H. Cure the mixture for at least 48 hours before final spreading and compaction.

I. Sprinkle the surface lightly during this curing period to compensate for evaporation loss.

3.4 COMPACTION

A. Spread the mixture over the roadbed and roll the surface with a steel wheel, sheep's foot, pneumatic roller, or a combination.

B. Maintain the optimum moisture content during compaction within two percent of optimum as shown in this Section, article 3.3, Proportion and Mix, paragarph G. Dry or sprinkle the mixture uniformly to meet the above moisture requirement.

3.5 FINISHING

A. Bring the roadbed to within " 0.1 ft of line and grade.

3.6 MEMBRANE SEAL

A. When shown on the typical section, seal the compacted roadbed with asphaltic material according to the type and rate shown.

B. Keep the membrane seal intact until it is covered by base or surface material.

C. Apply additional membrane seal to those areas where it has been destroyed under construction traffic or adjacent work at no additional cost to the Department.

END OF SECTION

SECTION 02721

UNTREATED BASE COURSE (UTBC)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Production, construction, and compaction of untreated base course material.

1.2 RELATED SECTIONS

A. Section 01572: Dust Control and Watering

1.3 REFERENCES

A. AASHTO T 11: Materials Finer than 75 μm (no. 200) Sieve in Mineral Aggregates by Washing

B. AASHTO T 19: Unit Weight and Voids in Aggregate

C. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates

D. AASHTO T 89: Determining the Liquid Limit of Soils

E. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils

F. AASHTO T 96: Resistance to Degradation of Small-Sized Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

G. AASHTO T 180: Moisture-Density Relations of Soils Using a 4.54 kg (10 lb) Rammer and 457 mm (18 in) Drop

H. AASHTO T 193: The California Bearing Ratio

I. AASHTO T 308: Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method

J. AASHTO T 310: Field Density and Moisture Content by Nuclear Gage

1.4 DEFINITIONS

A. **Mean of the Deviations:** The sum of the absolute values of the deviations divided by the number of tests in the lot.

1.5 SUBMITTALS

A. Ten days before placement begins, submit a written report on the following:
   1. Aggregate suitability. Refer to this Section, Part 2.
   2. Name of supplier and source.
   3. Job mix gradation including single values for each sieve size based on the dry weight of the aggregate.

B. Resubmit all quality documents 24 hours before a day's production starts if a change in source is required.
   1. Changes must fall within bands of Table 2 in this Section, and are subject to approval.
   2. Retroactive changes are allowed only for the first day's production for each construction season.

1.6 QUALITY ASSURANCE

A. Remove products found defective after installation and install acceptable products at no additional cost to the Department.

1.7 ACCEPTANCE

A. Engineer takes random sample from the grade.

B. Acceptance will be on a lot-by-lot basis where a lot consists of a single layer of not more than 8000 yd^2 placed to line and grade and compacted. Divide the lot into five sublots of approximately 1600 yd^2 each. When working with small daily amounts, limit lot to maximum of two weeks worth of production and adjust sublot size accordingly.
   1. Conduct one random moisture, gradation and density test within each sublot. AASHTO T 310.
      a. If the Mean of the Deviations of test results varies from the Combined Aggregate Target more than the minimum shown under the 0.70 pay factors of Table 2, the pay factor for the material allowed to remain in place is 0.50. This applies only if the Engineer does not order correction or removal of any or all of the material represented by the tests.

b. The results of five density tests must indicate that the average of 97 percent of maximum laboratory density has been met with no test less than 94 percent. AASHTO T 180, Method D.

C. Do not place additional material on any unaccepted layer.

D. Rework unacceptable material at no additional cost to the Department.

E. Price Adjustments - Rap Content (AASHTO T 308)
1. Based upon average asphalt cement content per lot.
2. Apply price adjustment to entire lot quantity.

Table 1

Asphalt Cement Content over Design Content (% by Weight of Mix)	**Price Adjustment (Dollars/ton)**
0.2 to 0.4	- 0.30
0.4 to 1.0	- 1.50
.1.0	Reject*

* Lots in Reject due to RAP content may stay in place, at the direction of the Engineer, with a 50% price adjustment.

Table 2 Pay Factors for Aggregate Gradation						
Mean of The Deviations of Sieve Gradation Results From The Combined Aggregate Target - Expressed in Percentage Points						
SIEVE SIZES	**Pay Factor**	**1 TEST** **Max-min**	**2 TESTS** **Max-Min**	**3 TESTS** **Max-Min**	**4 TESTS** **Max-Min**	**5 TESTS or More** **Max - Min**
½ inch and larger	**1.00**	0 - 15	0.0 - 12.1	0.0 - 10.8	0.0 - 10.0	0.0 - 9.5
	0.95	16 - 17	12.2 - 13.9	10.9 - 12.4	10.1 - 11.5	9.6 - 11.0
	0.90	18 - 19	14.0 - 15.1	12.5 - 13.5	11.6 - 12.5	11.1 - 11.9
	0.80	20 - 21	15.2 - 17.2	13.6 - 15.3	12.6 - 14.2	12.0 - 13.5
	0.70	22 - 23	17.3 - 18.8	15.4 - 16.7	14.3 - 15.5	13.6 - 14.7
3/8 inch	**1.00**	0 - 15	0.0 - 11.5	0.0 - 9.8	0.0 - 8.8	0.0 - 8.0
	0.95	16 - 17	11.6 - 13.3	9.9 - 11.3	8.9 - 10.1	8.1 - 9.2
	0.90	18 - 19	13.3 - 14.4	11.4 - 12.3	10.2 - 11.0	9.3 - 10.0
	0.80	20 - 21	14.5 - 16.3	12.4 - 13.9	11.1 - 12.5	10.1 - 11.4
	0.70	22 - 23	16.4 - 17.9	14.0 - 15.2	12.6 - 13.6	11.5 - 12.4
No. 4	**1.00**	0 - 14	0.0 - 10.5	0.0 - 8.8	0.0 - 7.8	0.0 - 7.0
	0.95	15 - 17	10.6 - 12.1	8.9 - 10.1	7.9 - 9.0	7.1 - 8.0
	0.90	18	12.2 - 13.1	10.2 - 11.0	9.1 - 9.8	8.1 - 8.7
	0.80	19 - 20	13.2 - 14.9	11.1 - 12.5	9.9 - 11.1	8.8 - 10.0
	0.70	21 - 22	15.0 - 16.3	12.6 - 13.6	11.2 - 12.1	10.1 - 10.8
No. 16	**1.00**	0 - 11	0.0 - 8.2	0.0 - 6.9	0.0 - 6.2	0.0 - 5.6
	0.95	12 - 13	8.3 - 9.4	7.0 - 7.9	6.3 - 7.1	5.7 - 6.4
	0.90	14	9.5 - 10.3	8.0 - 8.6	7.2 - 7.8	6.5 - 7.0
	0.80	15 - 16	10.4 - 11.6	8.7 - 9.8	7.9 - 8.8	7.1 - 8.0
	0.70	17	11.7 - 12.7	9.9 - 10.7	11.7 - 12.7	8.1 - 8.7
No. 50	**1.00**	0 - 9	0.0 - 7.0	0.0 - 6.1	0.0 - 5.5	0.0 - 5.2
	0.95	10	7.1 - 9.0	6.2 - 7.0	5.6 - 6.3	5.3 - 6.0
	0.90	11	9.1 - 8.8	7.1 - 7.6	6.4 - 6.9	6.1 - 6.5
	0.80	12 - 13	8.9 - 10.0	7.7 - 8.7	7.0 - 7.8	6.6 - 7.4
	0.70	14	10.1 - 10.9	8.8 - 9.5	7.9 - 8.5	7.5 - 8.1
No. 200	**1.00**	0 - 4.5	0.0 - 3.4	0.0 - 2.9	00 - 2.5	0.0 - 2.3
	0.95	4.6 - 5.2	3.5 - 3.9	3.0 - 3.3	2.6 - 2.9	2.4 - 2.6
	0.90	5.3 - 5.6	4.0 - 4.3	3.4 - 3.6	3.0 - 3.1	2.7 - 2.9
	0.80	5.7 - 6.4	4.4 - 4.8	3.7 - 4.1	3.2 - 3.6	3.0 - 3.3
	0.70	6.5 - 7.0	4.9 - 5.3	4.2 - 4.5	3.7 - 3.9	3.5 - 3.6

F. Price Adjustments - Gradation:

1. Based upon number of samples per lot and the minimum pay factor.
2. Pay factors for aggregate gradation when tested in accordance with AASHTO T 27 are indicated in Table 2.

PART 2 PRODUCTS

2.1 AGGREGATES

A. Clean, hard, tough, durable and sound mineral aggregates that consist of crushed stone, crushed gravel or crushed slag; free of detrimental and organic matter; and complies with Table 3 and Table 4.

Table 3

Aggregate Properties		
Dry Rodded Unit Weight	Not less than 75 lb/ft^3	AASHTO T 19
Material Passing No. 40 Sieve	Non plastic	AASHTO T 90/T 89
Aggregate Wear	Not to exceed 50 percent.	AASHTO T 96
Dry Weight Values	Within bands shown in Table 4	
Gradation Limits	Table 4	AASHTO T 11 AASHTO T 27
CBR with a 10 lb. surcharge	70% Minimum	AASHTO T 193

Table 4

Gradation Limits – Single Value Job-Mix Formula			
Sieve Size	**Percent Passing of Total Aggregate (Dry Weight)**		
	1-1/2 inch	1 inch	3/4 inch
1-1/2 inch	100	--	--
1 inch	--	100	--
3/4 inch	81 -91	--	100
1/2 inch	67 - 77	79 - 91	--
3/8 inch	--	--	78 - 92
No. 4	43 - 53	49 - 61	55 - 67
No. 16	23 - 29	27 - 35	28 - 38
No. 200	6 – 10	7 - 11	7 - 11

Untreated Base Course: Based on fine and coarse aggregate having approximately the same bulk specific gravities.

B. Recycled Asphalt Pavement (RAP): When the Contractor elects to use RAP in the untreated base course, meet the following:

1. Materials manufactured by rotomilling, crushing, or other means approved by the Engineer.
2. Mechanically blend with the virgin material, resulting in a homogeneous material. Do not use windrows and graders/dozers for blending.
3. Do not exceed target asphalt cement content, as calculated by total weight of mix, for final blend material (virgin and RAP).
4. Meet all requirements of this Section, article 2.1, Aggregates, with the following modifications:
   a. L.A. Wear requirement applies to virgin aggregate portion only.
   b. Non-plastic requirement applies to virgin aggregate portion only.
   c. One fractured face and sand equivalent requirements apply to combined material residue from ignition oven.

PART 3 EXECUTION

3.1 JOB-MIX GRADATION

A. Submit a written job-mix gradation for approval before production, including single values for each sieve size identified in Table 2, based on the dry mass of the aggregate.

B. Meet Table 4 bands for dry mass values.

C. For Blends using RAP:
1. Limit target AC content to two percent by total weight of combined material.
2. Submit two sets (five samples each) of ignition oven calibration samples containing blended material.
3. Submit one set (five samples) of ignition oven calibration samples containing 100 percent virgin material.
4. Modify drying procedures for gradation testing to minimize softening of the RAP asphalt cement. Reduce temperature and lengthen drying time. Recommended oven temperatures are approximately140 degrees F with a drying time of eight to 12 hours or until sample does not continue to lose mass.

D. Procedures for Changing the Job-Mix Gradation
1. Meet the requirements of this Section, article 2.1, Aggregates for all changes.
2. Submit changes in writing 24 hours prior to start of production for approval by the Engineer.

3.2 INSTALLATION

A. Mixing: Provide an optimum moisture content of ±2 percent at the time of placement. AASHTO T 180, Method D.

B. Placing: Place layers in equal thickness and compact each layer to a thickness not to exceed 6 inches in depth. Do not place on a frozen subgrade or a frozen layer. Refer to Section 01572.

C. Compaction: Meet requirements of this Section, article 1.7, Acceptance, paragraph, B1. Maintain optimum moisture content ±2 percent.
   1. Within 2 feet of back walls of structure abutments and approach slabs, use a hand-operated vibratory compactor or a vibratory roller.
   2. For blends using RAP where maximum laboratory density (AASHTO T 180, Method D) accurate field density values cannot be determined due to Asphalt Cement content, meet 98 percent of maximum field density, with no test less than 96 percent of maximum field density.
      a. Maximum Field Density
      b. Determined by use of a repetitive roller pattern over a two adjacent locations. Maximum Field Density is defined as the average of the maximum value attained on a nuclear density gauge for each location prior to breakdown of the material.
      c. Re-determine at least once per day.

D. Finishing: Uniform line and grade with surface deviations no more than 3/8 inch ± in 10 ft in any direction.
   1. Profile Tolerance — Correct any profile deficiency of greater than 3/8 inch.
      a. Rework minimum of 4 inch lift to achieve homogeneous density
      b. Determine limits of correction based on extent of deficiency. Extend work until existing deficiency is less than 3/8 inch.

E. Quality Control Testing — Submit a quality control plan to the Engineer prior to construction. Perform tests as stated in the Quality Control plan.

END OF SECTION

SECTION 02741

HOT MIX ASPHALT (HMA)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Products and procedures for laying, and compacting a surface course of one or more layers of HMA comprised of aggregate, asphalt binder, lime and other additives.

B. Mix materials at a central mixing plant.

1.2 RELATED SECTIONS

A. Section 01452: Profilograph and Pavement Smoothness

B. Section 02742S: Project Specific Surfacing Requirements

C. Section 02745: Asphalt Material

D. Section 02746: Hydrated Lime

E. Section 02748: Prime Coat/Tack Coat

F. Section 02969: Optional Use of Reclaimed Asphalt Pavement (PG Binder Projects Only)

1.3 REFERENCES

A. AASHTO PP 28: Standard Practice for Superpave Volumetric Design for Hot-Mix Asphalt (HMA)

B. AASHTO T 19: Unit Weights and Voids in Aggregate

C. AASHTO T 30: Mechanical Analysis of Extracted Aggregate

D. AASHTO T 89: Determining the Liquid Limit of Soils

E. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils

F. AASHTO T 96: Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine

G. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

H. AASHTO T 112: Clay Lumps and Friable Particles in Aggregate

I. AASHTO T 166: Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated-Surface Dry Specimens

J. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test

K. AASHTO T 195: Determining Degree of Particle Coating of Bituminous-Aggregate Mixtures

L. AASHTO T 209: Maximum Specific Gravity of Bituminous Paving Mixtures

M. AASHTO T 255: Total Moisture Content of Aggregate by Drying

N. AASHTO T 283: Resistance of Compacted Bituminous Mixture to Moisture Induced Damage (Modified by UDOT Materials Manual of Instruction Part 8 Test Procedure 8-957)

O. AASHTO T 304: Uncompacted Void Content of Fine Aggregate

P. AASHTO T 308: Determining the Asphalt Binder Content of Hot-Mix Asphalt (HMA) by the Ignition Method

Q. AASHTO T 312: Method for Preparing and Determining the Density of Hot-Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor

R. ASTM D 2950: Test Method for Density of Bituminous Concrete in Place by Nuclear Method

S. ASTM D 3549: Thickness or Height of Compacted Bituminous Paving Mixture Specimens

T. ASTM D 3665: Standard Practice for Random Sampling of Construction Materials

U. ASTM D 3666: Specification for Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials

V. ASTM D 4561: Practice for Quality Control Systems for Organizations Producing and Applying Bituminous Paving Materials

W. ASTM D 4791: Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

X. ASTM D 5506: Practice for Organizations Engaged in the Certification of Personnel Testing and Inspecting Bituminous Paving Materials

Y. ASTM D 5821: Determining the Percentage of Fractured Particles in Coarse Aggregate

Z. ASTM E 1274: Standard Test Method for Measuring Pavement Roughness Using a Profilograph

AA. Asphalt Institute Technical Bulletins

BB. UDOT Materials Manual of Instruction

CC. UDOT Quality Assurance Manual

1.4 ACCEPTANCE

A. A lot equals the number of tons of HMA placed during each production day. The Department will:
   1. Divide each lot into four sublots based on the scheduled production day.
   2. Take random samples behind the paver before any further compaction, and determine random numbers/locations from a random numbers table. ASTM D 3665, UDOT Materials Manual of Instruction Part 8-984: Sampling Methods.
      a. Take large enough samples for paired-T testing and split with contractor designated lab until testing discrepancies (based on tests outlined in this Section, article 3.9, Dispute Resolution, paragraph B1, in addition to daily acceptance tests for mix properties) between labs are identified and resolved.
   3. Inform the Contractor of the time and place for the sample not more than 15 minutes prior to the sampling.

4. Conduct the following tests:
   a. Asphalt Binder Content: One per sublot using ignition oven. AASHTO T 308
   b. Aggregate gradation: One test per sublot on the residue of the ignition oven tests. AASHTO T 30.
   c. VMA: 3 tests per lot. AASHTO T 312
5. Perform three Rice tests for each lot. Use the average for the lot to determine density of cores taken by the Contractor.
6. Determine thickness of cores taken by the Contractor.
7. Add the lot to the previous day's production if the minimum number of samples cannot be obtained for the final day's production and evaluate with the appropriate sample size.
8. Add the lot to the next day's production if the minimum number of samples cannot be obtained, and evaluate with the appropriate sample size.
9. Retest the lot if an individual test from a sublot is deemed an outlier based on ASTM E 178.

B. The Engineer conducts the acceptance testing for asphalt binder content, gradation, VMA, density, and thickness. AASHTO T 30, T 308, PP 28, T 166, ASTM D 3549. For small projects with plan quantities of HMA less than 3000 tons or for work such as utility work, traffic signals, detours, lane leveling, etc., the Engineer may elect to accept material based upon visual inspection.
   1. When acceptance is intended to be based upon visual inspection, the Engineer reserves the option of conducting any acceptance tests necessary to determine the material and workmanship meets the project requirements.

C. Obtain samples for density and thickness.
   1. Divide the lot into five sublots of approximately equal sizes.
   2. Obtain ten cores per lot randomly as instructed, and in the presence of the Engineer within two days after the pavement is placed.
   3. Comply with AASHTO T 166.
   4. If the random location for cores falls within one foot of the edge of the overall pavement section (outer part of shoulders), then move transversely to a point one foot from the edge of the pavement.
   5. Fill core holes with an acceptable asphalt mixture and compact.
   6. The Department will take possession of the cores immediately, and will begin testing the cores within 24 hours for density acceptance.
      a. Use Table 4 with n=10 to determine PWL for density.

D. Density: The target density for determining acceptance and incentive/disincentive is 93.5 percent of maximum Rice density for projects where design overlay thickness is greater than 2 inches. For projects where design overlay thickness is 2 inches or less, target density for determining acceptance and incentive/ disincentive is 92.5 percent of maximum Rice density. Refer to AASHTO T 209.

For small projects with plan quantities of HMA less than 3000 tons or for work such as utility work, traffic signals, detours, or lane leveling and when material is to be accepted on the basis of visual inspection according to this Section, article 1.4, Acceptance, paragraph B, acceptance for density may be based upon establishing and maintaining a roller pattern to obtain maximum density without over-stressing the pavement.

1. Obtain a minimum of two density determinations on a random basis for each sublot. ASTM D 3665.
2. When samples for gradation, asphalt binder content and VMA from lots are combined according to this Section, article 3.9, Dispute Resolution, in order to obtain an appropriate sample size for evaluation, a lot for density determination is defined as the combined production days.

E. Thickness: Base acceptance on the average thickness of a lot. A thickness lot equals a density lot. Divide a thickness lot into five sublots equal to density sublots. Thickness acceptance for thin lift projects (2 inches or less) consists of checking thickness regularly with a depth probe during placement and taking corrective action as necessary.

1. Take a minimum of two randomly selected thickness tests within each sublot.
2. The same core samples taken for density may be used for thickness verification.
3. The Department accepts a lot when:
   a. The average thickness of all sublots is not more than 1/2 inch greater nor 1/4 inch less than the total thickness specified.
   b. No individual sublot shows a deficient thickness of more than 3/8 inch.
   c. Place additional materials where lots or sublots are deficient in thickness. The minimum depth of compacted surface for correcting deficient thickness is 3 times the nominal maximum aggregate size.
   d. The Department pays for the quantity of additional material to bring the surface to design grade.
   e. The Department does not pay for the quantity of additional material above the design grade due to the minimum paving thickness required.
   f. The Engineer may allow excess thickness to remain in place or may order its removal. Remove and replace the entire depth of the course, if it is necessary to remove portions of the course.
   g. The Department pays for 50 percent of the mix in excess of the +1/2 inch tolerance when excess thickness is allowed to remain in place.
   h. The thickness tolerances established above do not apply to leveling courses. However, check final surfaces in stage construction.

F. Smoothness Tests

1. Determine acceptance and correct in accordance with Section 01452.

G. Cease production when any two out of three consecutive lots have a net disincentive or the air voids averaged for each lot are not between three and five percent for any two out of three consecutive lots.

1. Before production continues, submit a corrective action plan to the Engineer indicating the changes in production procedures that will be implemented to correct the deficiencies.

H. The Department pays incentive/disincentive on the assessed quantities of HMA mix according to Table 1 Incentive/Disincentive for Gradation, Asphalt Binder Content and Density or Table 2 Incentive/Disincentive for VMA. Base the incentive/disincentive on Percent Within Limit (PT) computation using Tables 3, 4, and 5. Use lowest single value combined for gradation (each of the sieves) and asphalt binder content for calculating the gradation/asphalt binder content incentive/disincentive in Table 1.

1. Meet PT of 88 or greater for density for eligibility for incentive in gradation/asphalt binder content and VMA. The Department does not pay incentive for gradation/asphalt binder content and VMA if the Contractor does not meet this condition.
2. For small projects with plan quantities of HMA less than 3000 tons, or for work such as utility work, traffic signals, detours, or lane leveling and when material is accepted on the basis of visual inspection per this Section, article 1.4, Acceptance, paragraph B, incentives/disincentives do not apply.

I. The Department rejects the lot if the Percent Within Limits (PT) for any individual measurement is less than 60 percent.

J. To reduce over-testing of small quantity production days such as ramps or bridgework, the Engineer may, in concurrence with the Contractor, choose to combine production from several days to form a single lot.

Table 1 Incentive/Disincentive for Gradation, Asphalt Binder Content and Density			
Gradation/Asphalt Binder Content		**Density**	
PT Based on Min. Four Samples	**Incentive/Disincentive (Dollars/Ton)**	**PT Based on Min. Ten Samples**	**Incentive/Disincentive (Dollars/Ton)**
> 99	0.83	> 99	0.83
96-99	0.67	96-99	0.67
92-95	0.37	92-95	0.37
88-91	0.06	88-91	0.06
84-87	-0.24	84-87	-0.24
80-83	-0.54	80-83	-0.54
76-79	-0.84	76-79	-0.84
72-75	-1.15	72-75	-1.15
68-71	-1.45	68-71	-1.45
64-67	-1.75	64-67	-1.75
60-63	-2.06	60-63	-2.06
<60	Reject	<60	Reject

Table 2 Incentive/Disincentive for VMA	
PT Based on Minimum Three Samples	**Incentive/Disincentive (Dollars/Ton)**
> 99	0.49
96-99	0.39
92-95	0.18
88-91	-0.03
84-87	-0.24
80-83	-0.44
76-79	-0.64
72-75	-0.85
68-71	-1.06
64-67	-1.27
60-63	-1.47
<60	Reject

Table 3 Upper and Lower Limit Determination	
Parameter	**UL and LL**
3/4 inch sieve for 1 inch HMA 1/2 inch sieve for 3/4 inch HMA 3/8 inch sieve for 1/2 inch HMA No. 4 sieve for 3/8 inch HMA	Target Value " 6.0%
No. 8 sieve	Target Value " 5.0%
No.50 sieve	Target Value " 3.0%
No. 200 sieve	Target Value " 2.0%
Asphalt Binder Content	Target Value " 0.35%
VMA Production Range Target Range (Field) Target Range (Design)	Field Target Value ± 1.25% 12.5 % - 13.5 % for 1 inch 13.5 % - 14.5 % for ¾ inch 14.5 % - 15.5 % for ½ inch 15.5 % - 16.5 % for 3/8 inch Modified as necessary to meet field target range
Density	Lower Limit: Target Value - 2.0% Upper Limit: Target Value + 3.0%

Table 4 Quality Index Values for Estimating Percent Within Limits										
PU/PL	**n=3**	**n=4**	**n=5**	**n=6**	**n=7**	**n=8**	**n=10**	**n=12**	**n=15**	**n=20**
100	1.16	1.50	1.75	1.91	2.06	2.15	2.29	2.35	2.47	2.56
99	1.16	1.47	1.68	1.79	1.89	1.95	2.04	2.09	2.14	2.19
98	1.15	1.44	1.61	1.70	1.77	1.80	1.86	1.89	1.93	1.97
97	1.15	1.41	1.55	1.62	1.67	1.69	1.74	1.77	1.80	1.82
96	1.15	1.38	1.49	1.55	1.59	1.61	1.64	1.66	1.69	1.70
95	1.14	1.35	1.45	1.49	1.52	1.54	1.56	1.57	1.59	1.61
94	1.13	1.32	1.40	1.44	1.46	1.47	1.49	1.50	1.51	1.53
93	1.12	1.29	1.36	1.38	1.40	1.41	1.43	1.43	1.44	1.46
92	1.11	1.26	1.31	1.33	1.35	1.36	1.37	1.37	1.38	1.39
91	1.10	1.23	1.27	1.29	1.30	1.31	1.32	1.32	1.32	1.33
90	1.09	1.20	1.23	1.24	1.25	1.25	1.26	1.26	1.27	1.27
89	1.08	1.17	1.20	1.21	1.21	1.21	1.21	1.21	1.22	1.22
88	1.07	1.14	1.16	1.17	1.17	1.17	1.17	1.17	1.17	1.17
87	1.06	1.11	1.12.	1.12	1.12	1.13	1.13	1.13	1.13	1.13
86	1.05	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
85	1.03	1.05	1.05	1.05	1.05	1.04	1.04	1.04	1.04	1.04
84	1.02	1.02	1.02	1.01	1.01	1.01	1.00	1.00	1.00	1.00
83	1.00	0.99	0.98	0.97	0.97	0.96	0.96	0.96	0.96	0.96
82	0.98	0.96	0.95	0.94	0.94	0.93	0.93	0.92	0.92	0.92
81	0.96	0.93	0.92	0.91	0.90	0.90	0.89	0.89	0.89	0.88
80	0.94	0.90	0.88	0.87	0.86	0.86	0.85	0.85	0.85	0.85
79	0.92	0.87	0.85	0.84	0.83	0.83	0.82	0.82	0.82	0.81
78	0.89	0.84	0.82	0.81	0.80	0.79	0.79	0.78	0.78	0.78
77	0.87	0.81	0.79	.0.78	0.77	0.76	0.76	0.75	0.75	0.75
76	0.84	0.78	0.76	0.75	0.74	0.73	0.72	0.72	0.72	0.72
75	0.82	0.75	0.73	0.72	0.71	0.70	0.69	0.69	0.69	0.68
74	0.79	0.72	0.70	0.68	0.67	0.67	0.66	0.66	0.66	0.65
73	0.77	0.69	0.67	0.65	0.64	0.64	0.62	0.62	0.62	0.62
72	0.74	0.66	0.64	0.62	0.61	0.61	0.60	0.59	0.59	0.59
71	0.71	0.63	0.60	0.59	0.58	0.58	0.57	0.56	0.56	0.56
70	0.68	0.60	0.58	0.56	0.55	0.55	0.54	0.54	0.54	0.53
69	0.65	0.57	0.55	0.54	0.53	0.52	0.51	0.51	0.51	0.50
68	0.62	0.54	0.52	0.51	0.50	0.50	0.48	0.48	0.48	0.48
67	0.59	0.51	0.49	0.48	0.47	0.47	0.46	0.45	0.45	0.45
66	0.56	0.48	0.46	0.45	0.44	0.44	0.43	0.42	0.42	0.42
65	0.53	0.45	0.43	0.42	0.41	0.41	0.40	0.40	0.40	0.39
64	0.49	0.42	0.40	0.39	0.38	0.38	0.37	0.37	0.37	0.37
63	0.46	0.39	0.37	0.36	0.35	0.35	0.35	0.34	0.34	0.34
62	0.43	0.36	0.34	0.33	0.33	0.33	0.32	0.31	0.31	0.31
61	0.39	0.33	0.31	0.30	0.30	0.30	0.29	0.29	0.29	0.28
60	0.36	0.30	0.28	0.27	0.26	0.26	0.25	0.25	0.25	0.25
<60	#0.35	#0.29	#0.27	#0.26	#0.25	#0.25	#0.24	#0.24	#0.24	#0.24

Enter table in the appropriate sample size column and round down to the nearest value.

Table 5

Definitions, Abbreviations, and Formulas for Acceptance	
Term	**Explanation**
Target Value (TV)	The target values for gradation, asphalt binder content and VMA are given in the Contractor's volumetric mix design. See this Section, article 1.4, Acceptance, paragraph D, for density target values.
Average (AVE)	The sum of the lot's test results for a measured characteristic divided by the number of test results; the arithmetic mean.
Standard Deviation (s)	The square root of the value formed by summing the squared difference between the individual test results of a measured characteristic and AVE, divided by the number of test results minus one. This statement does not limit the methods of calculations of s; other methods that obtain the same value may be used.
Upper Limit (UL)	The value above the TV of each measured characteristic that defines the upper limit of acceptable production. (Table 3)
Lower Limit (LL)	The value below the TV of each measured characteristic that defines the lower limit of acceptable production (Table 3)
Upper Quality Index (QU)	QU = (UL - AVE)/s
Lower Quality Index (QL)	QL = (AVE - LL)/s
Percentage of Lot Within UL (PU)	Determined by entering Table 4 with QU.
Percentage of Lot Within LL (PL)	Determined by entering Table 4 with QL.
Total Percentage of Lot (PL) Within UL and LL (PT)	PT = (PU + PL) - 100
Incentive/Disincentive	Determined by entering Table 1 and 2 with PT or PL.

All values for AVE, s, QU, and QL will be calculated to two decimal place accuracy, which will be carried through all further calculations. Rounding to lower accuracy is not allowed.

PART 2 PRODUCTS

2.1 ASPHALT BINDER

A. Refer to Special Provision 02742S: Project Specific Surfacing Requirements.

B. Asphalt material: Refer to Section 02745.

C. Sampling procedure: UDOT Materials Manual of Instruction Part 8-209

D. Asphalt Binder Management Plan: UDOT Materials Manual of Instruction Part 8-209

2.2 AGGREGATE

A. Refer to the Minimum Test Requirements.

B. Crusher processed virgin aggregate material consisting of crushed stone, gravel, or slag. Conform to Section 02969 for recycled mixes.

C. Use the following requirements, including Table 6, to determine the suitability of the aggregate.
   1. Coarse aggregates:
      a. Retained on No. 4 sieve.
   2. Fine aggregates:
      a. Clean, hard grained, and angular.
      b. Passing the No. 4 sieve.

Table 6

Aggregate Properties - HMA			
Test Method	**Test No.**	**Category 1**	**Category 2**
One Fractured Face	ASTM D 5821	95% min.	85% min. (1 inch and 3/4 inch), and 90% min. (1/2 inch and 3/8 inch)
Two Fractured Face	ASTM D 5821	90% min.	80% min. (1 inch and 3/4 inch), and 90% min. (1/2 inch and 3/8 inch)
Fine Aggregate Angularity	AASHTO T 304	45 min.	45 min.
Flat and Elongated 1 to 3 ratio	ASTM D 4791 (Based on 3/8 inch sieve and above)	20% max.	20% max.
L.A. Wear	AASHTO T 96	35% max.	40% max.
Sand Equivalent	AASHTO T 176 (Pre-wet method)	60 min.	45 min.
Plasticity Index	AASHTO T 89 and T 90	0	0
Unit Weight	AASHTO T 19	min. 75 lb/cu. ft.	min. 75 lb/cu. ft.
Soundness (sodium sulfate)	AASHTO T 104	16 % max. loss with five cycles	16 % max. loss with five cycles
Clay Lumps and Friable Particles	AASHTO T 112	2% max	2% max.
Natural Fines	N/A	0%	10% max.
Category 1: National Highway System and Truck Routes - Table 11. Category 2: All Other Routes			

D. Meet gradation requirements in Table 7.

Table 7

Aggregate Gradations (Percent Passing by Dry Weight of Aggregate)					
Sieve Size		**1 inch (SHRP 25 mm)**	**3/4 inch (SHRP 19 mm)**	**1/2 inch (SHRP 12.5 mm)**	**3/8 inch (SHRP 9.5 mm)**
Control Sieves	**1-1/2 inch**	100.0	-	-	-
	1 inch	90.0 - 100.0	100.0	-	-
	3/4 inch	<90	90.0 - 100.0	100.0	-
	1/2 inch	-	<90	90.0 - 100.0	100.0
	3/8 inch	-	-	<90	90.0 - 100.0
	No. 4	-	-	-	< 90
	No. 8	19.0 - 45.0	23.0 - 49.0	28.0 - 58.0	32.0 - 67.0
	No. 200	1.0 - 7.0	2.0 - 8.0	2.0 - 10.0	2.0 - 10.0

2.3 HYDRATED LIME

A. Meet the requirements of Section 02746.

2.4 VOLUMETRIC DESIGN

A. Comply with all requirements for Superpave Volumetric Mix Design according to Asphalt Institute, SP-1, and SP-2, AASHTO PP 28 and the following:
   1. Meet the requirements of Table 8 and Table 9.
   2. Use a laboratory qualified by UDOT Central Materials in the use of the Superpave Gyratory Compactor. AASHTO T 312.
   3. Use an FHWA-protocol approved Superpave Gyratory Compactor.
   4. Meet all volumetric mix design requirements for the selected target gradation.

B. Submit the Volumetric Mix Design data for verification at least 10 working days before beginning paving. Do not begin paving until verification is complete.
   1. Include all information regarding selection of design aggregate structure showing the target values of percent passing on all sieves listed in Table 7, and the design asphalt binder content.
   2. Provide information that aggregate proposed for use meet the requirements of Table 6.
   3. Supply QC data for target job mix gradation selection. Use those target values for price adjustments.

4. After the design is complete, run four sets of two Gyratory specimens at the design asphalt binder content to verify the optimum asphalt and all other design requirements.

C. Moisture Susceptibility

1. Incorporate hydrated lime into all volumetric designs. Use one percent, minimum, for Method A and 1½ percent, minimum for Method B (Refer to Section 02746).

D. Designate asphalt binder supplier.

E. Use gyratory mixing and compaction temperatures supplied by the Engineer.

F. The Department Region Materials Lab verifies the Volumetric Mix Design. UDOT Materials Manual of Instruction Part 8-960: Guidelines for Superpave Volumetric Mix Design. For small projects with plan quantities of HMA less than 3000 tons, or for work such as utility work, traffic signals, detours, or lane leveling, the Region Materials Engineer may accept the Volumetric Mix Design from data submitted with the proposed mix design or from a previous mix design. The Region Materials Engineer reserves the right to verify any mix design submitted.

G. Comply with the following requirements for Superpave volumetric mix design:

Table 8

Volumetric Design Gyrations				
20 Years Design ESALS (Million)	**Compaction Parameters**			**Voids Filled with Asphalt (VFA) (%)**
	$N_{initial}$ /% of G_{mm}*	**N_{design} /% of G_{mm}***	**N_{max} /% of G_{mm}***	
0.3	6/# 91.5	50/ ≥ 96.5	75/ # 98	70 - 80 **
0.3 to <3	7/# 90.5	75/ ≥ 96.5	115/ # 98	65 - 78
3 to < 30	8/# 89	100/ ≥ 96.5	160/ # 98	65 - 75
$30	9/ # 89	125/ ≥ 96.5	205/ # 98	65 - 75

* G_{mm}: Maximum specific gravity of Mix. (Rice Method)
** 67 percent specified lower limit VFA for 1 inch nominal maximum size mixture.

Table 9

Volumetric Design Requirements	
HMA design mixing and compaction temperatures	Provided by the Engineer
Dust Proportion Range	0.6 - 1.40
Voids in Mineral Aggregate (VMA) at N_{design} AASHTO PP 28.9.2, using G_{sb} at SSD. Equation based on percent of total mix.	Sufficient to Achieve Field Performance (Submit calculations or documentation to substantiate)
Hamburg Wheel Tracker UDOT Materials Manual of Instruction Part 8-990	Maximum 10 mm impression at 20,000 cycles.

H. Prepare and submit two sets (five samples each) of ignition oven calibration samples.
   1. Department uses these samples to determine the correction factors for the Region and Field lab ignition oven.
   2. Submit samples a minimum of three working days prior to paving.

2.5 CONTRACTOR INITIATED CHANGES IN MIX DESIGN

A. Submit all requests in writing at least 12 hours prior to incorporating changes into production.

B. Submit a field volumetric mix design for all target changes.
   1. Field volumetric mix design verification consists of three sets of two gyratory specimens run at the new target gradation and/or asphalt binder content. The Department's previous acceptance tests are allowed for field verification.
   2. If the field volumetric mix design meets the volumetric requirements, the Engineer, in consultation with the Region Materials Engineer, provides written concurrence of the verified field volumetric mix design.
   3. If the field volumetric mix verification does not meet the volumetric requirements, submit a new laboratory volumetric mix design from a laboratory qualified by UDOT Central Materials. Allow at least four working days for verification.
   4. The Department performs up to two volumetric mix design verifications at no cost to the Contractor. The Department charges $3000 for each additional laboratory and/or field verification required, including all laboratory or field volumetric mix design verifications required due to contractor initiated target changes.

C. Submit a new laboratory volumetric mix design if changes occur in the aggregate source, asphalt binder source or grade.

D. Do not make changes to production mix until request is reviewed and verified.

PART 3 EXECUTION

3.1 ADDING HYDRATED LIME

A. Method A, Lime Slurry; or Method B, Lime Slurry Marination: Refer to Section 02746.

3.2 HMA

A. Dry aggregate to an average moisture content of not more than 0.2 percent by weight. AASHTO T 255. Adjust burners to avoid damage or soot contamination of the aggregate.

B. Coat with asphalt binder 100 percent of the particles passing and 98 percent of the particles retained on the No. 4 sieve.
   1. AASHTO T 195.
   2. Discontinue operation and make necessary corrections if material is not properly coated.

C. Maintain temperature of the HMA between established limits.
   1. Do not overheat the material or cause thermal damage to the asphalt binder.
   2. Department rejects and Contractor removes materials heated over the established limits.
   3. Remove all material rejected by the Department for overheating.

3.3 HMA PLANT

A. Provide:
   1. Positive means to determine the moisture content of aggregate.
   2. Positive means to sample all material components.
   3. Sensors to measure the temperature of the HMA at discharge.
   4. The ability to maintain discharge temperature of the mix in accordance with the mix design.

B. Asphalt Binder Storage Tanks:
   1. Provide calibrated tanks so the quantity of material remaining in the tank can be determined at any time.
   2. Provide a positive means of sampling the asphalt binder from the tanks.

3.4 SURFACE PREPARATION

A. Locate, reference, and protect all utility covers, monuments, curb and gutter, and other components affected by the paving operations.

B. Remove all moisture, dirt, sand, leaves, and other objectionable material from the prepared surface before placing the mix.

C. Complete spot leveling 48 hours before placing pavement courses.
   1. Place, spread, and compact leveling mix on portions of the existing surface.
   2. Fill and compact any localized potholes more than 1 inch deep.

D. Allow sufficient cure time for prime coat/tack coat prior to placing HMA. Refer to Section 02748.

3.5 SURFACE PLACEMENT

A. When full-width or echelon paving is impractical and more than one pass is required, provide a 3:1 (horizontal to vertical) sloped edge adjacent to the next lane to be paved.

B. Adjust the production of the mixing plant and material delivery until a steady paver speed is maintained.

C. Offset longitudinal joints 6 to 12 inches in succeeding courses.
   1. Place top course joint within one foot of the centerline or lane line.
   2. If the previous pass has cooled below 175 degrees F, tack the longitudinal edge before placing the adjacent pass.

D. Offset transverse construction joints at least 6 ft longitudinally to avoid a vertical joint through more than one course.

E. Do not allow construction vehicles, general traffic, or rollers to pass over the uncompacted end or edge of freshly placed mix until the mat temperature drops to a point where damage or differential compaction will not occur.

F. Taper the end of a course subjected to traffic at approximately 50:1 (horizontal to vertical).
   1. Make a transverse joint by saw or wheel cutting and removing the portion of the pass that contains the tapered end.
   2. Tack the contact surfaces before fresh mix is placed against the compacted mix.

G. Use a motor grader, spreader box, or other approved spreading methods for projects under 180 yd^2, irregular areas, or for miscellaneous construction such as detours, sidewalks, and leveling courses.

3.6 COMPACTION

A. Use a small compactor or vibratory roller in addition to normal rolling at structures.

B. Operate in a transverse direction next to the back wall and approach slab.

3.7 LIMITATIONS

A. Do not place HMA on frozen base or subbase.

B. Use a UDOT approved release agent for all equipment and hand tools used to mix, haul, and place the HMA. Select from the Performance Data Products Listing (PDPL) maintained by the UDOT Research Division.

C. Do not place HMA during adverse climatic conditions, such as precipitation, or when roadway surface is icy or wet.

D. Place HMA from April 15, and October 15, and when the air temperature in the shade and the roadway surface temperature are above 50 degrees F.
   1. The Department determines if it is feasible to place HMA outside the above limits. Obtain written approval from the Engineer prior to paving from October 15, to April 15.

3.8 CONTRACTOR QUALITY CONTROL

This Section does not apply to projects of 20,000 tons or less.

A. General
   1. Reference the following standards for qualification, control, and guidelines:
      a. ASTM D 3666
      b. ASTM D 4561
      c. ASTM D 5506
   2. Include the following tests in ASTM D 5506, Part 2, Referenced Documents, for the following:
      a. AASHTO T 308
      b. AASHTO T 312, PP 28
      c. AASHTO T 283 Modified by UDOT Materials Manual of Instruction Part 8-957
      d. ASTM E 1274

3. Establish and maintain a quality control system providing assurance that materials and completed construction conform to Contract requirements.
4. Identify the Quality Control Manager by name. The Quality Control Manager implements and maintains the Quality Control Plan.
5. Provide the Engineer a certification stating that all the testing equipment to be used is properly calibrated and meets the specifications applicable for the specified test procedures. Provide evidence that Technicians are WAQTC certified. The Engineer may require the Contractor's technician to perform testing of samples to demonstrate an acceptable level of performance.
6. Perform split-sample, paired-T testing with the Department based on project quality control testing using an AASHTO accredited lab.
    a. Perform split-sample, paired-T analysis on all mix acceptance tests related to volumetric properties and the following background testing:
        1) Maximum Specific Gravity of Mix
        2) Bulk Specific Gravity of Mix
        3) Bulk Specific Gravity of Coarse Aggregates
    b. Continue until attaining successful Paired-T test results, meeting $\alpha = 0.05$, for a minimum of two consecutive production days.

B. Quality Control Plan (QCP)
1. Provide and maintain a Quality Control Plan covering all personnel, equipment, supplies, and facilities necessary to obtain samples, perform and document tests, and otherwise provide a quality product.
2. Submit the written QCP to the Engineer at least 10 days before beginning operations, or at the Preconstruction Conference.
3. The Department makes no partial payments for materials that are subject to specific quality control requirements without a QCP.
4. The Contractor or independent organization may operate the QCP. However, the Contractor is responsible for the QCP's administration, including compliance with the QCP and any modifications.
5. Address the following minimum items:
    a. Quality control organization chart and area of responsibility and authority of each individual.
    b. Names and qualifications of personnel as required by this Section, article 3.8, Contractor Quality Control, paragraph D, Quality Control Organization Personnel Requirements.
    c. Provide a description of outside organizations and their services (such as testing laboratories) if employed.
    d. Tests required to be performed, the frequency of testing, sampling locations, and location of the testing facilities.
    e. Documentation of test procedures verifying that tests are conducted in accordance with the testing plan, and that proper corrective actions are taken when required.

f. Procedures for verifying that testing equipment is available, complies with specified standards, and is calibrated against certified standards.
g. Procedures for verifying that tests are conducted in accordance with the appropriate ASTM and AASHTO standards.
h. Procedures for submitting test results to the Engineer daily.

6. QCP elements: address all elements that affect the quality of the HMA including:
   a. Mix Design
   b. Aggregate Grading
   c. Quality of Materials
   d. Stockpile Management
   e. Proportioning
   f. Mixing
   g. Placing and Finishing
   h. Sampling and Testing Procedures
   i. Joints
   j. Compaction
   k. Surface smoothness

C. Quality Control Organization
1. Implement the QCP by:
   a. Establishing a separate Quality Control Organization.
   b. Developing an organization chart to show all quality control personnel and how these personnel integrate with other management, production, and construction functions and personnel.
2. Identify all quality control staff on the organization chart by name and function, and indicate the total staff required to implement all elements of the quality control programs, including inspection and testing functions for different items of work.
3. If an outside organization or laboratory is used to implement all or part of the QCP, the personnel assigned are subject to the qualification requirements of this Section. Indicate on the organization chart which personnel are contractor employees and which are provided by an outside organization.

D. Quality Control Organization Personnel Requirements
1. As outlined in ASTM D 3666, Part 7, with the following modifications. Quality Control Manager:
   a. Institutes any actions necessary to successfully operate the QCP in compliance with specifications.
   b. Reports directly to a responsible officer in the Contractor's organization.

c. May supervise the QCP on more than one project provided that the Quality Control Manager can be at the job site within one hour after being notified of a problem.

2. Certification of Personnel. As outlined in ASTM D 5506 with the following changes:
   a. Provide a sufficient number of quality control technicians to adequately implement the QCP. These personnel will be either engineers or engineering technicians certified by WAQTC.
3. Quality Control Technicians:
   a. Report directly to the Quality Control Manager.
   b. Inspect all plant equipment used in proportioning and mixing to verify proper calibration and operating condition.
   c. Perform quality control tests necessary to adjust and control mix proportioning in accordance with the job mix formula.
   d. Inspect all equipment used in placing, finishing, and compaction to verify proper operating condition.
   e. Inspect all construction operations to verify conformance with the specifications.
   f. Perform all quality control testing as required by this Section, article 3.8, Contractor Quality Control, paragraph F, Quality Control Testing.
   g. Detail the criteria to be used in initiating correction of unsatisfactory production processes and construction practices.

E. Quality Control Testing Laboratory
1. Reference ASTM D 4561 with the following additions:
   a. Provide a fully equipped asphalt laboratory located within 30 minutes travel time of the plant or job site.
   b. Keep laboratory facilities clean and all equipment maintained in proper working condition.
   c. Permit the Engineer unrestricted access to inspect the quality control testing laboratory facility and witness quality control activities. The Department advises in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies or testing personnel and procedures.
   d. Suspend work when test results indicate materials are out of specification tolerances. Resume only when the deficiencies are corrected.
      1) Perform quality audits under this standard.
      2) Refer to UDOT Quality Assurance Manual.
2. Sampling:
   a. Use a statistically based procedure of random sampling. ASTM D 3665.
   b. The Engineer has the right to witness all sampling. UDOT Materials Manual of Instruction Part 8-984: Sampling Methods.

3. Noncompliance:
   a. When quality control activities do not comply with either the Quality Control Program or the Contract provisions, or failure to properly operate and maintain an effective Quality Control Program, the Engineer may:
      1) Order replacement of ineffective or unqualified personnel.
      2) Carry out the functions and operation of the approved Quality Control Program.
      3) Deduct costs incurred by the Department to operate the program or otherwise remedy the noncompliance from the total amount due the Contractor.

F. Quality Control Testing
   1. Perform all quality control tests necessary to control the production and construction processes applicable to these specifications and listed in the QCP.
   2. Establish a testing program to control as a minimum: asphalt binder content, aggregate gradation, VMA, temperatures, aggregate moisture, field compaction, and surface smoothness.
   3. Monitoring: The Department reserves the right to monitor any QC testing.
   4. Follow the requirements of Table 10, and conduct any additional testing to control the process.

Table 10

Quality Control Testing for HMA	
Testing Method/ Acceptance Documentation	**Testing Frequency**
AASHTO T 308 **Asphalt binder content**: by the ignition method	Minimum Four tests per lot **
AASHTO T 30 **Gradation**: Mechanical analysis of the remains of the Ignition test.	Minimum Four tests per lot
AASHTO T 255 **Moisture content**: of aggregate used in production by drying	Minimum One test per lot
Temperature for: dryer, bitumen in the storage tank, mixture at the plant, and mixture at the job site.	Record at least four times per lot
ASTM D 2950 **In-place Density Monitoring** Conduct all testing necessary to meet density requirements.	Minimum 10 density determinations per lot
AASHTO T 312, PP 28 **Field Gyratory Specimens** Verify mix design parameters meet Job-mix requirements, and adjust mix as needed to meet parameters. Mold field gyratory specimens at mix design temperatures determined by the Engineer.	Minimum of one determination (two Gyratory specimens each) of VMA and Air Voids for each lot.

** A lot is defined in article 1.4

G. Control Charts

1. Maintain daily linear control charts both for mean and range. Include in charts aggregate gradation, asphalt binder content, stockpile gradation, VMA, Density and in-place air voids.
2. Post control charts daily in a location satisfactory to the Engineer. As a minimum, identify:
   a. Project number
   b. Contract item number
   c. Test number
   d. Each test parameter
   e. Test results

3. 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 problem and no corrective action is taken, the Engineer may suspend production or acceptance of the material.

H. Quality Control Reports
1. Maintain records and submit daily reports of quality control activities.

3.9 DISPUTE RESOLUTION

A. When disputing the validity of the Department's acceptance tests, submit an engineering analysis within one week of receipt of test results.

B. At a minimum, include the following items in the engineering analysis:
1. Data supporting the Contractor's test results. Data must be based on project quality control testing performed by an AASHTO accredited lab that has performed a split-sample process with the Department and includes:
   a. Split-sample testing performed within the applicable contract
   b. Test data disputed along with:
      1) Maximum Specific Gravity of Mix
      2) Bulk Specific Gravity of Mix
      3) Bulk Specific Gravity of Coarse Aggregates
   c. Successful Paired-T test information, meeting $\alpha = 0.05$, for a minimum of two consecutive production days
2. Procedures or issues leading to disputed acceptance test results.
3. Determination of volumetric, durability and long-term structural properties from one or more of the following tests:
   a. Hamburg Rut Tester
   b. 5-Cycle Lottman
   c. Asphalt Pavement Analyzer - Rut and Fatigue tests
   d. Resilient Modulus
   e. SHRP PG Asphalt Binder Tests
   f. SHRP Gyratory Compactor
4. Incentive/Disincentive calculations based on Contractor and Department test values.
5. Recommendations for price adjustment based on expected long-term performance.

C. When paving plans indicate that a reject lot will be covered within 48 hours, the Department immediately reviews the analysis to identify possible discrepancies that can be resolved through validation testing based on the following:

1. Department performs repeat testing on remaining material from original Department test.
2. Department personnel perform repeat testing in the presence of Contractor representative within a 24 hour time period.
3. Use results to validate or invalidate original Department result. Validation test results may not be used in lieu of acceptance results.
4. Base validation on results within two standard deviations (project acceptance samples) of original acceptance result. Remove invalidated test results from acceptance lot and reevaluate lot based on reduced sample size.
5. The Engineer reviews the results and notifies the Contractor of any findings that affect the reject status of the lot along with the Department's position on whether the lot is to be removed or may remain in place at the $15.00/ton deduction for Reject Lot.

D. Within three working days of receipt, the Resident Engineer, Region Materials Engineer, and Region Construction Engineer review the analysis and notify the Contractor in writing of acceptance or rejection. Notification of rejection includes the following:

1. Engineering basis for rejecting the Contractor's analysis, including specific points of objection.
2. Department data and analysis to justify Department position.
3. Time frame for removal of material or pay adjustment to be applied to the lot.

E. When the Department concludes the engineering analysis has merit, the Department, in conjunction with the Contractor, immediately begins a review of the acceptance test results. The review includes, but is not be limited, to the following:

1. Independent Assurance review of all equipment and procedures and methods used for sampling, splitting, and testing.
2. A review of the Department and Contractor's raw test data and calculations for documentation or calculation errors.
3. Production and testing of additional correlation samples.
4. Cross-witnessing of test procedures by Contractor Quality Control and Department personnel.
5. Distribution any other pertinent information.
6. Discussion of other possible means for variation.

Note: If engineering analysis is initiated due to failure of statistical methods to verify Contractor testing and there is no net difference between incentive/disincentive based on Contractor or Department testing, the Engineer may verify contractor test values based on engineering analysis.

F. Do not continue production without concurrence from the Engineer or until differences in the test results are resolved.

G. If errors in testing or reporting are discovered, the Department corrects the applicable test results and re-applies the acceptance/pay adjustment procedures.
   1. If errors are identified that cannot be corrected and the quality of the lot is in question, the Department may choose to evaluate the lot using the Hamburg Wheel Tracker or the Asphalt Pavement Analyzer.
      a. Use five stratified random samples cut from the roadway
      b. The Region Materials Engineer and Resident Engineer decide, in conjunction with the Contractor, the status of the lot and associated pay adjustment, based on the following:
         1) Fatigue Life
         2) Stripping Potential
         3) Rutting Potential
         4) Expected Pavement Performance Period vs. Design Life
   2. Errors that are identified within the Department's testing result in a review of the Contractor's schedule and if appropriate, make adjustments to the CPM.

H. If errors in testing cannot be identified, select an Independent Third Party (Agreed on by the Department and the Contractor) to witness sample splitting and testing by both the Contractor and the Department. The Independent Third Party identifies/produces additional material for split-sample testing.

I. If testing errors are identified by the Third Party, the Department makes appropriate adjustments to the acceptance test results and re-applies the acceptance/pay adjustment procedures.

J. The party responsible for the identified error pays for the services of the Independent Third Party.

K. If no errors are identified, the Department evaluates the lot using the original testing results.

Table 11

National Highway System and Truck Routes Category 1		
Interstate Routes	**Beginning**	**Ending**
1-15	Arizona State Line	Idaho State Line
1-70	Jct I-70 - Cove Fort	Colorado State Line
1-80	Nevada State Line	Wyoming State Line
1-84	Idaho State Line	Jct I-80 – Coalville
1-215	Jct I-80 - Parleys Canyon	Jct I -15 - North Salt Lake
US Routes		
US-6	Nevada State Line	Jct US-50 – Delta
US-6	Jct I-15 - Spanish Fork	Jct I-70 - Green River
US –40	Jct I-80 - Park City	Colorado State Line
US-50	Jct US-6 - Delta	Jct I-15 – Holden
US –89	Arizona State Line	Jct I-70 – Sevier
US –89	Jct I-70 - Salina	Jct SR-28 – Gunnison
US-89	Jct US-6 - Spanish Fork	Jct SR-73 – Lehi
US-89	Jct I-15 - Draper, Exit 295	Jct SR-269 - 5th and 6th South
US-89	Jct I-15 - Farmington	Jct I-80 – Uintah
US-89	Jct I-84 - Uintah	Jct SR-134 - North Ogden
US-89	Jct US-91 - Logan	Idaho State Line
US-91	Jct I-15 - Brigham City	Jct US-89 – Logan
US-189	Jct I-15 - South Provo	Jct US-40 - Heber City
US-191	Arizona State Line	Jct I-70 – Thompson
US-666	Jct US-191 - Monticello	Colorado State Line

State Routes	Beginning	Ending
SR-9 - Zions Park		
SR-10 - Castle Valley	Jct I-70 - Fremont Jct	Jct US-6 – Price
SR-12 - Bryce Canyon	Jct US-89 - Panguitch	Jct SR-63 – Bryce Canyon
SR-26 – Riverdale Road	Jct I-15 - Exit 342	Jct US-89 – Ogden
SR-28 - Levan Desert	Jct US-89 - Gunnison	Jct I-15 - South Nephi
SR-31 - Huntington	Mile Post 33	Mile Post 49
SR-36 - Tooele Access	Jct entrance - Tooele Army Depot	Jct I-80 – Tooele Interchange
SR-39 - 20th and 21st Odgen	Jct I-15 - Exit 344	Jct SR-203 - Harrison Blvd
SR-52 - 8th North, Orem	Jct 1-15 - Orem	Jct US -189 - Olmstead Jct
SR-57 - Orangeville Bypass	Jct SR-10 - Hunter Power Plant	Entrance - Wilberg Coal Mine
SR-71 - 7th and 9th East Street, Salt Lake City	Jct SR0-209 - 90th South Street	Jct SR-186 - 4th South Street
SR-73 - Lehi Connection	Jct I-15 - South Lehi	Jct US-89 – South Lehi
SR-79 - 12th Street Ogden	Jct I-15 - Exit 347	Jct SR-203 – Harrison Blvd.
SR-96 - Scofield Access	Mile Post 3	Mile Post 4
SR-111 - Bacchus Highway	Jct SR-48 - Bingham Highway	Jct SR-201 - 21st South Expressway
SR-134 - 2700 North	Jct I-15 - North Ogden, Exit 352	Jct US-89 – North Ogden
SR-152 - Van Winkle Expressway	Jct SR-71 - 9th East Street	Jct I-215 - East (Exit 8)
SR-154 - Bangerter Highway	Jct I-15 - Draper	Jct I-80 - Salt Lake Intl Airport
SR-171 - 33rd and 35th South, Salt Lake City	Jct SR-172 - 56th West Street	Jct I-215 - East, Exit 3
SR-172 - 56th West Street Salt Lake City	Jct 6200 South - Kearns	Jct I-80 – International Center
SR-186 Foothill Blvd	Jct SR-71 - 7th East Street, SLC	Jct I-215 - East (Exit 1)
SR-190 - Big Cottonwood	Jct I 215 - East, Exit 7, SLC	Jct SR-210 – Little Cottonwood
SR-201 - 21st South Expressway	Jct I-80 - Lake Point	Jct I-15 - South Salt Lake
SR-203 - Harrison Blvd	Jct US-89 - South Ogden	Jct SR-39 - 12th Street

State Routes	Beginning	Ending
SR-209 - 90th & 94th South	Jct SR-68 - Redwood Road (SLC)	Jct SR-210 - Little Cottonwood
SR-210 - Little Cottonwood	Jct SR-190 - Big Cottonwood	Jct SR-209 - 90th and 96th South
SR-264 - Skyline Mine Road	Mile Post 12	Mile Post 15
SR-265 - University Parkway	Jct I-15 - Exit 272	Jct I-215 East, Exit 5
SR-266 - 45th & 47th South Taylorsville	Jct I-215 - West, Exit 15	Jct I-215 - East, Exit 5
SR-269 - 5th & 6th South Salt Lake City	Jct I-215, Exit 310	Jct SR-71 - 7th East Street

END OF SECTION

SECTION 02743

HOT MIX ASPHALT - BIKE AND PEDESTRIAN PATHS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Products and procedures for constructing a surface course of one or more layers of HMA comprised of aggregate, asphalt binder, lime and other additives for bike and pedestrian paths.

B. Mix materials at a central mixing plant.

1.2 RELATED SECTIONS

A. Section 02741: Hot Mix Asphalt (HMA)

B. Section 02745: Asphalt Material

C. Section 02746: Hydrated Lime

D. Section 02748: Prime Coat/Tack Coat

1.3 REFERENCES

A. AASHTO T 11: Materials Finer Than 75 µm (No. 200) Sieve In Mineral Affregates By Washing

B. AASHTO T 19: Bulk Density ("Unit Weight") and Voids in Aggregate

C. AASHTO T 27: Sieve Analysis Of Fine and Coarse Aggregates

D. AASHTO T 30: Mechanical Analysis of Extracted Aggregate

E. AASHTO T 89: Determining the Liquid Limit of Soils

F. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils

G. AASHTO T 96: Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine

H. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

I. AASHTO T 112: Clay Lumps and Friable Particles in Aggregate

J. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test

K. AASHTO T 304: Uncompacted Void Content of Fine Aggregate

L. AASHTO T 308: Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Oven

M. AASHTO TP 4: Method for Preparing and Determining the Density of Hot-Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor

N. ASTM D 4791: Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

O. ASTM D 5821: Determining the Percentage of Fractured Particles in Coarse Aggregate

1.4 ACCEPTANCE

A. Certify that the mix meets the gradation and asphalt binder requirements of Aggregate Gradation Table (Table 2) and Job Mix Design Requirements. Submit design data sheet to support. AASHTO T 30, T 308.

PART 2 PRODUCTS

2.1 ASPHALT MATERIALS

A. Use the following asphalt materials:
   1. Asphalt Binder: Performance Graded (PG) Binder.
   2. Flush Coat: CSS-1 or SS-1.

2.2 AGGREGATE

A. Refer to Section 02741 except for Aggregate Properties Table.
B. Use Table 1 following for Aggregate Properties.

Table 1
Aggregate Properties

Properties	Test Method	Test Requirements
One Fractured Face	ASTM D 5821	N/A
Two Fractured Face	ASTM D 5821	90% Min.
Fine Agg. Angularity	AASHTO T 304	45 Min.
Flat & Elongated 1:3 Ratio	ASTM D 4791 (Based on 3/8 inch and above)	20 % Max.
L.A. Wear	AASHTO T 96	35 % Max.
Sand Equivalent	AASHTO T 176	45 Min.
Plasticity Index	AASHTO T 89 and T 90	0
Unit Weight	AASHTO T 19	75 lb/ft^3 Min.
Soundness Loss	AASHTO T 104 - Sodium Sulfate	16 % Max. loss with five cycles
Deleterious Materials	AASHTO T 112	2 % Max.
Natural Fines	---	10% Max.

C. Meet gradation in Table 2.

Table 2
Aggregate Gradations (Percent Passing by Dry Weight of Aggregate)
AASHTO T 11 & AASHTO T 27

Sieve Size		Percent
Control Sieves	**1/2 inch**	100.0
	3/8 inch	90.0 - 100.0
	# 4	< 90.0
	# 8	32.0 - 67.0
	# 200	2.0 - 10.0

2.3 HYDRATED LIME

A. Use a minimum of one percent hydrated lime.

B. Meet requirements of Section 02746.

2.4 VOLUMETRIC DESIGN REQUIREMENTS

A. Hot Mix supplier is responsible for satisfying all requirements for Superpave Volumetric Mix Design:
   1. Use a laboratory qualified by UDOT Central Quality Assurance Section in the use of the Superpave Gyratory Compactor. AASHTO TP 4.
   2. Certify that the mix design meets requirements for Volumetric Mix Design outlined in this section.
   3. Project Engineer may accept the Volumetric Mix Design from data submitted with the proposed mix design or from a previous mix design. The Region Materials Engineer reserves the right to verify any mix design submitted.

B. Comply with requirements in Table 3.
   1. Obtain Mixing Temperature from the Engineer.

Table 3
Superpave Volumetric Mix Design

Compaction Stage	Number of Gyrations (N)	% of G_{mm} (AASHTO T209)
Initial	6	# 91.5
Design	50	$ 98.5
Maximum	75	#100.0

PART 3 EXECUTION

3.1 SURFACE PREPARATION

A. Refer to Section 02741, Part 3.

3.2 COMPACTION

A. Establish a rolling pattern to obtain maximum density without over-stressing the pavement.

3.3 ASPHALT EMULSION

A. Apply the flush coat at a uniform rate of 0.10 gal/yd^2 undiluted emulsion or 0.15 gal/yd^2 2:1 diluted emulsion. Note: 2:1 diluted emulsion represents two parts undiluted emulsion and one part water.

END OF SECTION

SECTION 02745

ASPHALT MATERIAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Asphalt materials

1.2 PAYMENT PROCEDURES

A. Price adjustments for asphalt cement and liquid asphalt (chip-seal emulsions and/or cut-backs):
   1. Standard department procedures governs price adjustments made where asphalt material does not conform to the specifications
      a. If the price adjustment exceeds 30 percent, the Engineer may order the removal of any or all the defective asphalt material.
      b. The pay factor for such material is 0.50 when allowed to remain in place.

B. Price adjustments for Performance Graded Asphalt Binder (PGAB):
   1. Standard department PGAB management plan governs price reductions or removal of material where the binder does not conform to the specifications.

1.3 REFERENCES

A. AASHTO M 81: Cut-Back Asphalt (Rapid-Curing Type)

B. AASHTO M 82: Cut-Back Asphalt (Medium-Curing Type)

C. AASHTO M 140: Emulsified Asphalt

D. AASHTO M 208: Cationic Emulsified Asphalt

E. AASHTO M 226: Viscosity Graded Asphalt Cement

F. AASHTO M 320: Performance Graded Asphalt Cement

G. AASHTO R 28: Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV).

H. AASHTO T 44: Solubility of Bituminous Materials

I. AASHTO T 48: Flash and Fire Points by Cleveland Open Cup

J. ASHTO T 49: Penetration of Bituminous Materials

K. AASHTO T 50: Float Test for Bituminous Materials

L. AASHTO T 51: Ductility of Bituminous Materials

M. AASHTO T 59: Testing Emulsified Asphalt

N. AASHTO T 201: Kinematic Viscosity of Asphalts

O. AASHTO T 228: Specific Gravity of Semi-Solid Bituminous Materials

P. AASHTO T 240: Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)

Q. AASHTO T 300: Force Ductility of Bituminous Materials

R. AASHTO T 301: Elastic Recovery Test of Bituminous Materials by Means of a Ductilometer

S. AASHTO T 313: Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)

T. AASHTO T 314: Determining the Fracture Properties of Asphalt Binder in Direct Tension

U. AASHTO T 315: Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR).

V. AASHTO T 316: Viscosity Determination of Asphalt Binder Using Rotational Viscometer.

W. ASTM D 92: Flash and Fire Points by Cleveland Open Cup

X. ASTM D 1190: Concrete Joint Sealer, Hot-Applied Elastic Type

Y. ASTM D 2007: Characteristic Groups in Rubber Extender and Processing Oils and Other Petroleum-Derived Oils by the Clay-Gel Absorption Chromatographic Method

Z. ASTM D 2026: Cutback Asphalt (Slow-Curing Type)

AA. ASTM D 3405: Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements

BB. ASTM D 4402: Viscosity Determinations of Unfilled Asphalts Using the Brookfield Thermosel Apparatus

CC. ASTM D 5329: Sealants and Fillers, Hot-Applied, For Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements

DD. ASTM D 5801: Toughness and Tenacity of Bituminous Materials

EE. California Test Methods

FF. UDOT Materials Manual of Instruction

GG. UDOT Minimum Sampling and Testing GuideHH UDOT Asphalt Binder Quality Management Plan

1.4 SUBMITTALS

A. For each shipment of material, supply a vendor-prepared bill of lading showing the following information:
   1. Type and grade of material
   2. Type and amount of additives, used, if applicable
   3. Destination
   4. Consignee's name
   5. Date of Shipment
   6. Railroad car or truck identification
   7. Project number
   8. Loading temperature
   9. Net weight in tons (or net gallons corrected to 60 degrees F, when requested)
   10. Specific gravity
   11. Bill of lading number
   12. Manufacturer of asphalt material

1.5 DELIVERY, STORAGE, AND HANDLING

A. Each shipment of asphalt material must:
   1. Be uniform in appearance and consistency.
   2. Show no foaming when heated to the specified loading temperature.

B. Do not supply shipments contaminated with other asphalt types or grades than those specified.

1.6 GRADE OF MATERIAL

A. The Engineer determines the grade of material to be used based on the supply source designated by the Contractor when the bid proposal lists more than one grade of asphalt material.

PART 2 PRODUCTS

2.1 PERFORMANCE GRADED ASPHALT BINDER (PGAB)

A. Supply PGABs under the Approved Supplier Certification (ASC) System. Refer to the UDOT Minimum Sampling and Testing Guide, Section 509, Asphalt Binder Management Plan.

B. As specified in AASHTO M 320 for all PGABs having algebraic differences less than 92 degrees between the high and low design temperatures.

C. As specified in Tables 1, 2, 3, 4, 5, 6, 7, and 8 for all PGABs having algebraic differences equal to or greater than 92 degrees between the high and low design temperatures.

Table 1

PG58-34		
Original Binder		
Dynamic Shear Rheometer, AASHTO T 315	@58°C, G*, kPa	1.30 Min.
	@58°C, phase angle, degrees	74.0 Max.
Rotational Viscometer, AASHTO T 316	@135°C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@5°C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod[1]	%	65 Min.
PAV Residue, 20 hours, 2.10 Mpa, 100 °C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@16°C, kPa	5000 Max.
Bending Beam Rheometer, AASHTO T 313	@-24°C, S, MPa	300 Max.
	@-24°C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@-24°C, Failure Strain, %	1.5 Min.
	@-24°C, Failure Stress[2], MPa	4.0 Min.

[1]Modify paragraph 4.5 as follows: After 20 cm has been reached, stop the ductilometer and within 2 seconds, sever the specimen at its center with a pair of scissor…
[2] No allowances will be given for passing at a colder grade

Table 2

PG64-28		
Original Binder		
Dynamic Shear Rheometer, AASHTO T 315	@64°C, G*, kPa	1.30 Min.
	@64°C, phase angle, degrees	74.0 Max.
Rotational Viscometer, AASHTO T 316	@135°C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@64°C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod[1]	%	65 Min.
PAV Residue, 20 hours, 2.10 Mpa, 100 °C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@22°C, kPa	5000 Max.
Bending Beam Rheometer, AASHTO T 313	@-18°C, S, MPa	300 Max.
	@-18°C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@-18°C, Failure Strain, %	1.5 Min.
	@-18°C, Failure Stress[2], MPa	4.0 Min.

[1]Modify paragraph 4.5 as follows: After 20 cm has been reached, stop the ductilometer and within 2 seconds, sever the specimen at its center with a pair of scissors…
[2] No allowances will be given for passing at a colder grade

Table 3

PG64-34		
Original Binder		
Dynamic Shear Rheometer, AASHTO T 315	@64°C, G*, kPa	1.30 Min.
	@64°C, phase angle, degrees	71.0 Max.
Rotational Viscometer, AASHTO T 316	@135°C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
RTFO Residue, AASHTO T-240		
Dynamic Shear Rheometer, AASHTO T 315	@64°C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod[1]	%	70 Min.
PAV Residue, 20 hours, 2.10 Mpa, 100 °C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@19°C, kPa	5000 Max.
Bending Beam Rheometer, AASHTO T 313	@-24°C, S, MPa	300 Max.
	@-24°C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@-24°C, Failure Strain, %	1.5 Min.
	@-24°C, Failure Stress[2], MPa	4.0 Min.

[1]Modify paragraph 4.5 as follows: After 20 cm has been reached, stop the ductilometer and within 2 seconds, sever the specimen at its center with a pair of scissors…
[2] No allowances will be given for passing at a colder grade

Table 4

PG70-22		
Original Binder		
Dynamic Shear Rheometer, AASHTO T 315	@70°C, G*, kPa	1.30 Min.
	@70°C, phase angle, degrees	74.0 Max.
Rotational Viscometer, AASHTO T 316	@135°C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@70°C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod[1]	%	65 Min.
PAV Residue, 20 hours, 2.10 Mpa, 100 °C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@28°C, kPa	5000 Max.
Bending Beam Rheometer, AASHTO T 313	@-12°C, S, MPa	300 Max.
	@-12°C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@-12°C, Failure Strain, %	1.5 Min.
	@-12°C, Failure Stress[2], MPa	4.0 Min.

[1]Modify paragraph 4.5 as follows: After 20 cm has been reached, stop the ductilometer and within 2 seconds, sever the specimen at its center with a pair of scissors…
[2] No allowances will be given for passing at a colder grade

Table 5

PG70-28		
Original Binder		
Dynamic Shear Rheometer, AASHTO T 315	@70°C, G*, kPa	1.30 Min.
	@70°C, phase angle, degrees	71.0 Max.
Rotational Viscometer, AASHTO T 316	@135°C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@70°C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod[1]	%	70 Min.
PAV Residue, 20 hours, 2.10 Mpa, 100 °C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@25°C, kPa	5000 Max.
Bending Beam Rheometer, AASHTO T 313	@-18°C, S, MPa	300 Max.
	@-18°C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@-18°C, Failure Strain, %	1.5 Min.
	@-18°C, Failure Stress[2], MPa	4.0 Min.

[1]Modify paragraph 4.5 as follows: After 20 cm has been reached, stop the ductilometer and within 2 seconds, sever the specimen at its center with a pair of scissors…
[2] No allowances will be given for passing at a colder grade

Table 6

PG70-34		
Original Binder		
Dynamic Shear Rheometer, AASHTO T 315	@70°C, G*, kPa	1.30 Min.
	@70°C, phase angle, degrees	71.0 Max.
Rotational Viscometer, AASHTO T 316	@135 °C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@70°C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod[1]	%	75 Min.
PAV Residue, 20 hours, 2.10 Mpa, 100 °C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@22°C, kPa	5000 Max.
Bending Beam Rheometer, AASHTO T 313	@-24°C, S, MPa	300 Max.
	@-24°C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@-24°C, Failure Strain, %	1.5 Min.
	@-24°C, Failure Stress[2], MPa	4.0 Min.

[1]Modify paragraph 4.5 as follows: After 20 cm has been reached, stop the ductilometer and within 2 seconds, sever the specimen at its center with a pair of scissors…
[2] No allowances will be given for passing at a colder grade

Table 7

PG76-22		
Original Binder		
Dynamic Shear Rheometer, AASHTO T 315	@76°C, G*, kPa	1.30 Min.
	@76°C, phase angle, degrees	71.0 Max.
Rotational Viscometer, AASHTO T 316	@135°C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@76°C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod[1]	%	70 Min.
PAV Residue, 20 hours, 2.10 Mpa, 100 °C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@ 31°C, kPa	5000 Max.
Bending Beam Rheometer, AASHTO T 313	@-12°C, S, MPa	300 Max.
	@-12°C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@-12°C, Failure Strain, %	1.5 Min.
	@-12°C, Failure Stress[2], MPa	4.0 Min.

[1]Modify paragraph 4.5 as follows: After 20 cm has been reached, stop the ductilometer and within 2 seconds, sever the specimen at its center with a pair of scissors…
[2] No allowances will be given for passing at a colder grade

Table 8

PG76-28		
Original Binder		
Dynamic Shear Rheometer, AASHTO T 315	@76°C, G*, kPa	1.30 Min.
	@76°C, phase angle, degrees	71. 0 Max.
Rotational Viscometer, AASHTO T 316	@135°C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@76°C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod[1]	%	75 Min.
PAV Residue, 20 hours, 2.10 Mpa, 100 °C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@28°C, kPa	5000 Max.
Bending Beam Rheometer, AASHTO T 313	@-18°C, S, MPa	300 Max.
	@-18°C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@-18°C, Failure Strain, %	1.5 Min.
	@-18°C, Failure Stress[2], MPa	4.0 Min.

[1]Modify paragraph 4.5 as follows: After 20 cm has been reached, stop the ductilometer and within 2 seconds, sever the specimen at its center with a pair of scissors…
[2] No allowances will be given for passing at a colder grade

2.2 ASPHALTIC CEMENT, LIQUID ASPHALTS, REJUVENATING AGENTS

A. As specified in AASHTO M 226, Table 2 with the following modifications:
   1. Delete and replace ductility at 77EF (25EC) with ductility at 39.2EF (4EC) with values as detailed below.

AC - 2.5	AC - 5	AC - 10	AC - 20
50+	25+	15+	5+

B. As specified for cationic and anionic emulsified asphalt.
   1. All standard Slow Setting (SS, CSS), Medium Setting (MS, CMS), and Rapid Setting (RS, CRS) grades; inclusive of all High-Float designations (HF).
   2. Supply under the Approved Supplier Certification System (ASC).
   3. Meet AASHTO M 208 and M 140.

C. Conform to the requirements of one of these tables:
   1. Table 9: Cationic Rapid Setting Emulsified Polymerized Asphalt (CRS-2P)
   2. Table 10: Latex Modified Cationic Rapid Setting Emulsified Asphalt (LMCRS-2)
   3. Table 11: Cationic Medium Setting Emulsified Asphalt (CMS-2S)
   4. Table 12: High Float Medium Setting Emulsified Asphalt (HFMS-2)
   5. Table 13: High Float Medium Setting Emulsified Polymerized Asphalt (HFMS-2P)
   6. Table 14: High Float Rapid Setting Emulsified Polymerized Asphalt (HFRS-2P)
   7. Table 15: Cationic Rapid Setting Emulsified Asphalt (CRS-2A, B)

D. Curing cut-back asphalt:
   1. As specified for slow curing (SC) in ASTM D 2026.
   2. As specified for medium curing (MC) in AASHTO M 82.
   3. As specified for rapid curing (RC) in AASHTO M 81.

E. Conform to requirements for Emulsified Asphalt Pavement Rejuvenating Agent:
   1. Table 16: Type B
   2. Table 17: Type B Modified
   3. Table 18: Type C
   4. Table 19: Type D

Table 9

Cationic Rapid Setting Emulsified Polymerized Asphalt (CRS-2P)			
Tests	**AASHTO Test Method**	**Min.**	**Max.**
Emulsion			
Viscosity , SF, 140EF (60EC), s (Project-site Acceptance/Rejection Limits)	T59	100	400
Settlement (a) 5 days, percent	T 59		5
Storage Stability Test (b) 1 d, 24 h, percent	T 59		
Demulsibility (c) 35 ml, 0.8% sodium dioctyl Sulfosucinate, percent	T 59	40	
Particle Charge Test	T 59	Positive	
Sieve Test, percent	T 59		0.10
Distillation			
Oil distillate, by volume of emulsion, percent			0
Residue (d), percent		68	
Residue from Distillation Test			
Penetration, 77EF(25EC), 100 g, 5 s, dmm	T 49	80	150
Ductility, 39.2EF(4EC), 5 cm/min, cm Toughness, lb-in Tenacity, lb-in	T 51 ASTM D 5801 ASTM D 5801	35 75 50	
Solubility in trichloroethylene, percent	T 44	97.5	

(a) The test requirement for settlement may be waived when the emulsified asphalt is used in less than a five-day time; or the purchaser may require that the settlement test be run from the time the sample is received until it is used, if the elapsed time is less than 5 days.

(b) The 24-hour (1-day) storage stability test may be used instead of the five-day settlement test.

(c) The demulsibility test is made within 30 days from date of shipment.

(d) Distillation is determined by AASHTO T 59, with modifications to include a 350 ± 5EF (177±3°C) maximum temperature to be held for 15 minutes.

Modify the asphalt cement prior to emulsification.

Table 10

Latex Modified Cationic Rapid Setting Emulsified Asphalt (LMCRS-2)			
Tests	**AASHTO Test Method**	**Min.**	**Max.**
Emulsion			
Viscosity, SF, 122EF (50EC), s– (Project Site Acceptance/Rejection Limits)	T59	75	300
Settlement (a) 5 days, percent	T 59		5
Storage Stability Test (b) 1 d, 24 h, percent	T 59		1
Demulsibility (c) 35 ml, 0.8% sodium dioctyl Sulfosucinate, percent	T 59	40	
Particle Charge Test	T 59	Positive	
Sieve Test, percent	T 59		0.3
Distillation			
Oil distillate, by volume of emulsion, percent			0
Residue (d), percent		65	
Residue from Distillation Test			
Penetration, 77EF (25EC), 100 g, 5 s, dmm	T 49	40	200
Torsional Recovery (e)		18	

(a) The test requirement for settlement may be waived when the emulsified asphalt is used in less than a five-day time; or the purchaser may require that the settlement test be run from the time the sample is received until it is used, if the elapsed time is less than 5 days.

(b) May use the 24-hour (1-day) storage stability test instead of the five-day settlement test.

(c) Make the demulsibility test within 30 days from date of shipment.

(d) Determine distillation by AASHTO T 59,with modifications to include a 350 ± 5EF (177±3EC) maximum temperature to be held for 15 minutes.

(e) CA 332 (California Test Method)

Co-mill latex and asphalt during emulsification

Table 11

Cationic Medium Setting Emulsified Asphalt (CMS-2S)		
Tests	**AASHTO Test Method**	**Specification**
Emulsion		
Viscosity, SF, 122EF (50EC), s	T 59	50 - 450
Percent residue	T 59	60 min
One-day storage stability, percent	T 59	1 max
Sieve, percent	T 59	0.10 max
Particle charge	T 59	Positive
Oil Distillate, percent by volume of emulsion	T 59	5-15
Residue		
Penetration, 77EF (25EC), 100g, 5 sec, dmm	T 59	100-250
Solubility, percent	T 59	97.5 min.

Table 12

High Float Medium Setting Emulsified Asphalt (HFMS-2)			
Tests	**AASHTO Test Method**	**Min.**	**Max.**
Emulsion			
Viscosity, SF, 122°F (50°C), s (Project Site Acceptance/Rejection Limits	T59	70	300
Storage Stability Test, 1d, 24 h, percent	T59		1.0
Sieve Test , percent	T59		0.1
Distillation	T59		
Oil Distillate, by volume of emulsion, percent	T59	NA	NA
Residue, percent	T59	65	
Residue from Distillation Test			
Penetration, 77°F (25°C), 100g, 5 s, dmm	T49	50	200
Float Test, 140°F (60°C), s	T50	1200	
Solubility in Trichloroethylene, percent	T44	97.5	
Ductility, 77°F (25°C) 5cm/min, cm	T51	40	

Table 13

High Float Medium Setting Emulsified Polymerized Asphalt (HFMS-2P) (a)			
Tests	**AASHTO Test method**	**Min.**	**Max.**
Emulsion			
Viscosity, SF, 122EF (50EC), s (Project Site Acceptance/Rejection Limits)	T 59	100	450
Storage Stability Test (a) 1 d, 24 h, percent	T 59		0.1
Sieve Test, percent	T 59		0.1
Distillation			
Oil distillate, by volume of emulsion, percent	T 59	1	7
Residue (c), percent	T 59	65	
Residue from Distillation Test			
Penetration, 77EF (25EC), 100 g, 5 s, dmm	T 49	70	300
Float Test, 140EF (60EC), s	T 50	1200	300
Solubility in trichloroethylene, percent	T 44	97.5	
Elastic Recovery, 77EF (25EC), percent	T 301	50	

(a) Supply an HFMS-2P (anionic, polymerized, high-float) as an emulsified blend of polymerized asphalt cement, water, and emulsifiers. Polymerize the asphalt cement with a minimum of 3.0% polymer by weight of the asphalt cement prior to emulsification. After standing undisturbed for a minimum of 24 hours, the emulsion shall be smooth and homogeneous throughout with no white, milky separation, pumpable, and suitable for application through a distributor.

(b) May use the 24-hour (1-day) storage stability test instead of the five-day settlement test.

(c) Determine the distillation by AASHTO T 59, with modifications to include a 350± 5EF (177±3EC) maximum temperature to be held for 15 minutes.

Table 14

High Float Rapid Setting Emulsified Polymerized Asphalt (HFRS-2P) (a)			
Tests	**AASHTO Test method**	**Min.**	**Max.**
Emulsion			
Viscosity, SF @ 122EF (50EC), s (Project Site Acceptance/Rejection Limits)	T 59	50	450
Storage Stability Test (b) 1 d, 24 h, percent	T 59		1
Demulsibility 0.02 N Ca Cl_2, percent	T 59	40	
Sieve Test, percent	T 59		0.1
Distillation			
Oil distillate, by volume of emulsion, percent	T 59		3
Residue (c), percent	T 59	65	
Residue from Distillation Test			
Penetration, 77°F (25EC), 100 g, 5 s, dmm	T 49	70	150
Float Test, 140EF (60EC), s	T 50	1200	
Solubility in trichloroethylene, percent	T 44	97.5	
Elastic Recovery, 77EF (25EC), percent	T 301	58	

(a) Supply an HFMS-2SP (anionic, polymerized, high-float) as an emulsified blend of polymerized asphalt cement, water, and emulsifiers. Polymerize the asphalt cement with a minimum of 3.0% polymer by weight of the asphalt cement prior to emulsification. After standing undisturbed for a minimum of 24 hours, the emulsion shall be smooth and homogeneous throughout with no white, milky separation, pumpable, and suitable for application through a distributor.

(b) May use the 24-hour (1-day) storage stability test instead of the five-day settlement test.

(c) Determine the distillation by AASHTO T 59, with modifications to include a 350 ± 5EF (177±3EC) maximum temperature to be held for 15 minutes.

Table 15

Cationic Rapid Setting Emulsified Asphalt (CRS-2A,B)			
Tests	**AASHTO Test Method**	**Min**	**Max**
Emulsion			
Viscosity, SF, 122EF (50EC), s (Project Site Rejection/Acceptance Limits)	T 59	140	400
Storage stability test, 24 h, percent	T 59		1
Demulsibility, 35 mL 0.8 percent Sodium Dioctyl Sulfosucinate, percent	T 59	40	
Particle charge test	T 59	Positive	
Sieve test, percent	T 59		0.10
Distillation			
Oil distillate, by volume of emulsion, percent	T 59		0
Residue, percent	T 59	65	
Use PG58-22 and PG64-22 as base asphalt cement for CRS-2A, B, respectively. Specification for high temperature performance: original and RTFO G*/sin* within 3EC of grade.			

Table 16

Emulsified Type B Asphalt Pavement Rejuvenating Agent Concentrate		
Tests	**Test Method**	**Limits**
Viscosity, SF, 77EF (25EC), s	AASHTO T 59	25-150
Residue, percent W	AASHTO T 59 (mod) (a)	62 Min.
Sieve Test, percent W	AASHTO T 59	0.10 Max.
5-day Settlement	AASHTO T 59	5.0 Max.
Particle Charge	AASHTO T 59	Positive
Pumping Stability (b)		Pass
Residue from Distillation (a)		
Viscosity @ 140°F (60°C), mm^2/s	AASHTO T 201	2500-7500
Solubility in 1,1,1 Trichloroethylene, percent	AASHTO T 44	98 Min.
Flash Point, COC	ASTM D 92	204EC, Min.
Asphaltenes, percent W	ASTM D 2007	15 Max.
Saturates, percent W	ASTM D 2007	30 Max.
Aromatics, percent W	ASTM D 2007	25 Min.
Polar Compounds, percent W	ASTM D 2007	25 Min.

(a) Determine the distillation by AASHTO T 59 with modifications to include a 300 ±5EF (149±3EC) maximum temperature to be held for 15 minutes.

(b) Test pumping stability by pumping 475 ml of Type B diluted 1 part concentrate to 1 part water, at 77EF (25°C) through a 1/4 inch gear pump operating at 1750 rpm for 10 minutes with no significant separation or coagulation in pumped material.

Type B: an emulsified blend of, lube oil and/or lube oil extract, and petroleum asphalt.

Table 17

Emulsified Type B Modified Asphalt Pavement Rejuvenating Agent Concentrate		
Property	**Test Method**	**Limits**
Viscosity, SF, 77EF (25EC), s	AASHTO T 59	50-200
Residue by distillation or Evaporation (a), percent W	AASHTO T 59	62 Min.
Sieve Test, percent W	AASHTO T 59	0.20 Max.
5-day Settlement, percent W	AASHTO T 59	5.0 Max.
Particle Charge	AASHTO T 59	Positive
Pumping Stability (b)		Pass
Residue from Distillation (a)		
Viscosity (c) 275EF (135EC), cP	ASTM D 4402	150 - 300
Penetration, 77EF (25EC), dmm	AASHTO T 49	180 Min.
Solubility in 1,1,1 Trichloroethylene, percent	AASHTO T 44	98 Min.
Flash Point, COC, EF (EC)	AASHTO T 48	400(204) Min.
Asphaltenes, percent W	ASTM D 2007	20-40
Saturates, percent % W	ASTM D 2007	20 Max.
Polar Compounds, percent W	ASTM D 2007	25 Min.
Aromatics, percent W	ASTM D 2007	20 Min.
PC/S Ratio	ASTM D 2007	1.5 Min.
(a) Determine the distillation by AASHTO T 59 with modifications to include a 300±5EF (149± 3°C) maximum temperature to be held for 15 minutes. (b) Pumping stability is tested by pumping 475 ml of Type B diluted 1 part concentrate to 1 part water, at 77EF (25EC) through a 1/4 inch gear pump operating at 1750 rpm for 10 minutes with no significant separation or coagulation in pumped material. (c) Brookfield Thermocel Apparatus-LV model. ≥ 50 rpm with a #21 spindle, 7.1 g residue, at > 10 torque		
As required by the Asphalt Emulsion Quality Management Plan, UDOT Minimum Sampling and Testing Guide, Section 508) the supplier certifies that the base stock contains a minimum of 15% by weight of Gilsonite Ore. Use the HCL precipitation method as a qualitative test to detect the presence of Gilsonite.		

Table 18

Emulsified Type C Asphalt Pavement Rejuvenating Agent Concentrate		
Property	**Test Method**	**Limits**
Viscosity, SF, 77EF (25EC), s	AASHTO T 59	10-100
Residue (a), percent W (Type C supplied ready to use 1:1 or 2:1.	AASHTO T 59 (a)	30 Min. 1:1 40 Min. 2:1
Sieve Test, percent W (b)		0.10 Max.
5-day Settlement, percent W	AASHTO T 59	5.0 Max.
Particle Charge	AASHTO T 59	Positive
pH (May be used if particle charge test is inconclusive)		2.0 - 7.0
Pumping Stability (c)		Pass
Tests of Residue from Distillation (a)		
Viscosity, 275EF (135°C), mm^2/s	AASHTO T 201	475-1500
Solubility in 1,1,1 Trichloroethylene, percent	AASHTO T 44	97.5 Min.
RTFO mass loss, percent W	AASHTO T 240	2.5 Max.
Specific Gravity	AASHTO T 228	0.98 Min.
Flash Point, COC	AASHTO T 48	232 EC, Min.
Asphaltenes, percent W	ASTM D 2007	25 Min., 45 Max.
Saturates, percent W	ASTM D 2007	10 Max.
Polar Compounds, percent W	ASTM D 2007	30 Min.
Aromatics, percent W	ASTM D 2007	15 Min.

(a) Determine the distillation by AASHTO T 59 with modifications to include a 300± 5EF (149 ± 3EC) maximum temperature to be held for 15 minutes.

(b) Test method identical to AASHTO T 59 except that distilled water is used in place of 2 % sodium oleate solution.

(c) Test pumping stability by pumping 475 ml of Type diluted 1 part concentrate to 1 part water, at 77EF (25EC) through a 1/4 inch gear pump operating at 1750 rpm for 10 minutes with no significant separation or coagulation in pumped material.

As required by the Asphalt Emulsion Quality Management Plan, UDOT Minimum Sampling and Testing Guide, Section 508), the supplier certifies that the base stock contains a minimum of 10% by weight of Gilsonite ore. Use the HCL precipitation method as a qualitative test to detect the presence of Gilsonite.

Table 19

Emulsified Type D Asphalt Pavement Rejuvenating Agent Concentrate		
Property	**Test Method**	**Limits**
Viscosity, SF, 77EF (25EC), s	AASHTO T 59	30-90
Residue, (a) percent W	AASHTO T 59 (mod) (a)	65
Sieve Test, percent W	AASHTO T 59	0.10 Max.
pH		2.0 - 5.0
Residue from Distillation (c)		
Viscosity, 140EF (60EC), cm^2/s	AASHTO T 201	300-1200
Viscosity, 275EF (135EC), mm^2/s	AASHTO T 201	300 Min.
Modified Torsional Recovery (b)	CA 332 (Mod)	40 % Min.
Toughness, 77EF (25EC), in-lb	ASTM D 5801	8 Min.
Tenacity, 77EF (25EC), in-lb	ASTM D 5801	5.3 Min.
Asphaltenes, percent W	ASTM D 2007	16 Max.
Saturates, percent W	ASTM D 2007	20 Max.

(a) California test method #331 for recovery of residue.
(b) Torsional recovery measurement to include first 30 seconds.
(c) Determine the distillation by AASHTO T 59 with modifications to include a 300±5EF (149±3EC) maximum temperature to be held for 15 minutes.

2.3 HOT-POUR CRACK SEALANT FOR BITUMINOUS CONCRETE

A. Combine a homogenous blend of materials to produce a sealant meeting properties and tests in Table 20.

B. Packaging and Marking: Supply sealant pre-blended, pre-reacted, and pre-packaged in lined boxes weighing no more than 30 lb.
   1. Use a dissolvable lining that will completely melt and become part of the sealant upon subsequent re-melting.
   2. Deliver the sealant in the manufacturer's original sealed container. Clearly mark each container with the manufacturer's name, trade name of sealant, batch or lot number, and recommended safe heating and application temperatures.

Table 20

Hot-Pour Bituminous Concrete Crack Sealant			
Application Properties:			
Workability:	Pour readily and penetrate 0.25 inch and wider cracks for the entire application temperature range recommended by the manufacturer.		
Curing:	No tracking caused by normal traffic after 45 minutes from application.		
Asphalt Compatibility: ASTM D 5329, Section 14.	No failure in adhesion. No formation of an oily ooze at the interface between the sealant and the bituminous concrete or softening or other harmful effects on the bituminous concrete.		
Material Handling:	Follow the manufacturer's safe heating and application temperatures.		
Test Method	**Property**	**Minimum**	**Maximum**
AASHTO T 51	Ductility, modified, 1cm/min, 39.2EF (4EC), cm	30	
UDOT method 967	Cold Temperature Flexibility	no cracks	
AASHTO T 300 (a)	Force-Ductility, lb force		4
ASTM D 5329	Flow 140EF (60EC), 5 hrs 75Eangle, mm		3
ASTM D 3405 (b)	Tensile-Adhesion, modified	300%	
AASHTO T 228	Specific Gravity, 60EF (15.6EC)		1.140
ASTM D 5329	Cone Penetration, 77EF (25EC), 150 g, 5 sec., dmm		90
ASTM D 5329	Resilience, 77EF (25EC), 20 sec., percent	30	
ASTM D 4402	Viscosity, 380EF (193.3EC), SC4-27 spindle, 20 rpm, cP		2500
ASTM D 5329	Bond as per ASTM D 1190, Section 6.4		Pass

(a) Maximum of 4 lb force during the specified elongation of 30 cm @ 1 cm/min, 39.2EF (4EC).

(b) Use ASTM D 3405, Section 6.4.1. Delete bond and substitute tensile-adhesion test in accordance to D 5329.

PART 3 EXECUTION Not used

END OF SECTION

SECTION 02746

HYDRATED LIME

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Products and procedures for incorporating hydrated lime into all asphalts mixes.

1.2 REFERENCES

A. AASHTO M 303: Lime for Asphalt Mixtures

B. AASHTO T 26: Quality of Water to be Used in Concrete

C. AASHTO T 84: Specific Gravity and Absorption of Fine Aggregate

D. AASHTO T 85: Specific Gravity and Absorption of Coarse Aggregate

E. AASHTO T 255: Total Moisture Content of Aggregate by Drying

F. ASTM C 110: Physical Testing of Quicklime, Hydrated Lime, and Limestone

G. ASTM C 1097: Hydrated Lime for Use in Asphaltic-Concrete Mixtures

1.3 QUALITY ASSURANCE

A. Prequalification: Hydrated Lime, through UDOT's Quality Management Plan for Hydrated Lime.

PART 2 PRODUCTS

2.1 HYDRATED LIME

A. Hydrated Lime: Meet AASHTO M 303, Type I, as specified.
   1. Conform physical requirements to ASTM C 1097, subparagraph d.1.
   2. Use test method ASTM C 110, paragraph 5.4.

2.2 WATER

A. Potable Water. AASHTO T 26

PART 3 EXECUTION

3.1 APPLICATION

A. Add hydrated lime to all asphalt pavement mixes.
   1. Add the determined quantity of lime, following mix design.
   2. Base the amount of hydrated lime used on the dry weight of the aggregate.
   3. Use either Method A or B, following AASHTO T 84, AASHTO T 85, and AASHTO T 255, unless Method B is called for in the bid schedule.

B. Method A: Lime Slurry: One part lime and three parts water by weight.
   1. Maintain the lime slurry mix in a malted milk consistency.
   2. Deliver lime slurry to the twin shaft pugmill for mixing with aggregate.

C. Method B: Lime and Aggregate Stockpile Marination:
   1. Marinate the aggregate in the stockpile for 24 hours.

D. Mixing Methods A and B: Provide a horizontal twin shaft pugmill.
   1. Adjust mixing paddles in the pugmill so that the aggregate being discharged is completely coated by the lime slurry.
   2. Do not allow volume of material in the pugmill to extend above the vertical position of the blade tips.

3.2 CONTROLLING AND MONITORING

A. Control the lime batching operation by the Program Logic Control (PLC) System based upon production set up data.

B. Monitor the following aspects and record on the computer data log printout:
   1. Display target and actual rates.
   2. Belt weight bridge for lime.
   3. Locked-in water meter.
   4. Meter to transfer lime slurry.
   5. Closed end loop to mainframe computer.

3.3 QUALITY CONTROL

A. Tolerance Controls
   1. Tolerance lime weight vessel static calibration " 1.5 percent.
   2. Dynamic delivery calibration " 1.5 percent.
   3. Inlet flow meter " 2 percent.
   4. Discharge flow meter " 1.5 percent.

B. Verification
   1. Submit to the Engineer Post Lottman Data on Hot Mix Asphalt.
   2. Meet the system Tensile Stress Requirement.

END OF SECTION

SECTION 02748

PRIME COAT/TACK COAT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for applying:
   1. Prime coat: Liquid or emulsified asphalt to a prepared subgrade or untreated base course.
   2. Tack coat: Cutback or emulsified asphalt to the existing surface or new pavement surface and intermediate lifts.

B. Blotter materials and procedures for absorbing excess asphalt as required.

1.2 RELATED SECTIONS

A. Section 01554: Traffic Control

B. Section 02324: Compaction

C. Section 02745: Asphalt Material

1.3 REFERENCES

A. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates.

B. AASHTO T 201: Kinematic Viscosity of Asphalts.

PART 2 PRODUCTS

2.1 PRIME COAT

A. Liquid or emulsified asphalt: Refer to Section 02745.

B. Blotter material: Granular materials following AASHTO T 27, meeting the following criteria:

Sieve Size	Percent Passing
No. 4	90 to 100
No. 10	25 to 80
No. 200	0 to 15

2.2 TACK COAT

A. Cutback or emulsifed asphalt of the type and grade called for in the bid proposal and Section 02745.

B. Tack coat referred to for paving fabrics is a PG 58-22 or PG 64-22.

C. Do not use an emulsion or cutback in paving fabric placement.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

A. Prime Coat:
1. Shape the surface to the required grade and section.
2. Keep the surface free from ruts, corrugations, or other irregularities.
3. Compact the surface following Section 02324.

B. Tack Coat:
1. Clean the surface of all materials that prevent the tack coat from bonding to the existing surface (e.g. mud, dirt, leaves, etc.)
2. Cover all tacked surface areas with surfacing materials the same day the tack coat is applied.

3.2 APPLICATION

A. Do not apply prime coat or tack coat:
1. On a wet surface.
2. When the surface temperature is below 50 degrees F.
3. When weather conditions prevent it from adhering properly.

B. Protect all structures including guardrails, guide posts, etc. from being spattered or marred.

C. Secure approval for the quantities, rate of application, temperatures, and areas to be treated.

D. Use a pressure distributor to apply the asphalt in a uniform, continuous spread.

E. Keep the viscosity between 50 and 100 centistokes. AASHTO T 201.

F. Immediately apply another application to underprimed surface.

G. Apply a prime or tack coat to all surfaces, including vertical that will come in contact with Hot Mix Asphalt.

H. Spread blotter material if the prime coat fails to penetrate. Use the quantities required to absorb the excess asphalt.

3.3 TRAFFIC CONTROL

A. Refer to Section 01554.

B. Maintain the prime coat/tack coat until the next course is placed.

C. Keep all traffic off the prime coat until it has cured and dried.

D. Provide detours for existing traffic.

E. Restrict operations to allow at least one-way traffic.

END OF SECTION

SECTION 02749

ASPHALT DRIVEWAY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Construct asphalt concrete driveways.

1.2 RELATED SECTIONS

A. Section 02316: Roadway Excavation

B. Section 02721: Untreated Base Course

C. Section 02741: Hot Mix Asphalt

D. Section 02748: Prime Coat/Tack Coat

PART 2 PRODUCTS **Not used**

PART 3 EXECUTION

3.1 SUBGRADE

A. Refer to Section 02316.

3.2 UNTREATED BASE COURSE

A. Refer to Section 02721.

3.3 PRIME COAT

A. Refer to Section 02748.

3.4 ASPHALT CONCRETE

A. Refer to Section 02741.

END OF SECTION

SECTION 02752

PORTLAND CEMENT CONCRETE PAVEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing Portland Cement Concrete Pavement.

1.2 RELATED SECTIONS

A. Section 00555: Prosecution and Progress

B. Section 01452: Profilograph and Pavement Smoothness

C. Section 03055: Portland Cement Concrete

D. Section 03152: Concrete Joint Control

E. Section 03211: Reinforcing Steel and Welded Wire

F. Section 03390: Concrete Curing

1.3 REFERENCES

A. AASHTO M 154: Air Entraining Mixtures for Concrete

B. AASHTO M 157: Ready-Mixed Concrete

C. AASHTO T 11: Materials Finer Than 75 Fm (No. 200) Sieve in Mineral Aggregates by Washing

D. AASHTO T 23: Making and Curing Concrete Test Specimens in the Field

E. AASHTO T 24: Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

F. AASHTO T 26: Quality of Water to be Used in Concrete

G. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates

H. AASHTO T 97: Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

I. AASHTO T 119: Slump of Portland Cement Concrete

J. AASHTO T 121: Weight Per Cubic Foot, Yield, and Air Content (Gravimetric) of Concrete

K. AASHTO T 141: Sampling Fresh Concrete

L. AASHTO T 152: Air Content of Freshly Mixed Concrete by the Pressure Method

M. ASTM D 3405: Joint Sealant, Hot-Applied, for Concrete and Asphalt Pavements

N. Department of Labor Standards

O. UDOT Quality Management Plan

1.4 SUBMITTALS

A. Profilograph: Submit to the Engineer the day following testing, a copy of measured profile data and generated graphic reports containing a scaled reproduction of the measured profile with stationing, deviation information, and document points.

B. Concrete:
   1. Refer to Section 03055.
   2. Furnish the Engineer with mix design, trial batch gradation, and 28-day compressive strength test results from the trial batches before placing concrete.
   3. Use the same materials and admixtures intended for production in the trial batches.
   4. From the batch trial results, determine the cement content, aggregate ratio, and quantities of other mix components necessary to meet a design 28-day compressive strength of 5210 psi and a 7-day flexural strength of 490 psi.
   5. The proportioning and mixing of the trial batches are subject to inspection.
   6. Do not place pavement before obtaining written approval of the mix design.
   7. Meet the approved trial batch proportions. Changes in the mix proportions require new trial batches.

1.5 PROJECT CONDITIONS/LIMITATIONS

A. **Seasonal:** Do not pave from October 15 to April 15. Submit cold weather concrete plan to the Engineer for written approval to pave outside these limits.

B. **Hot Weather and Cold Weather:** Refer to Section 03055.

C. **Night Operations:** Provide proper lighting from one-half hour after sunset to one-half hour before sunrise following Section 00555.

1.6 ACCEPTANCE - OVER LEAN OR UNTREATED BASE COURSE

A. Department will assess price adjustments for strength, thickness, and surface smoothness separately on the contract bid price.

B. Thickness acceptance is determined by core lengths located randomly one core per 12,000 ft^2 area.

C. Core lengths:
1. Engineer divides the pavement into consecutive areas not to exceed 12,000 ft^2.
2. Add a final area of less than 6,000 ft^2 to the previous section to make one section.
3. A final area of greater than 6,000 ft^2 will constitute a separate area.
4. Hand-placement areas will be considered separately. Take one core per placement area.

D. Engineer takes three measurements on each core and records to the nearest 1/16 in. Use the average to determine the acceptability and pay factors for deficient thickness areas using Table 1.

Table 1
Price Reductions for Deficient Thickness
Over New Surfaces

Deficient Thickness (in inches)	Pay Factor
0 to 1/8	1.00
1/8 to 1/4	0.90
1/4 to 1/2	0.75
1/2 to 3/4	0.60

1. The Engineer may accept pavement deficient by more than 3/4 inch at 50 percent pay or require removal and replacement.

2. Make all corrections, including removal and replacement at no additional cost to the Department.

E. Engineer takes two additional cores for any deficient core (one on each side) where the thickness varies by 1/8 in. Locate the new core between the deficient core and each of the adjacent cores.

F. Deficient areas of slab thickness are defined by new cores plotted along with the original cores.

G. Engineer graphs the deficient areas with the following assumptions:
1. The graph represents the thickness of the pavement.
2. The thickness varies linearly along the pavement's length from core depth to core depth.
3. The pavement is a constant depth in the transverse direction.

1.7 ACCEPTANCE - OVER EXISTING SURFACES

A. Department will assess price adjustments for strength, thickness, and surface smoothness separately on the contract bid price.

B. Thickness acceptance of the finished pavement is determined from the graph of the deviations from the profile grade established by the plans or Engineer.

C. Engineer takes elevations at 100 ft intervals, and compares against the profile and graph to determine deficient thickness areas.

D. Price adjustments for pavement areas with deviations below thickness profile will be computed using Table 2.

Table 2
Price Reductions for Deficient Thickness over Existing Surfaces

Deviations Below Profile (in feet)	Pay Factor
0.0 to 0.02	1.00
0.02 to 0.04	.90
0.04 to 0.06	.60

1. The Engineer may accept pavement deficient by more than 3/4 inch at 50 percent pay or require removal and replacement.
2. Make all corrections, including removal and replacement at no additional cost to the Department.

E. The Engineer may accept pavement areas with deviations of more than 0.06 ft at 50 percent pay or require removal and replacement. Make all corrections, including removal and replacement, at no additional cost to the Department.

1.8 ACCEPTANCE - COMPRESSIVE STRENGTH (ACCEPTANCE/RETESTING)

A. Department will use Table 3 to determine price adjustments for concrete compressive strength.
   1. The price adjustment applies to the test lot represented by the strength test.
   2. The Engineer evaluates all concrete with a compressive strength of more than 400 PSI below specification to determine capability of the material to maintain the integrity of the structure for payment. This concrete may be accepted at 50 percent pay factor or required to be replaced.

Table 3
Pay Adjustments for Compressive Strength Based on 28 days

Psi below 4,000	Pay Factor
1 to 100	0.95
101 to 200	0.90
201 to 300	0.85
301 to 400	0.80

B. Hand-placement areas will be considered separately.

C. The Engineer notifies the Contractor within three calendar days of determining the 28-day compression if any strength test is below specifications. The Contractor may request referee testing in writing within 35 calendar days after placing concrete.
   1. An independent third party testing agency will conduct referee testing within 35 calendar days after placement at no additional cost to the Department.
   2. All testing laboratories must:
      a. Be certified by the Cement and Concrete Reference Laboratory.
      b. Use ACI accredited level one or level two inspectors.
      c. Be acceptable to both the Department and the Contractor.
   3. Obtain six pairs of cores at locations directed by the Engineer. Condition and wet test the cores as specified in AASHTO T 24.
   4. Engineer adjusts the core strengths to standard equivalent cylinder strength by dividing by a factor of 0.85. Each pair of adjusted core strengths will be averaged and considered as a single core test result.
   5. Basis of acceptance of the lot will be as follows:
      a. If any of the adjusted referee core test results are less than 4,000 psi, Engineer uses the lowest core test result or the original cylinder test value, whichever is lowest.
      b. If all the six adjusted referee core test results exceed 4,000 psi and the average is below 4,700 psi, Engineer uses the original cylinder test for the pay factor.

c. If all the six adjusted core test results exceed 4,000 psi and the average exceeds 4,700 psi, Department accepts lot at full pay.

D. Engineer and Contractor jointly determine alternate methods of acceptance for the lot represented by a specimen apparently damaged during the curing process or otherwise unacceptable.

E. Fill the core holes with concrete after coring making sure that the holes are cleaned and dry at the time they are filled.
1. Coat the sides of the holes with an epoxy resin adhesive from the Performance Data Products Listing (PDPL) maintained by the UDOT Research Division.
2. Consolidate the concrete by rodding or vibrating.
3. Strike off level with the pavement surface, texture, and treat with the specified curing-sealing compound.
4. Protect concrete in core holes from any damage for a minimum of 48 hrs.

1.9 SMOOTHNESS

A. Determine acceptance and correct in accordance with Section 01452.

PART 2 PRODUCTS

2.1 CONCRETE

A. Use AA(AE) concrete.

B. Refer to Section 03055.

2.2 AGGREGATE

A. Refer to Section 03055 for coarse, fine, and combined aggregates.

B. Separate and stockpile in two sizes coarse aggregate sizes 2 inch to No. 4 sieve, and 1½ inch to No. 4 sieve with the separation being made on the 1 inch and 3/4 inch respectively.

C. Use a No. 200 sieve to determine the material size in accordance with AASHTO T 11 and T 27.

2.3 WATER

A. Use water for washing aggregates, mixing concrete, and at the testing platform that, when compared with distilled water, does not change the setting time of Portland Cement more than 25 percent, or reduce the compressive strength of mortar more than 10 percent.

B. Limit the maximum concentration of sulfate as SO_4 to 3000 ppm.

C. Potable water may be used without testing.

D. Conform to AASHTO T 26.

2.4 ADMIXTURES

A. Air-entraining Agents
   1. Select from the Accepted Products Listing maintained by the UDOT Research Division.
   2. When concrete is central-mixed and transported in non-agitating haul units, incorporate synthetic/non-visol resin air entraining admixtures.
   3. When central-mixed with agitating haul units or transit mixed, conform to the material standard found in AASHTO M 154.
      a. Thoroughly mix all entraining agents before use.
      b. Constantly agitate any agent that settles during batching.

2.5 POZZOLAN

A. Refer to Section 03055.

2.6 CONCRETE CURING COMPOUND

A. Refer to Section 03390.

2.7 EXPANSION JOINT MATERIALS

A. Refer to Section 03152.

2.8 JOINT SEALERS

A. Unless specified otherwise, provide pre-approved hot applied joint sealant for transverse-sawed, longitudinal-sawed, and all contact joints following Section 03152.

B. Select sealers and joint material from the Accepted Products Listing maintained by UDOT Research Division.

2.9 STEEL REINFORCEMENT

A. Tie Bar: Grade 60, deformed reinforcing steel epoxy-coated following Section 03211.

B. Dowel Bars: Grade 60, smooth steel rod, epoxy- coated, following Section 03211.

2.10 CONCRETE COLORANT FOR STATION MARKERS

A. Brick Red 160 or Tile Red A-28 surface, dry-shake type concrete colorant.

2.11 BATCH PLANT

A. Meet the requirements of the UDOT Quality Management Plan for Ready-Mix Concrete.

B. Equip batch plant with a numerical printout device that makes a continuous, permanent, and accurate record of:
   1. The weights of all individual ingredients including water and cement added after initial batching.
   2. The time of day for each batch shown in hours and minutes.
   3. Date and daily accumulated totals.
   4. Commercial batch plants that are not dedicated to the project are exempt from the daily accumulated total requirement.

C. Give the Engineer a copy of the record at the end of each production day.

D. If the printout device malfunctions, finish the shift following the initial malfunction. Then stop operations until the device is fully operational.

E. Have the beams scales, and water meters on the batching plant checked, certified, and sealed by the Utah Department of Agriculture, Division of Weights and Measures annually and each time the plant or weighing device is moved.

2.12 TESTING PLATFORM

A. Provide a stable, 40 ft by 8 ft testing platform with a canopy when concrete is hauled in dump trucks.
   1. Provide a lockable 8 ft by 10 ft by 8 ft storage room at one end.

2. Locate the platform within 250 ft of the batch plant.
3. Platform height must equal the concrete haul truck bed height.
4. Platform must meet the Department of Labor standards outlined in Safety and Health Regulations for Construction.
5. Provide adequate railing, and stairs with a handrail.
6. Provide 110 V electrical power and pressurized water.
7. Maintain suitable lights and outlets and a communication system with the batch plant control room.

2.13 VEHICLES FOR HAULING

A. Haul vehicles are limited to the legal axle load.

B. Present certified scale axle weights for each unit in terms of yardage to be hauled.

C. Permissible to use:
1. End dump trucks with essentially watertight beds and endgates, and rounded corners.
2. Agitator trucks with open tops.
3. Transit mixers that conform to the standard found in AASHTO M 157.

D. Do not use bottom or belly dump units.

2.14 CYLINDER STORAGE DEVICE

A. Use a device that maintains a temperature of 60 degrees F to 80 degrees F and is equipped with an automatic 7-day temperature recorder. The recorder's accuracy must be within 2 degrees and have a permanent recording feature.

B. Use device or devices with the capacity to accommodate the required test cylinders and beams for a minimum of two day's operation. Stop placing concrete if capacity is lacking.

C. Make the storage devices available on the job site at least 48 hours before placement.

D. Submit written procedures explaining operation and required monitoring or care of the device for approval.

E. A 24-hour test run may be required.

2.15 SLIP FORM PAVER

A. Self-propelled machine with no fluid leaks, equipped with automatic line and grade control capability.

B. Capable of:
   1. Spreading the dumped concrete uniformly across the grade by an auger or a traveling strike-off device.
   2. Vibrating, tamping, striking-off, and shaping the concrete to the desired line grade and thickness in one continuous pass.

C. Under normal operating conditions, do not place wheeled or tracked power equipment in front of the paver redistributing the concrete.

D. Vibrator minimum requirements:
   1. Eccentric Diameter: 1-7/8 inch
   2. Frequency: 9500 vibrations per minute minimum.
   3. Spacing: 18 inch maximum mounted longitudinally.

E. Operate the vibrators horizontally at the midpoint of the concrete slab and mounted so they maintain this position.

F. Run the vibrators parallel to the direction of the paving.

G. Check each vibrator for operation daily.
   1. Shutdown paving operations immediately if any indication of malfunction occurs.
   2. Resume operations only after repairing or replacing the vibrator.

H. Trailing forms: long enough to leave a smooth, straight, vertical edge.

I. The vibrating and tamping elements: stop when the forward movement of the paver stops.

2.16 FINISHING EQUIPMENT REQUIREMENTS

A. Machine float that may be attached to the paver.

B. Burlap drag.

C. Transverse tining machine (single use) and a comb equipped with steel tines randomly spaced (3/4 in " 1/8 inch).

D. Curing-sealing compound application machine (single use) with a fully atomizing type power spray and a wind protection hood.

E. Dual-use tining and curing machine may be used when placement rate is 100 yds^3/h or less.

2.17 PAVEMENT SURFACE ROUGHNESS TESTING DEVICE - PROFILOGRAPH

A. Refer to Section 01452.

PART 3 EXECUTION

3.1 PREPARATION

A. The profilograph must be on the project site before beginning paving operations.

B. Aggregate Stockpiles
   1. Prepare site by clearing, grubbing, smoothing, and compacting.
   2. Construct stockpile platforms to prevent intrusion of subgrade materials into aggregates.
   3. Provide adequate drainage for the stockpile site.
   4. Construct either individual stockpiles containing materials for a single day of paving, or elongated stockpiles (maximum 25 ft in height, 30 ft top width) with material identified.
      a. Build stockpiles a minimum of two working days before use.
      b. Acceptance of stockpiles is in daily increments only and a maximum of 30 calendar days before use.
      c. May construct standby stockpiles to prevent or avoid delays. Cover until needed.
   5. Construct by distributing over entire base in layers not to exceed 5 ft.
      a. Do not dump or spill over sides.
      b. Equip conveyors with rock ladder or tremie.
      c. Maximum drop from rock ladder or tremie is 10 ft.
   6. Restrict conical piles to a 10 ft maximum height before distribution.
   7. Supply loader and operator to assist in sampling for testing.

3.2 APPLICATION - FORMED PAVING OPTION

A. Construct pavement between metal side forms conforming to the guidelines in this Section.

B. Do not allow springing to occur under the weight of paving and finishing equipment.

C. Forms:
1. Keep free from warps, bends, kinks, and keep equal in depth to the specified pavement edge.
2. Maintain deviation of the forms within 1/8 in from a plane in the top surface or within 1/4 in from a plane surface on the inside face.
3. Set at a distance equal to a day's maximum run.
4. Firmly stake side forms using steel dowels placed on each side of every joint, and spaced not more than 5 ft apart.
5. Tightly join form sections by an interlocking joint free of vertical and horizontal movement.
6. Stop paving operation if the side forms do not meet line and grade, or if side forms are loose.
7. Keep side forms in place for at least 12 hours after the concrete has been placed. Clean and oil forms after each use.
8. Remove the side forms without damage to the edge of the pavement. Immediately fill any honeycomb areas at once with mortar composed of one part Portland Cement, two parts sand, and sufficient water to form a thick paste.
9. Protect the edges of the pavement with curing-sealing compound after the form removal.

D. Vibrators:
1. Attach vibrators to the concrete finishing machine in front of the strikeoff auger and mount as transverse moving or longitudinal fixed at 18 inch maximum spacing to clear tie bars.
2. Vibrator minimum requirements:
   a. Eccentric Diameter: 1-7/8 inch.
   b. Frequency: 9500 vibrations per minute.
3. Use hand-operated vibrators on a regular pattern not to exceed 12 inches in each direction for irregular areas where required.

3.3 LINE AND GRADE CONTROL

A. Establish the necessary stakes for grade control over existing surfaces, and provide the elevation control benchmarks.

B. Use previously established stakes for grade control on the underlying course or courses of lean concrete or asphalt base course.

C. Equip machinery with a control system that automatically controls concrete placement to the specified longitudinal grades.

D. Control systems:
   1. Must be automatically actuated from an independent line and grade control reference using a system of mechanical sensors or sensor-directed devices.
   2. Use sensors that maintain the equipment at the proper transverse slope and elevation to obtain the required thickness and surface.
   3. Furnish, place, and maintain supports, wire devices, and materials as required to provide continuous line and grade reference controls for the placing machine, etc.

3.4 BATCHING MATERIALS

A. As specified for weighing and batching materials. Conform to AASHTO M 157.

B. Batch mixer: Conform to the standard, and operate at the drum speed recommended by the manufacturer.
   1. Do not lose bulk cement and fly ash when transporting into the mixer.
   2. Introduce cement before fly ash.
   3. Add admixtures to the mix water separately and at different times.
   4. Conduct mixing efficiency tests at the beginning of placing concrete, and evaluate as specified in AASHTO M 157, Annex A-1.
   5. Maintain a mixing time of 80 seconds at manufacturer recommended mixing speed after all materials are in the drum. If necessary, increase mixing time in 10 second increments until the mixer efficiency evaluation is passed.
   6. Correct poor mixing efficiency at no additional cost to the Department.
   7. Replace mixing blades when they are worn down 1 inch or more below the original height.
   8. Do not allow buildup of cement or mortar on the mixer drums and blades.

C. Centrally mixed materials:
   1. Base mixing time on the results of the mixer efficiency evaluation, and do not mix less than 80 seconds.
   2. Mix materials for a minimum of 30 seconds after the last addition of water or cement is made after initial batching.

D. Transit mixed materials:
   1. Add a minimum of 30 revolutions at mixing speed when water is introduced after initial batching. Follow AASHTO M 157.
   2. Do not add water to retemper the concrete.
   3. Do not add water to the mix after acceptance testing.

3.5 PLACING CONCRETE

A. Keep the base surface moistened 500 ft in front of the paver without allowing areas of standing water to occur.

B. Place material according to Section 01452 and Section 02752 of Measurement and Payment, Price Reductions for Deficient Thickness, in the Bid Book.

C. Place the concrete to the full width of the pavement in a single operation.

D. Vibrate, screed, and mechanically tamp the spread concrete.

E. Discharge and place the mixed concrete with a lay down machine within the time frame listed below after introducing the mixing water to the cement and aggregates. Reject concrete not placed within the following time period.
   1. Non-agitating Haul Equipment: 35 minutes.
   2. Agitating Haul Equipment: 75 minutes.

F. Deposit the concrete so rehandling is not required.

G. Thoroughly vibrate against and along the faces of the forms.

H. Use shovels or other approved tools for any necessary hand spreading. Do not use rakes.

I. Do not add water to the pavement surface behind the final screed on the paver.

J. Spray water directly on the final burlap drag only in the quantity necessary to keep the burlap wet.

K. Do not add water to the surface for finishing. If water is added, paving operations may be shut down or the concrete rejected.

L. Concrete may be placed in an adjoining longitudinal section three days after initial placement.

M. Provide protection for initial surface.

3.6 HANDLING AND PLACING REINFORCING STEEL

A. Properly store all steel received.

B. Keep tie bars clean, free from damage, and free from distortion.

C. Place tie bars in the middle third of the slab, as shown on the plans.
   1. Refer to PV series Standard Drawings.
   2. Place normal to direction of paving and parallel to the slab surface.
   3. Hold tie bars, as shown in the plans.
   4. Place by using automatic bar inserters, support on chairs, through forms, or drilled and epoxied in. Manual insertion is not permitted.

D. When load transfer dowel bars are required, place bars in the middle third of the slab depth, parallel to the centerline and surface of the slab. Limit deviations from parallel to 1/4 inch in the length of the dowel bar.

3.7 FINISHING

A. Finish the surface smooth and true to grade by machine float immediately after placing concrete. Finish at a rate equal to the progress of the paving operation.

B. If preliminary finishing is delayed more than 30 minutes after initial screeding, shut down the mixing operation until the situation is resolved.

C. Texture the pavement by burlap drag and transverse tining.
   1. Use at least three plies of wet burlap and drag parallel to the centerline without tearing.
   2. Complete the drag finish with one pass.
   3. Form depressions in the plastic concrete surface with the tining comb:
      a. Randomly spaced (3/4 inch " 1/8 inch).
      b. 3/32 inch to 5/32 inch in deep normal to centerline.
      c. Do not tear or remove excess mortar in the tining process.
   4. Do not tine Urban Highways with design speeds less than 40 mph.

D. Mark station numbers every 500 ft and date of placement 25 ft from start and finish of a day's placement on the outside edge of the concrete pavement:
   1. After texturing and before curing-sealing.
   2. Use a "brand" with changeable numbers a minimum of 3 inches high.
   3. Smooth an area approximately 9 inch by 18 inch with a float, color with concrete colorant, and press the "brand" approximately 1/4 inch into the concrete to form the appropriate station number.

3.8 CURING

A. Refer to Section 03390.

3.9 FIELD QUALITY CONTROL

A. Engineer random samples all concrete.

B. Compliance with the mix design is determined by inspecting the batching procedures.
   1. The Department furnishes the molds and machines for testing.
   2. Furnish material, internal vibrators and storage devices following this Section, Part 2, article, Cylinder Storage Device for making and curing the test specimens as per AASHTO T 23.
   3. Maintain cylinders at a temperature range of 60 degrees F to 80 degrees F for the initial curing period of not less than 24 hours.
   4. Cure concrete cylinders and flexure beams in the field a minimum of 24 hours before moving.
   5. Maintain storage devices.

C. Engineer samples materials centrally mixed with non-agitating haul units at the batch plant platform in accordance with AASHTO T 141.
   1. One set of strength tests represents 2650 yds^2 of pavement.
   2. Hand-placed areas are considered separately for strength and thickness.
   3. Run each truckload of concrete past the platform for inspection. The Engineer may test any or all truckloads.
   4. Perform correlation testing to determine the loss of entrained air from the platform to the finished in-place pavement.
      a. Perform air test on concrete at the platform, and again from the same load in the finished pavement. Record any change in the air content.
      b. Make necessary adjustments at the platform to achieve adequate air-entrainment in the finished pavement.
      c. Perform two tests, one in the morning and one in the afternoon, for each day of paving operations.

D. Engineer samples and tests materials centrally mixed with agitating haul units or transit mixed at placement location. One set of strength tests represents 725 yds^2 of pavement or one day's placement whichever is smaller (a lot).

E. Engineer tests air and slump in accordance with AASHTO T 152, and T 119 on the first three loads at startup and after any shutdown of more than one hour.
   1. Slow the batching operation to allow completion of each air and slump test before the next batch is made. Communicate test results to the batch plant operator and make necessary corrections.
   2. Engineer takes random samples during the day. Any samples taken that differ from air or slump test requirements require the testing and acceptance of three consecutive loads before full operation resumes.
   3. Engineer verifies samples that are out of specifications by conducting an additional test on the same load. When the second test is within specifications, Engineer conducts a third test as the deciding factor.

F. Yield tests: Engineer takes in conjunction with an air test at least one per day in accordance with AASHTO T 121.

G. Compressive Strength: Engineer conducts a strength test consisting of one set of three cylinders made at the platform or point of placement. Conform to AASHTO T 23.

H. Flexural Strength: Engineer casts two beams for each day concrete is placed.
   1. Conform to AASHTO T 23 and T 97.
   2. Beams used to determine when a pavement can be opened for traffic shall be cured in the field at the site of the represented pavement.

3.10 PROTECTION

A. Protect pavement against all damage and marring.

B. Keep Contractor hauling equipment and traffic off the pavement until at least ten days after concrete placement as per AASHTO T 97, or until 100 percent of the minimum flexural strength has been achieved.
   1. Use barricades to prevent traffic from using the pavement.
   2. Construct crossings to bridge the concrete as approved by the Engineer when necessary at no additional cost to the Department.

C. Protect from rain and hail damage.
   1. Cease operation when rain is threatening.
   2. Remove, replace, or repair any pavement damaged by rain or hail as directed at no additional cost to the Department.

3.11 JOINTS

A. Construct contact joints, sawed joints, or transverse expansion joints as shown on the plans.

B. Keep the faces of all joints at right angles to the top surface of the pavement with all longitudinal joints parallel to the centerline and coinciding with the traffic lane lines.

C. Place fresh concrete against previously cured concrete at planned locations to form contact joints.
   1. When used, retain transverse contact joint forms in place until paving operations resume.
   2. Join concrete on both sides of all longitudinal and transverse contact joints with tie bars as shown in contract plans.
   3. Maintain the tie bars in their proper position during concrete placement.

4. Saw and seal all contact joints to the dimensions shown on the plans.

D. Longitudinal contact joints:
   1. Construct with tie bars to the dimensions shown on the plans.
   2. Do not allow the finished surface across longitudinal contact joints to deviate from a straight line by more than 1/8 inch in 10 ft when tested with a straight edge.
   3. Shut down operations until specified tolerances are achieved if the edge slump requirements are not satisfied within 200 ft longitudinally of the start of a contact joint.
   4. If the edge slump exceeds the specified 1/8 inch in 10 ft, repair the edge by the following procedures before placing adjacent concrete:
      a. Saw off the slumped edge to the full thickness with a diamond saw.
      b. Drill holes in the sawed edge and epoxy in new tie bars.
      c. Use No. 8 by 24 inch epoxy-coated tie bars. Place midpoint in the slab at 12 inches on center embedded 12 inches into the slab.
   5. Straighten bent tie bars and re-coat with epoxy paint at the bend point before placing concrete in the adjacent lane.

E. Use power driven saws to construct sawed joints. Maintain a minimum of two working power saws and one working standby power saw during concreting operations.
   1. Single cut all transverse and longitudinal joints (1/8 inch wide) to one third the depth of the design pavement thickness (T/3).
   2. Saw initial or “control” transverse contraction joints at 50 ft intervals or less to control cracking.
      a. Begin sawing immediately after the concrete has sufficiently hardened and before uncontrolled cracking occurs.
      b. Conduct continuous sawing operations during both day and night regardless of weather conditions.
      c. Provide lighting during nighttime sawing.
   3. Immediately flush all joints with water after sawing and wash cuttings from road surface.
   4. Thoroughly clean joints of all loose debris, cement powder, etc., with a jet of water at 2000 psi minimum pressure.
   5. Keep the transverse joints clean and dry before placing moisture resistant backer rod and/or sealant.
      a. Clean the joint with air at a minimum of 100 psi just before placing the backer rod.
      b. Equip air compressors with operating oil and water traps.
   6. Unless specified otherwise, install hot-pour joint sealant (ASTM D 3405) the full depth of the saw cut.
   7. Fill the longitudinal joints evenly 1/8 inch " below the pavement surface.

8. Do not permit hauling equipment or traffic on the pavement before all sawed joints are sealed.
9. Match joints in adjacent lanes to form a continuous line across the pavement width including the concrete shoulders.

F. Make night and transverse contact joints normal to the centerline without keyways on the vertical face.
1. Use No. 10 by18 inch epoxy-coated tie bars placed midpoint in the slab at 12 inches on center and embedded 9 inches on each side.
2. Form joints with tie bars placed through the form or saw joints with tie bars drilled and epoxied or as approved.

G. Form transverse expansion joints at structure approaches as shown on the plans by using a joint filler strip and joint sealer.
1. Firmly support the filler strip by metal holder and end supports that remain in place after completing the pavement.
2. Secure the metal holder and end supports to prevent movement of the filler strip away from the position indicated on the plans when placing and vibrating the concrete.
3. Extend the joint filler the full width of the concrete being placed less 1/4 inch on each end.
4. Remove any concrete that flows around the ends of the joint filler.

3.12 DEFECTIVE PAVEMENT PANELS

A. A panel is that area of pavement within the traffic lane bounded by two transverse joints.

B. Engineer determines defective panels within 21 calendar days after placement.

C. Repair or replace defective pavement panels before acceptance for smoothness at no additional cost to the Department.

D. Remove and replace panels within the traffic lane when multiple full depth cracks separate the panel into three or more parts including the adjacent shoulder.

E. Remove and replace portions of panels within the traffic lane and the adjacent shoulder with any full depth transverse crack within 4 ft or less of a transverse sawed joint. Use methods that do not disturb adjacent panels.

F. Drill and epoxy tie bars as well as dowel bars into existing pavement. Coat dowel bars with a release agent on the free end.

G. Groove to a 1 inch depth by 3/8 inch width and seal any random full depth cracks that open 1/64 inch or more at the surface in 21 calendar days after placement. Silicone sealant required.

H. Leave tight random cracks less than 1/64 inch wide undisturbed.

I. Any core taken for determining full-depth crack is at no additional cost to the Department when the core verifies full-depth cracking.

END OF SECTION

SECTION 02753

FULL DEPTH SLAB REPLACEMENT FOR CONCRETE PAVEMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Remove panel or partial panel full depth of existing pavement.

B. Clean, grade and reconsolidate base.

C. Install dowels and/or tie bars.

D. Furnish and replace repair material, and cure repair material.

1.2 RELATED SECTIONS

A. Section 02752: Portland Cement Concrete Pavement

B. Section 03055: Portland Cement Concrete

C. Section 03152: Concrete Joint Control

D. Section 03310: Structural Concrete

E. Section 03390: Concrete Curing

1.3 REFERENCES

A. American Concrete Institute (ACI) Guide

PART 2 PRODUCTS

2.1 FULL DEPTH CONCRETE PAVEMENT REPAIR MATERIAL

A. Follow Section 02752, except that it is acceptable to use High Range Water Reducers. (Super Plasticizers).

B. Provide concrete mix design for verification following Section 02752.

C. Contractor may accelerate the rate of concrete strength gain to match the field placement schedule with written permission from the Engineer.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove panel, panels, or panel section.
   1. Determine the extent/dimensions of the repair from the plan sheets, or as directed by the Engineer. Adhere to the requirements of PV series Standard Drawings.
   2. Complete removal, make full depth cuts around the perimeter of the rectangular section to be removed. Minimize saw over cuts.
   3. Remove panels by lift-out method. Use chains and lift pins to facilitate removal and minimize disturbance of the base material.
   4. Repair damage caused by the Contractor's operations to adjacent slabs and underlying base courses.
   5. Remove all loose particles of old Portland Cement Concrete (PCC) prior to placing new PCC.

B. Reconstruct base to grade, and compact to standard specifications.

C. Form any side that does not have an adjacent panel. Form to match existing panels, providing a vertical edge.

D. Place dowel and/or tie bars.
   1. Place bars in locations as per PV series Standard Drawings. Use tie-bars or smooth dowels where indicated on standard drawings.
   2. Stockpile bars in an area where they are kept clean and free from damage.
   3. Drill holes mid-depth of the slab without causing damage to the remaining pavement section and orient holes such that bar placement tolerances can be met. Use gang drills, unless otherwise approved by the Engineer.

4. Clean holes of dust, grease and other contaminants.
5. Inject epoxy gel, Type II bonding compound into the back of the drilled hole.
    a. Select from the Performance Data Products Listing (PDPL) maintained by the UDOT Research Division.
    b. Provide sufficient quantity of bonding compound to completely fill the void between the bar and the outer limits of the drilled hole.
    c. Use retention rings to prevent the bonding compound from flowing out of the hole.
6. Align bars horizontally and vertically to meet requirements of the standard drawings.
7. Repair any bar coating damage with appropriate repair material.
8. Coat protruding portion of dowel bar with lubricant consisting of paraffin wax, lithium grease or other semi-solid, inert lubricant approved by the Engineer.
9. Set bonding compound and stabilize bar prior to mix placement. Remove and replace loose bars, at the Contractor's expense, prior to placing concrete mix.

E. Prepare existing joints for placement.
1. Maintain existing pavement joint layout.
2. Place a bond breaker approved by the Engineer, on the existing pavement edges that compose existing joints, either transverse or horizontal.
3. Saw joint on the same line if repairs straddle an existing joint line. Perform sawing in accordance with Section 03390.

3.2 PLACING CONCRETE

A. Place concrete in compliance with Section 03310.

B. Consolidate the mix with a mechanical vibrator in accordance with ACI 309 guidelines. Do not over-consolidate. Do not use hand vibrators to move mix.

C. Discard any unused mix after 30 minutes from the time mixing was completed for accelerated strength gain rate mix designs. Place normal mixes in accordance with Section 03055.

D. Weather Limitations - Place, cure and protect in accordance with Section 02752.

3.3 CONCRETE FINISHING

A. Finish patch to +/- 1/8 inch of existing profile.
   1. Correct patch profiles in excess of 1/8 inch higher than the existing pavement profile through surface grinding or removal and replacement.
   2. Correct patch profiles in excess of 1/8 inch lower than the existing pavement profile through removal and replacement of the patch.
   3. Contractor pays for any corrections to the finish of the patch.

B. Do not tool joints that are to be saw-cut and sealed.

C. Texture the surface to match the existing pavement.

3.4 CURING CONCRETES

A. Cure the slab surface before it begins to dry with material meeting the requirements of Section 03152. Uniformly spray the surface at a minimum rate of 0.44 gal/yd^2.

B. Do not open to traffic until compressive strength tests show that a minimum of 3,000 psi has been reached.

C. Cut all previously existing joints to original dimensions.

D. Fill all sawing overcuts with a repair epoxy from the Performance Data Products Listing (PDPL) maintained by the UDOT Research Division.

E. Replacement slab must perform under traffic at specified time of opening without failure.

F. Contractor pays for removing and replacing any defective panels. Refer to Section 02752.

3.5 PROTECTION

A. Protect the individual placements with approved barricades.

END OF SECTION

SECTION 02755

CONCRETE SLAB JACKING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Injection of a product to raise and support a failed section of concrete pavement back to an acceptable grade for a suitable ride.

1.2 REFERENCES

A. ASTM C 618: Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

B. ASTM C 1107: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

C. ASTM D 790: Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

D. ASTM D 1621: Compressive Properties of Rigid Cellular Plastics.

E. ASTM D 1622: Apparent Density of Rigid Cellular Plastics.

1.3 QUALITY ASSURANCE

A. Obtain approval from the Engineer for injection material properties prior to placement.

B. Provide to the Engineer copies of invoices from mix suppliers.

1.4 WARRANTY

A. Supplier warrants all materials and workmanship for a period of one year against shrinkage or deterioration.

B. Supplier replaces by re-injection or slab replacement any material that fails during the warranty period.

1.5 PAYMENT PROCEDURES

A. Accepted liquid quantities measured using a calibrated meter paid for at the contract unit price per cubic meter.

PART 2 PRODUCTS

2.1 HIGH DENSITY POLYURETHANE

A. Water based formulation of expanding high-density polyurethane used for raising slabs that set to full compressive strength within 15 minutes after injection.

PROPERTY	ASTM	LIMITS
Density	D 1622	Min 3.8 lb/ft^3 - Max 4.3 lb/ft^3
Tensile Strength	D 790*	Min. 100 psi
Elongation	N/A	Max. 5.1%
Compressive Strength at Yield Point	D 1621	Min. 90 psi

*Use the value of flexural strength or flexural yield as tensile strength.

2.2 PORTLAND CEMENT DRY MIX DESIGN

A. Use standard mix design for jacking and grouting slabs with voids less than 30 inches as follows:
   1. One part (by volume) Portland Cement Type I or II, refer to ASTM C 1107.
   2. Three parts (by volume) pozzolan (natural or artificial), refer to ASTM C 618 Type F.

B. Use optional mix design for jacking and grouting slabs with voids greater than 30 inches as follows:
   1. One part (by volume) Portland Cement Type I or II, refer to ASTM C 1107.

2. One part (by volume) pozzolan (natural or artificial), refer to ASTM C 618 Type F.
3. Two parts (by volume) clean sand.

C. Obtain Engineer's approval for any deviation from dry mix proportions of mix design including addition of liquefier and/or water reducing agents.

D. Adjust water content to meet local conditions

2.3 EQUIPMENT

A. Equipment capable of supplying a homogenous product at the appropriate rate.

B. Certified scales or measuring devices to measure delivered product and to proportion product components.

C. Concrete drill or saw capable of producing circular holes of adequate size for the application type.

D. Elevation measuring devices with an accuracy of 1/8 inch.

E. Concrete saw capable of cutting joints between failed and non-failed slabs.

PART 3 EXECUTION

3.1 PREPARATION

A. Establish a finish target profile of pavement using elevation measuring device or string lines.

B. Saw-cut joints between failed and non-failed slabs as necessary to prevent damage to non-failed slabs.

3.2 INSTALLATION

A. Drill holes as determined in roadway slab.

B. Inject product to evenly raise slab to finished grade profile.

C. Fill injection holes with at least 4 inches of non-shrink grout.

D. Final grade after jacking must be within " 1/8 inch of finished grade profile.

END OF SECTION

SECTION 02761

LONGITUDINAL RUMBLE STRIP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing longitudinal rumble strip on the final roadway surface.

1.2 ABREVIATIONS

A. HMAP - Hot Mix Asphalt Pavement

B. PCCP - Portland Cement Concrete Pavement

PART 2 PRODUCTS

2.1 EQUIPMENT - HMAP/ PCCP GRINDER

A. Construct longitudinal rumble strip with equipment using a rotary type cutting head, capable of obtaining the required groove width in a single pass while moving in the same direction as the flow of traffic.
   1. Use equipment with cutting head(s) having independent suspension from the power unit to allow the head to self align with the slope of the shoulder.
   2. Use cutting head(s) that provide a smooth surface (approximately 1/16 inch between peaks or valleys).

B. Apply asphalt flush coat at a uniform rate of 0.10 gal/yd^2 diluted two parts concentrate to one part water by the manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

A. Construct longitudinal rumble strip to the dimensions and spacing as shown on PV series Standard Drawings.
   1. Establish lane widths of 12 ft prior to the installation of longitudinal rumble strip.
   2. Construct longitudinal rumble strip prior to the placement of Chip Seal Coat, if required.

B. Provide a positive means of controlling the alignment.
   1. Alignment of the edge of the pattern will be randomly verified by the Engineer.

C. Construct a 500 ft long test section to demonstrate that the equipment, personnel and methods of operation are capable of producing acceptable results.
   1. Do not proceed with work until it is demonstrated that the required dimensions, alignment and smoothness can be achieved without tearing or otherwise damaging the pavement.
   2. Repair or replace pavement as determined by the Engineer if the test section is unacceptable.

D. Remove resulting debris prior to opening the adjacent lane to traffic.
   1. Dispose of material in accordance with all Federal, State and Local regulations and in a manner acceptable to the Engineer.

END OF SECTION

SECTION 02762

PLOWABLE PAVEMENT MARKER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing plowable pavement marker.

1.2 REFERENCES

A. ASTM A 536: Ductile Iron Castings

1.3 SUBMITTALS

A. Provide a manufacturer's certificate of compliance for each housing, reflector, and epoxy.

PART 2 PRODUCTS

2.1 HOUSING

A. ASTM A 536

B. Use a marker housing of nodular iron, Grade 80-55-06, hardened to 52-54RC

C. Use a rectangular housing, not less than 10 inches long by 5.5 inches wide, including lugs, by 1.76 inches deep.

D. Use plowable marker housings that contain a minimum of three ramps to protect reflector from damage.

2.2 REFLECTOR

A. Acrylic prismatic reflector.

B. Reflective area not less than 1.44 in^2 per face.

C. Specific intensity of the reflector at 0.2 degrees observation angle.
   1. White:
      a. 3.00 at 0 degrees horizontal entrance angle.
      b. 1.20 at 20 degrees horizontal entrance angle.

   2. Yellow:
      a. 1.80 at 0 degrees horizontal entrance angle.
      b. 0.72 at 20 degrees horizontal entrance angle.

2.3 EPOXY

A. Rapid setting type with

1.	Pot life at 77 degrees F:	6 minutes to 11 minutes
2.	Bond strength one hour at 77 degrees F:	180 psi
3.	Bond strength 24 hour at 88 degrees F:	400 psi
4.	Property retention:	5 cycles
5.	0 degrees F to 100 degrees F:	6 Months

PART 3 EXECUTION

3.1 PLACING CRITERIA

A. Use standard profile marker housing only in very low snowfall areas. For all other locations, use low profile marker housing.

B. Use two-way plowable marker housings on centerline of two-way roadways and other locations as noted on the plans. Use one-way plowable marker housings for lane and shoulder delineation, divided highways, and other locations as noted on the plans.

C. Use Table 1 to determine the height of the housing above pavement surface (standard or low profile) for both two-way and one way plowable marker housing design.

Table 1
Height of Housing above Pavement (Inches)

	Two way marker	One way marker
Standard	# 0.41	# 0.30
Low Profile	# 0.25	NA

3.2 RECTANGULAR MARKER

A. Placement:
   1. Produce a hole and grooves in pavement parallel to the traffic, with the depth and configuration consistent with housing. Locate the hole and grooves cut for marker placement in solid sound pavement areas. Avoid placement over any joints, cracks, or similar roadway imperfections. Place according to manufacturer's instructions.
   2. Clean surface of the keel and web of oil, grease, or any contaminant that reduces the bond to the epoxy adhesive.
   3. Partially fill the clean dry hole with epoxy cement.
   4. Place reflector housing in epoxy filled grooves and apply sufficient foot pressure to seat the housing.
   5. Contact the pavement surface with all four leveling lugs.
   6. Place reflector with all leading edges below or flush with the pavement surface.

B. Do not exceed an angle formed by the longitudinal axis of the marker and the adjacent pavement stripe of 50 degrees.

3.3 LIMITATIONS

A. Do not install when temperatures are below 50 degrees F.

END OF SECTION

SECTION 02765

PAVEMENT MARKING PAINT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish VOC Compliant Solvent Based or Acrylic Water Based pavement marking paint meeting Federal Specification TTP-115 F for Low Volatile Organic Compounds (VOC) of 1.25 lbs/gal.

B. Apply to asphaltic or concrete pavement as edge lines, center lines, broken lines, guide lines, symbols and other related markings.

C. Remove pavement markings.

1.2 REFERENCES

A. AASHTO M 247: Glass Beads Used in Traffic Paint

B. ASTM D 562: Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using the Stormer-Type Viscometer

C. ASTM D 711: No-Pick-Up Time of Traffic Paint

D. ASTM D 2205: Selection of Tests for Traffic Paints

E. ASTM D 2743: Uniformity of Traffic Paint Vehicle Solids by Spectroscopy and Gas Chromatography

F. ASTM D 3723: Pigment Content of Water-Emulsion Paints

G. ASTM D 3960: Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings

H. ASTM D 4451: Pigment Content of Paints

I. ASTM D 5381: X-Ray Fluorescence (XRF) Spectroscopy of Pigments and Extenders

J. Federal Standards 595B, 37875, 33538, and 11105

K. UDOT Materials Manual of Instruction

1.3 ACCEPTANCE

A. UDOT ENGINEER:
1. Randomly samples pavement marking paint and submits to Central Chemistry Lab for acceptance.
2. Randomly generates the location of each test and removes all loose or excess beads from the line prior to testing.
3. Visually inspects each line to verify bead adhesion and compliance with specified line dimensions requirements.
4. Verifies that the paint and beads are being applied within specified tolerances a minimum of once each production day.
5. Verify quantities used by measuring both paint and bead tanks prior to and after application.

B. Repaint any line or symbol failing to meet bead adherence and dimensional requirements.

C. Repaint any line or symbol failing to meet the minimum application requirements for paint or beads.

PART 2 PRODUCTS

2.1 PAINT

A. Choose an approved pavement marking paint from the UDOT Research Division Accepted Products Listing. Follow Federal Standards 595B, 37875, 33538, and 11105. Meet the following requirements for VOC Compliant Solvent Based Paint or Acrylic Water Based Paint:

CIELAB (L*a*b*) D65/10E		
White	**Yellow**	**Red**
L* 91.9 to 95.6	L* 70.0 to 72.7	L* 31.4 to 33.4
a* -1.8 to -2.1	a* 22.5 to 24.8	a* 51.6 to 52.6
b* 3.8 to 2.2	b* 89.7 to 73.9	b* 34.1 to 35.1

1. No-track time: Not more than 5 minutes when tested according to ASTM D 711.
2. Volatile Organic Compounds Content: Less than 1.25 lbs/gal ASTM D 3960.
3. Free of lead, chromium, or other related heavy metals ASTM D 5381.
4. Pigment: Percent by weight: Acrylic Water Based minimum of 62.0 " 2.0 VOC Compliant Solvent minimum of 52.0. ASTM D 3723.
5. Total Solids: Percent by weight: Acrylic Water Based minimum of 77.0 VOC Compliant Solvent minimum of 70.0. ASTM D 2205.
6. Acrylic water based paint must contain a minimum of 40 percent, by weight, 100 percent acrylic cross-linkable emulsion as determined by infrared analysis and other chemical analysis available to UDOT. ASTM D 2205 and UDOT Manual of Instruction Section 996.
7. VOC compliant solvent based paint must contain 37.5 percent, by weight, copolymer alkyd-resin ASTM D 2205.
8. ASTM D 562, ASTM D 2743, ASTM D 4451 and ASTM D 5381: Tests used to verify paint samples meet Accepted Products Listing.

2.2 GLASS SPHERE (BEADS) USED IN PAVEMENT MARKING PAINT

A. Specific Properties:
   1. Meet AASHTO M 247.
   2. Meet type II, uniform gradation.

PART 3 EXECUTION

3.1 PREPARATION

A. Line Control.
   1. Establish control points at 100 ft intervals on tangent and at 50 ft intervals on curves.
   2. Maintain the line within 2 inches of the established control points and mark the roadway between control points as needed.
      a. Remove paint that is not placed within tolerance of the established control points and replace at no expense to the Department. Refer to this Section, article 3.4, Remove Pavement Markings.

B. Remove dirt, loose aggregate and other foreign material and follow manufacturer's recommendations for surface preparation.

3.2 APPLICATION

A. Pavement Marking Paint: Apply at the following rates:
   1. 4 inch Solid Line: From 270 to 350 ft/gal
   2. 4 inch Broken Line: From 1080 to 1400 ft/gal
   3. 8 inch Solid Line: From 135 to 175 ft/gal

B. Replace pavement markings that are less than 14 wet mils in thickness.

C. No payment for pavement markings placed in excess of 18 wet mils in thickness.

D. Painted Legends and Symbols 1 gallon per 100 square feet.

E. Glass Sphere (Beads): Apply a minimum of 8 lbs/gal of paint, the full length and width of line and pavement markings.

F. Begin striping operations no later than 24 hours after ordered by the Engineer.

G. At time of application apply lines and pavement markings only when the air and pavement temperature are:
   1. 40 degrees F and rising for VOC Compliant Solvent Based Paint.
   2. 50 degrees F and rising for Acrylic Water Based Paint.

H. Comply with Traffic Control Drawing TC 16

3.3 CONTRACTOR QUALITY CONTROL

A. Application Rate: Verify that the paint and beads are being applied within specified tolerances prior to striping.

3.4 REMOVE PAVEMENT MARKINGS

A. Use one of these removal methods:
   1. Grinding
   2. High pressure water spray
   3. Sand blasting
   4. Shot blasting.

B. Use equipment specifically designed for removal of pavement marking material.

END OF SECTION

SECTION 02768

PAVEMENT MARKING MATERIALS

(Warranty Specification)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Methods and materials for installing pavement marking materials including Pavement Marking Tape, Solvent-Free and Lead-Free Epoxy, Methyl-Methacrylate, and Thermoplastic legends.

1.2 RELATED SECTIONS

A. Section 01554: Traffic Control

1.3 SUBMITTALS

A. Manufacturer Warranty:
   1. Provide a full warranty covering 100 percent of the pavement marking materials.
      a. Manufacturer is responsible for quality control of the materials, proper placement by the Contractor or subcontractor, and all other factors that affect the service life of the materials.
      b. In the event of a performance failure, remove and/or replace 100 percent of the markings for all failed sections at no cost to Department.
      c. Failed sections are defined in this Section, Part 2 for each pavement marking material.

B. Warranty Bond:
   1. The manufacturer provides a warranty bond for the total bid price of the material. The total bid price will be calculated by using the quantity of pavement marking material listed in the engineers estimate and the average unit bid price for said material obtained from the Construction Division's Project Development Business System (PDBS).
   2. Warranty period covers the specified service life of the materials, and begins after all pavement markings are installed and accepted.
   3. Submit proof of bond to the Engineer before placing the material.

C. Traffic Control: Refer to Section 01554.

1.4 DELIVERY, STORAGE, AND HANDLING

A. In accordance with manufacturer's recommendations.

B. Provide Material Safety Data Sheets (MSDS) upon delivery of material.

1.5 MANUFACTURER SERVICE REQUIREMENT

A. Provide technical support to the Contractor during the placement of the marking materials, including information about handling, storage, placement, and other training that may preserve the quality of the installed markings.

1.6 SERVICE LIFE TESTING

A. Department performs service life testing.

B. Performance measures: Retro-reflectivity, color contrast and stability, and durability under all traffic volumes and wear conditions, unless stated otherwise.

C. Retro-reflectivity is measured using a Federally approved instrument (30 m geometry).

D. When performing Service Life Testing, take readings on clean surface areas free of debris.

PART 2 PRODUCTS

2.1 PAVEMENT MARKING TAPE

A. Preformed adhesive tape with a raised profile for longitudinal lines on all pavement surfaces.

B. Preformed adhesive tape with a flat or raised profile for legends and symbols on all pavement surfaces.

C. Minimum service life for the following applications under all traffic volumes and wear conditions:
   1. Longitudinal lines: 48 months.
   2. Legends and symbols: 18 months.

D. Performance Measures for Retro-reflectivity, Color Contrast/stability, and Durability.
   1. Minimum Retro-reflectivity:
      a. White longitudinal lines: 125 millicandelas.
      b. Yellow longitudinal lines: 125 millicandelas.
      c. Legends and symbols: 125 millicandelas.
   2. Minimum Color Contrast and Stability: For white markings, provide a minimum yellowness index of 30 when measured with a portable colorimeter (XYZ C/2).
   3. Minimum Durability Level: 90 percent of the longitudinal line on any 1000 ft segment or 90 percent of the legend and symbol must be present.
   4. Failure to meet any of the specified performance measures on at least 90 percent of the longitudinal line, in any 1000 foot segment, or 90 percent of a legend or symbol is considered a complete failure of that marking. Replace under the warranty terms.

2.2 SOLVENT-FREE EPOXY

A. 100 percent lead free, two-component (resin and hardener) epoxy system for longitudinal lines, legends, and symbols and for all pavement surfaces.

B. Minimum service life for the following applications under all traffic volumes and wear conditions:
   1. Type 1 - Fast dry
      a. Longitudinal: Center, skip, and edge lines: 24 months.
      b. Legends and symbols: 12 months.
   2. Type 2 - Slow dry
      a. Longitudinal: Center, skip, and edge lines: 48 months.
      b. Legends and symbols: 24 months.

C. Performance Measures for Retro-reflectivity, Color Contrast/stability, and Durability.
   1. Minimum Retro-reflectivity:
      a. White longitudinal lines: 125 millicandelas.
      b. Yellow longitudinal lines: 125 millicandelas.
      c. Legends and symbols: 125 millicandelas.
   2. Minimum color stability: Yellowness Index of White Paint on concrete or asphalt surfaces: 30 or less.
   3. Minimum Durability Level: 90 percent of the longitudinal line on any 1000 ft segment or 90 percent of the legend and symbol must be present.
   4. Failure to meet any of the specified performance measures on at least 90 percent of the longitudinal line, in any 1000 foot segment, or 90 percent of a legend or symbol is considered a complete failure of that marking. Replace under the warranty terms.

D. Retain a one pint sample from each lot or batch used.
   1. 24 months for Type I
   2. 48 months for Type II.

E. Repaint pavement markings that are below 16 wet mils in thickness.
   1. No payment for materials placed in excess of 20 wet mils in thickness.

F. Use beads according to manufacturer's recommendations.

2.3 METHYL METHACRYLATE

A. Use a two-component pavement marking system compliant with Federal VOC regulations used for longitudinal lines, legends and symbols and for use on all pavement surfaces.

B. Profiled, Non-profiled, Inlaid, Inverted Profile with bump, Inverted Profile without bump, Spray.

C. Minimum surface life for the following applications, under all traffic volumes and wear conditions:
   1. Longitudinal lines: 48 months.
   2. Legends and symbols: 18 months.

D. Performance Measures for Retro-reflectivity and Durability.
   1. Minimum retro-reflectivity:
      a. White Longitudinal markings: 125 millicandelas.
      b. Yellow Longitudianal markings: 125 millicandelas.
      c. Legends and Symbols : 125 millicandelas.
   2. Minimum Durability level: 90 percent of the longitudinal line on any 1000 ft segment or 90 percent of the legend and symbol must be present.
   3. Failure to meet any of the specified performance measures on at least 90 percent of the longitudinal line, in any 1000 ft segment, or 90 percent of the legend or symbol is considered a complete failure of the marking. Replace under the warranty terms.

E. Remove and replace pavement marking that is below 80 wet mils in thickness.
   1. No payment for materials placed in excess of 100 wet mils in thickness.

F. Use beads according to manufacturer's recommendations.

2.4 THERMOPLASTIC

A. Used for legends and symbols only on all pavement surfaces.

B. Heat-fused preformed and Hot Melt pavement marking materials.

C. Minimum Service Life for Legends and Symbols, under all traffic volumes and wear conditions:
   1. Legends and Symbols: 24 months.

D. Performance Measures for Retro-reflectivity, and Durability.
   1. Minimum Level of Retro-reflectivity: 125 millicandelas.
   2. Minimum Durability: 90 percent of the each legend or symbol must be present.
   3. Failure to meet any of the specified performance measures on at least 90 percent of the legend or symbol is considered a complete failure of that legend or symbol. Replace under the warranty terms.

E. Hot-melt Thermoplastic:
   1. Remove and replace legends and symbols that are below 80 wet mils in thickness.
   2. No payment for materials placed in excess of 100 wet mils in thickness.

PART 3 EXECUTION

3.1 PREPARATION

A. Conduct surface preparations in accordance with manufacturer's recommendations.

3.2 APPLICATION

A. Apply Pavement Marking Materials according to manufacturer's specifications.

END OF SECTION

SECTION 02771

CURBS, GUTTERS, DRIVEWAYS, PEDESTRIAN ACCESS RAMPS, AND PLOWABLE END SECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing curbs, gutter transitions, driveways, pedestrian access ramps, and plowable end sections.

1.2 RELATED SECTIONS

A. Section 02061: Select Aggregate

B. Section 02324: Compaction

C. Section 02330: Embankment

D. Section 02776: Concrete Sidewalk, Median Filler, and Flatwork

E. Section 03055: Portland Cement Concrete

F. Section 03152: Concrete Joint Control

G. Section 03211: Reinforcing Steel and Welded Wire

H. Section 03310: Structural Concrete

I. Section 03390: Concrete Curing

J. Section 05120: Structural Steel

1.3 ACCEPTANCE

A. Curbs, gutters, driveways, disabled pedestrain ramps and plowable end sections may be accepted at a reduced price when the concrete strength is below that specified.
   1. Price adjustment pay factor following Section 03055.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT CONCRETE

A. Class AA(AE). Refer to Section 03055.

2.2 EXPANSION JOINT FILLER

A. Preformed material. Refer to Section 03152.

2.3 UNTREATED BASE COURSE

A. Refer to Section 02061.

2.4 STEEL

A. Reinforcing: Refer to Section 03211. Deformed billet-steel reinforcing bars as specified.

B. Structural: Refer to Section 05120. As specified or as indicated on the plans.

PART 3 EXECUTION

3.1 PREPARATION

A. Construct subgrade to plan elevations following Section 02330.

B. Place and compact fill material and untreated base course. Follow Section 02324.

C. May use a slip form curb and gutter machine.

D. Dampen the untreated base course before placing concrete.

E. Curbs and Gutters: Refer to GW series Standard Drawings.

F. Pedestrian Access Ramp: Refer to GW series Standard Drawings.

G. Plowable End Section: Refer to GW series Standard Drawings.

H. Forms: Refer to Section 02776.

3.2 PLACING CONCRETE

A. Furnish materials and construct structural concrete following Section 03310.
   1. Do not use mechanical vibrators.
   2. Hand tamp forms to eliminate honeycomb.
   3. Deposit concrete continuously when using a slip form machine.
   4. Use dowels as shown on the plans when placing curb on existing pavement.

3.3 FINISHING CONCRETE

A. Round edges to a ½ inch radius.

B. Use a float to finish the top and front face of the curb and the top of the gutter.

C. Finish the traveled portion of the driveway with a broom finish.

D. Remove form marks or irregularities from finish surfaces.

E. Truncated dome on pedestrian access ramps as shown.

3.4 JOINTS

A. Place joints perpendicular to the subgrade and as shown.

B. Contraction joints:
   1. 1/8 inch to 3/16 thick steel plates.
   2. Space the joints every 10 ft.
   3. Remove the templates as soon as the concrete takes an initial set.
   4. Cut joint 1½ inches deep when using slip form method to place the concrete.

C. Expansion Joints:
   1. Place expansion joint every 30 ft.
   2. Expansion joint not required when using slip form method to place concrete, except at adjacent pavement, curb radius, sidewalk, or structures.
   3. ½ inch thick premolded expansion joint filler.
   4. Place joint filler between the curb and gutter and sidewalk, or structures.

3.5 CONCRETE CURING AND PROTECTION

A. Cure the surface. Refer to Section 03390.

B. After curing, seal the surface. Refer to Section 03390.

END OF SECTION

SECTION 02773

ASPHALT CONCRETE CURB

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing asphalt concrete curb.

1.2 RELATED SECTIONS

A. Section 02745: Asphalt Material

B. Section 02748: Prime Coat/Tack Coat

PART 2 PRODUCTS

2.1 ASPHALT CEMENT

A. Refer to Section 02745.

2.2 MINERAL AGGREGATE

A. As specified in AASHTO and the following gradation:

Mineral Aggregate Gradation	
Sieve Size	**Percent Passing (by weight)**
1/2 inch	100
No. 4	50-70
No. 10	30-50
No. 200	5-10

2.3 TACK COAT

A. Refer to Section 02748.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean existing surface thoroughly.

B. Place tack coat at 0.06 gal/yd^2 residual asphalt or less.

3.2 PLACEMENT

A. Use an extrusion machine to place the curb.

B. Maintain the temperature of the hot mix asphalt as designated by the mix design. Refer to Section 02745.

C. Finish top and inside face of curb uniformly and free of irregularities.

END OF SECTION

SECTION 02776

CONCRETE SIDEWALK, MEDIAN FILLER, AND FLATWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing concrete sidewalk, median filler, and flatwork.

1.2 RELATED SECTIONS

A. Section 02324: Compaction.

B. Section 02330: Embankment

C. Section 02721: Untreated Base Course

D. Section 03055: Portland Cement Concrete

E. Section 03152: Concrete Joint Control

F. Section 03390: Concrete Curing

1.3 ACCEPTANCE

A. Concrete Sidewalk, Median Filler, and Flatwork may be accepted at a reduced price when the concrete strength is below that specified.
   1. Price adjustment pay factor following Section 03055.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT CONCRETE

A. Class AA(AE). Refer to Section 03055.

B. Substitute higher class of concrete if desired.

C. For flatwork: High purity, chemically inert, unfading, and alkali-fast synthetic pigment coloring material.

2.2 EXPANSION JOINT FILLER

A. Preformed material. Refer to Section 03152.

2.3 UNTREATED BASE COURSE

A. Untreated Base Course. Refer to Section 02721.

2.4 EMBANKMENT MATERIAL

A. Refer to Section 02330.

PART 3 EXECUTION

3.1 PREPARATION

A. Construct subgrade to plan elevations and following Section 02330.

B. Place and compact fill material following Section 02324.

C. Concrete flatwork coloring:
   1. Conform to the samples provided by the Engineer.
   2. Provide a matching sample, 1 ft^2 for the Engineer's approval before placing concrete.
   3. Thoroughly mix color pigment in the concrete before placing.

D. Forms:
   1. Use approved concrete forms on all curves that transition smoothly from curves to straight section. Keep forms free of flat sections and sharp bends.
   2. Use wood, metal, reinforced fiberglass, or plastic forms free of warps or bends. Anchor securely in place.

3.2 PLACING AND FINISHING CONCRETE

A. Dampen the subgrade just before concrete placement.

B. Hand methods of strike-off and consolidation are permitted.

C. Finish the surface with a moist wooden float.

D. Round edges to a 1/2 inch radius.

E. Brush to a transverse broom finish.

3.3 EXPANSION AND CONTRACTION JOINTS

A. Place joints perpendicular to the subgrade and at right angles to the longitudinal axis of the sidewalk or median.

B. Contraction Joints:
   1. 1/8 inch to 3/16 inch thick steel plates.
   2. Space the joints 10 feet apart.
   3. Remove the steel plates as soon as the concrete takes an initial set.

C. Expansion Joints:
   1. ½ inch thick premolded expansion joint filler. Refer to Section 03152.
   2. Place expansion joint every 30 ft.
   3. Place joint filler between the sidewalk or median filler and the curb or adjacent pavement, sidewalk, driveway pavement, or structure.

3.4 CONCRETE CURING AND PROTECTION

A. Refer to Section 03390.

END OF SECTION

SECTION 02785

CHIP SEAL COAT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for applying liquid or emulsified asphalt on a cleaned surface followed with an application of cover material and bituminous flush coat.

B. Cover materials.

1.2 RELATED SECTIONS

A. Section 01455: Materials Quality Requirements

B. Section 01558: Temporary Pavement Markings

C. Section 02745: Asphalt Material

D. Section 02748: Prime Coat/Tack Coat

1.3 REFERENCES

A. AASHTO M 140: Emulsified Asphalt

B. AASHTO M 208: Cationic Emulsified Asphalt

C. AASHTO MP 1: Performance Graded Asphalt Binder

D. AASHTO T 11: Materials Finer Than 75 Fm (No. 200) Sieve in Mineral Aggregates by Washing

E. AASHTO T 19: Unit Weight and Voids in Aggregate

F. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates

G. AASHTO T 40: Sampling Bituminous Materials

H. AASHTO T 96: Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine

I. AASHTO T 104: Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

J. AASHTO T 278: Surface Frictional Properties Using the British Pendulum Tester

K. AASHTO T 279: Accelerated Polishing of Aggregates Using the British Wheel

L. ASTM D 4791: Flat Particles Elongated Particles or Flat and Elongated particles in Coarse Aggregate

M. ASTM D 5821: Determining the Percentage of Fractured Particles in Coarse Aggregate

N. UDOT Materials Manual of Instruction

O. UDOT Minimum Sampling and Testing Guide

PART 2 PRODUCTS

2.1 PERFORMANCE GRADED PG BINDER - AASHTO MP 1

A. PG58-22 following Section 02745

B. PG64-22 following Section 02745

2.2 ANIONIC EMULSIONS

A. RS-2 following AASHTO M 140

2.3 CATIONIC EMULSIONS - AASHTO M 208

A. CRS-2A following Section 02745

B. CRS-2B following Section 02745

C. CRS-2P following Section 02745

D. LMCRS-2 following Section 02745

2.4 HIGH FLOAT EMULSIONS

A. HFRS-2P following Section 02745

B. HFMS-2 following AASHTO M 140

C. HFMS-2P following Section 02745

2.5 FLUSH COAT

A. Use one of the following emulsions agreed upon by the Engineer, following Section 02745, diluted two parts concentrate to one part water by the Manufacturer:
   1. CSS-1
   2. CSS-1h
   3. SS-1
   4. SS-1h
   5. HFMS-2P

2.6 COVER MATERIAL

A. Use crusher processed virgin aggregate consisting of natural stone, gravel, or slag meeting the requirements of Table 1.

Table 1

Chip Seal Cover Material Properties		
Unit Weight	AASHTO T 19	100 lb/ft^3, max
One Fractured Face	AASHTO D 5821	95% min.
Two Fractured Faces	AASHTO D 5821	90% min.
LA wear, see Note 1	AASHTO T 96	30% max.
Soundness	AASHTO T 104	10% max.
Flats & Elongates, 1:3 ratio	ASTM D 4791	5% max.
Stripping, see Note 1	Materials MOI 8-945	10% max.
Polishing, see Note 1	AASHTO T 278, T 279	31 min.
Note 1: The Department has the right to waive this requirement if the aggregates have proven acceptable through successful past performance as determined by the Engineer.		

B. Grade with the following limits to meet the specified test standard in AASHTO T 27 and T 11.

Table 2

Sieve Size	Percent Passing		
	Type A	**Type B**	**Type C**
1/2 in	100		100
3/8 in	85-100		70-90
No. 4	0-20	100	0-5
No. 8	0-5	85-100	0-3
No. 16		10-25	
No. 50		0-5	
No. 200	0-1	0-2	0-1

2.7 BLOTTER MATERIAL

A. Refer to Section 02748.

2.8 TEMPORARY PAVEMENT MARKERS

A. Refer to Section 01558.

2.9 SOURCE QUALITY ACCEPTANCE- CHIP SEAL COAT ASPHALT EMULSION

A. Refer to Minimum Sampling and Testing Guide requirements Section 02745.
   1. Provide a separate oil sampler meeting the requirements of AASHTO T 40 for each delivered truck and trailer not equipped with sampling valves that meet AASHTO T 40. Do not place any chip seal coat emulsion from equipment not meeting this requirement.
   2. Take the samples in the presence of Department personnel using their sample bottles.
   3. Clean and dry the oil sampler after each use following applicable environmental regulations.
   4. Do not place chip seal coat emulsion until the respective viscosity test meets the specification following Section 02745.

2.10 SOURCE QUALITY CONTROL - COVER MATERIAL

A. Department samples at a frequency according to Table 3.

Table 3

Stockpiles - Samples and Tests	
Lot Quantity (Ton)	**Number of Samples**
Lot $ 2500	5
1500 < Lot < 2500	4
Lot # 1500	3

B. The Department samples for acceptance either at the source of supply or at the project stockpile. If material previously accepted at the supply source is suspect when delivered to the project, the Department retests following Section 01455.

Table 4

Cover Material (Type A, B, and C) Acceptance Schedule For Gradation (Percent passing)				
Sieve Gradation Size	Pay Factor*	Acceptance Band Type A	Acceptance Band Type B	Acceptance Band Type C
	Cover Material	Average of Tests	Average of Tests	Average of Tests
1/2 inch	1.00 0.95 0.90 0.85 Reject	100.0 99.0 98.0 97.0 < 96.9		100.0 99.0 98.0 97.0 <96.9
3/8 inch	1.00 0.95 0.90 0.85 Reject	85.0 - 100 84.0 - 84.9 83.0 - 83.9 82.0 - 82.9 < 81.9		70.0 - 90.0 69.5 - 91.5 69.2 - 92.0 68.0 - 92.0 <67.9 and >92.1
No. 4	1.00 0.95 0.90 0.85 Reject	0 - 20 20.1 - 21 21.1 - 22 22.1 - 23 > 23.1	100.0 99.0 98.0 97.0 < 96.9	0 - 5.0 5.1 - 5.5 5.6 - 6.0 6.1 - 7.0 > 7.1
No. 8	1.00 0.95 0.90 0.85 Reject	0 - 5 5.1 - 5.5 5.6 - 6.0 6.1 - 7.0 > 7.1	85.0 - 100 84.0 - 84.9 83.0 - 83.9 82.0 - 82.9 < 81.9	0.0 - 3.0 3.1 - 3.5 3.6 - 4.0 4.1 - 5.0 > 5.1
No. 16	1.00 0.95 0.90 0.85 Reject		10.0 - 25.0 9.5 - 25.5 9.0 - 26.0 8.5 - 26.5 < 8.4 and > 26.6	
No. 50	1.00 0.95 0.90 0.85 Reject		0.0 - 5.0 5.1 - 5.5 5.6 - 6.0 6.1 - 7.0 > 7.1	
No. 200	1.00 0.75 0.50 Reject	0.0 - 1.0 1.1 - 1.5 1.6 - 2.0 >2.1	0.0 - 2.0 2.1 - 2.5 2.6 - 3.0 > 3.1	0.0 - 1.0 1.1 - 1.5 1.6 - 2.0 >2.1

* use the lowest individual pay factor for combined gradation

PART 3 EXECUTION

3.1 PREPARATION

A. Clean the surface of all dirt, sand, dust, and other objectionable material to the satisfaction of the Engineer.

B. Protect all structures from being spattered or marred including guardrail, guide posts, concrete barriers, parapet walls, etc.

3.2 LIMITATIONS

A. Complete all work, excluding bituminous flush coat, between May 15 and August 31.

B. Do not place any chip seal coat if the Engineer determines that excess moisture is present in the pavement structure.

C. Place seal coat when:
   1. Pavement temperature is between 70 degrees F and 136 degrees F.
   2. Air temperature is 70 degrees F and rising in the shade.

D. Apply bituminous flush coat material no later than seven days after the application of the cover material, or as directed by the Engineer.

E. Apply bituminous flush coat material when the air temperature in the shade is 50 degrees F and rising.

F. Do not apply bituminous flush coat material during fog, rain, or other adverse conditions.

G. Complete all chip seal operations, including sweeping during daylight hours.

3.3 COVER MATERIAL STOCKPILE

A. Construct on a clean area to minimize contamination.

B. Construct to facilitate uniform dampening. Avoid excess moisture.

3.4 TEMPORARY PAVEMENT MARKER APPLICATION

A. Refer to Section 01558.

3.5 ASPHALT MATERIAL /COVER MATERIAL APPLICATION

A. Use a distributor equipped with a hydrostatic system capable of maintaining a tolerance of " 0.03 gal/yd^2.
   1. Spray the application at a rate sufficient to obtain 60 to 70 percent chip embedment after the completion of rolling operations as determined by the Engineer.
   2. Application rates may vary throughout the project depending on existing conditions.
   3. Equipment is subject to inspection and approval by the Engineer.

B. Apply the asphalt emulsion at a minimum temperature of 145 degrees F.

C. Provide blotter material meeting the requirements of Section 02748 and application equipment approved by the Engineer at the Project location prior to beginning seal coat work.

D. Place building paper adjacent to the transverse construction joint prior to starting each spraying operation. Maintain the control valve to act instantaneously, both in start-up and cut-off.

E. Locate longitudinal joints within 6 inches of the traffic lane line location or within 12 inches of the center of a traffic lane. Construct the meet lines with no skips or voids between adjacent passes. Avoid a double thickness of cover material.

F. Spread the cover material maintaining a tolerance of " 1.0 lb/yd^2.
   1. Equipment is subject to inspection and approval by the Engineer.

G. Calibrate the spreader at the beginning of each day and as often as required.

Approximate Spread Rates

Unit Weight lbs/ft^3	Application Rate lbs/yd^2
60 – 65	17.0
65 – 70	18.4
70 –75	19.8
75 – 80	20.7
80 – 85	22.1
85 – 90	23.5
90 – 95	24.9
95 - 100	25.8

3.6 SURFACE ROLLING

A. Use a minimum of two pneumatic-tire rollers in a longitudinal direction to roll surface after the cover material has been spread.

B. Use a minimum of three passes to seat the cover material.
   1. A pass is defined as traveling in one direction only. Two passes is rolling forward and back.

C. Control bleeding with blotter material and as directed by the Engineer.

D. Set the roller speed to prevent bouncing or skidding. Reduce roller speeds during directional changes to prevent tearing of the surface. Repair all damage done to the seal coat by the rollers.

E. Synchronize the speed of the distributor and chip spreader with that of the rolling operation.

F. Sweep excess cover material off the roadway after the emulsion has set. Remove excess cover material to the satisfaction of the Engineer before opening the roadway to traffic.

3.7 BITUMINOUS FLUSH COAT APPLICATION

A. Clean the surface of all dirt, sand, dust, lose chips, and other objectionable material to the satisfaction of the Engineer.

B. Apply the bituminous flush coat at a rate of 0.11 gal/yd^2. Keep traffic off the flushed surface until the bituminous material has set sufficiently to prevent tracking or pick-up.

C. Provide vendor's bill of lading certifying the material was diluted in accordance with this Section, article 2.5, Flush Coat, paragraph A. The Department may sample and test this material for specification compliance.

3.8 TRAFFIC CONTROL

A. Refer to Section 01554.

END OF SECTION

SECTION 02786

OPEN-GRADED SURFACE COURSE (OGSC)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing OGSC.

1.2 RELATED SECTIONS

A. Section 01452: Profilograph and Pavement Smoothness

B. Section 02741: Hot Mix Asphalt (HMA)

C. Section 02745: Asphalt Material

D. Section 02746: Hydrated Lime

E. Section 02748: Prime Coat/Tack Coat

1.3 REFERENCES

A. AASHTO T 11: Materials Finer Than 75Fm (No. 200) Sieve in Mineral Aggregates by Washing

B. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates

C. AASHTO T 30: Mechanical Analysis of Extracted Aggregate

D. AASHTO T 89: Determining the Liquid Limit of Soils

E. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils

F. AASHTO T 96: Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine

G. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

H. AASHTO T 112: Clay Lumps and Friable Particle in Aggregate

I. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test

J. AASHTO T 278: Surface Frictional Properties Using the British Pendulum Tester

K. AASHTO T 279: Accelerated Polishing of Aggregates Using the British Wheel

L. AASHTO T 304: Uncompacted Void Content of Fine Aggregate

M. AASHTO T 308: Determining the Asphalt Binder Content of Hot-Mix Asphalt (HMA) by the Ignition Method

N. ASTM D 979: Sampling Bituminous Paving Mixtures

O. ASTM D 3042: Standard Test for Insoluble Residue in Carbonate Aggregate

P. ASTM D 3665: Random Sampling of Construction Materials

Q. ASTM D 4791: Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

R. ASTM D 5821: Determining the Percentage of Fractured Particles in Coarse Aggregate

S. UDOT Quality Management Plan

T. UDOT Materials Manual of Instruction

U. UDOT Minimum Sample and Testing Guide

1.4 ACCEPTANCE

A. A lot equals the number of tons placed during each production day. When daily production rates are anticipated at less than 900 tons per production day, lots may be increased to equal the number of tons placed during up to three production days as agreed upon in advance by both the Contractor and the Engineer.

B. Submit an engineering analysis within one week, if requesting a rejected lot remain in place.
   1. Include in the analysis: Data and engineering principles that indicate why the pavement should remain in place.
   2. The Engineer, Region Materials Engineer, and Region Construction Engineer review the analysis for acceptance, denial, or revision within three working days.
   3. If the request is denied, remove the rejected material from the project within 72 hours and replace it with an acceptable material.
   4. If rotomilling is required, agree on removal time period.
   5. Department deducts $15.00 per ton if a rejected lot is allowed to remain in place.

C. Binder Content and Gradation
   1. Engineer takes four random samples per lot at the plant according to UDOT Materials Manual of Instruction Part 8 - 894. ASTM D 979, ASTM D 3665.
   2. If only three samples can be taken on the production day for reasons beyond the Contractor's control; compute incentive/disincentive from the three random samples rather than four.
   3. Add the lot to the next day's production if four random samples cannot be taken. Evaluate pay adjustment with the appropriate sample size.
   4. Add the lot to the previous day's production for the last day's production if four random samples cannot be taken. Evaluate with the appropriate sample size.
   5. Obtain the binder content from the ignition oven test. AASHTO T 308.
   6. Compute Incentive/Disincentive for binder content per lot based on Table 1 using the single test result with the largest deviation from the target.

Table 1

Binder Content	**Pay Adjustment in $/ton OGSC**
Within ± 0.30% of target	+1.00
Between ± 0.31% and ± 0.45% of target	0.00
Between ± 0.46% ± 0.60% of target	-2.00
Greater than ± 0.61%	Reject

   7. Engineer conducts aggregate gradations tests per lot on the residue of the ignition oven test. AASHTO T 30.
   8. Incentive/Disincentive for gradation is based on Percent Within Limits computation using Table 2, 3, 4, and 5.

9. The Department will reject the lot if the Percent Within Limits is less than 60 percent.

Table 2	
Gradation Upper and Lower Limit Determination	
Parameter	UL and LL
3/8" sieve	Target Value ± 6.0 percent
# 4 sieve	Target Value ± 6.0 percent
# 8 sieve	Target Value ± 5.0 percent
# 200 sieve	Target Value ± 2.0 percent

Table 3 **Incentive/Disincentive for Gradation**	
Gradation	
PT **Based on Min. Four Samples**	**Incentive/Disincentive** **(Dollars/Ton)**
> 99	0.83
96-99	0.67
92-95	0.37
88-91	0.06
84-87	-0.24
80-83	-0.54
76-79	-0.84
72-75	-1.15
68-71	-1.45
64-67	-1.75
60-63	-2.06
<60	Reject

Table 4 Quality Index Values for Estimating Percent Within Limits										
PU/PL	**n=3**	**n=4**	**n=5**	**n=6**	**n=7**	**n=8**	**n=10**	**n=12**	**n=15**	**n=20**
100	1.16	1.50	1.75	1.91	2.06	2.15	2.29	2.35	2.47	2.56
99	1.16	1.47	1.68	1.79	1.89	1.95	2.04	2.09	2.14	2.19
98	1.15	1.44	1.61	1.70	1.77	1.80	1.86	1.89	1.93	1.97
97	1.15	1.41	1.55	1.62	1.67	1.69	1.74	1.77	1.80	1.82
96	1.15	1.38	1.49	1.55	1.59	1.61	1.64	1.66	1.69	1.70
95	1.14	1.35	1.45	1.49	1.52	1.54	1.56	1.57	1.59	1.61
94	1.13	1.32	1.40	1.44	1.46	1.47	1.49	1.50	1.51	1.53
93	1.12	1.29	1.36	1.38	1.40	1.41	1.43	1.43	1.44	1.46
92	1.11	1.26	1.31	1.33	1.35	1.36	1.37	1.37	1.38	1.39
91	1.10	1.23	1.27	1.29	1.30	1.31	1.32	1.32	1.32	1.33
90	1.09	1.20	1.23	1.24	1.25	1.25	1.26	1.26	1.27	1.27
89	1.08	1.17	1.20	1.21	1.21	1.21	1.21	1.21	1.22	1.22
88	1.07	1.14	1.16	1.17	1.17	1.17	1.17	1.17	1.17	1.17
87	1.06	1.11	1.12.	1.12	1.12	1.13	1.13	1.13	1.13	1.13
86	1.05	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
85	1.03	1.05	1.05	1.05	1.05	1.04	1.04	1.04	1.04	1.04
84	1.02	1.02	1.02	1.01	1.01	1.01	1.00	1.00	1.00	1.00
83	1.00	0.99	0.98	0.97	0.97	0.96	0.96	0.96	0.96	0.96
82	0.98	0.96	0.95	0.94	0.94	0.93	0.93	0.92	0.92	0.92
81	0.96	0.93	0.92	0.91	0.90	0.90	0.89	0.89	0.89	0.88
80	0.94	0.90	0.88	0.87	0.86	0.86	0.85	0.85	0.85	0.85
79	0.92	0.87	0.85	0.84	0.83	0.83	0.82	0.82	0.82	0.81
78	0.89	0.84	0.82	0.81	0.80	0.79	0.79	0.78	0.78	0.78
77	0.87	0.81	0.79	.0.78	0.77	0.76	0.76	0.75	0.75	0.75
76	0.84	0.78	0.76	0.75	0.74	0.73	0.72	0.72	0.72	0.72
75	0.82	0.75	0.73	0.72	0.71	0.70	0.69	0.69	0.69	0.68
74	0.79	0.72	0.70	0.68	0.67	0.67	0.66	0.66	0.66	0.65
73	0.77	0.69	0.67	0.65	0.64	0.64	0.62	0.62	0.62	0.62
72	0.74	0.66	0.64	0.62	0.61	0.61	0.60	0.59	0.59	0.59
71	0.71	0.63	0.60	0.59	0.58	0.58	0.57	0.56	0.56	0.56
70	0.68	0.60	0.58	0.56	0.55	0.55	0.54	0.54	0.54	0.53
69	0.65	0.57	0.55	0.54	0.53	0.52	0.51	0.51	0.51	0.50
68	0.62	0.54	0.52	0.51	0.50	0.50	0.48	0.48	0.48	0.48
67	0.59	0.51	0.49	0.48	0.47	0.47	0.46	0.45	0.45	0.45
66	0.56	0.48	0.46	0.45	0.44	0.44	0.43	0.42	0.42	0.42
65	0.53	0.45	0.43	0.42	0.41	0.41	0.40	0.40	0.40	0.39
64	0.49	0.42	0.40	0.39	0.38	0.38	0.37	0.37	0.37	0.37
63	0.46	0.39	0.37	0.36	0.35	0.35	0.35	0.34	0.34	0.34
62	0.43	0.36	0.34	0.33	0.33	0.33	0.32	0.31	0.31	0.31
61	0.39	0.33	0.31	0.30	0.30	0.30	0.29	0.29	0.29	0.28
60	0.36	0.30	0.28	0.27	0.26	0.26	0.25	0.25	0.25	0.25
<60	#0.35	#0.29	#0.27	#0.26	#0.25	#0.25	#0.24	#0.24	#0.24	#0.24

Enter table in the appropriate sample size column and round down to the nearest value.

Table 5 Definitions, Abbreviations, and Formulas for Acceptance	
Term	**Explanation**
Target Value (TV)	The target values for gradation, asphalt binder content and VMA are given in the Contractor's volumetric mix design. See article 1.4, line E, for density target values.
Average (AVE)	The sum of the lot's test results for a measured characteristic divided by the number of test results; the arithmetic mean.
Standard Deviation (s)	The square root of the value formed by summing the squared difference between the individual test results of a measured characteristic and AVE, divided by the number of test results minus one. This statement does not limit the methods of calculations of s; other methods that obtain the same value may be used.
Upper Limit (UL)	The value above the TV of each measured characteristic that defines the upper limit of acceptable production. (Table 3)
Lower Limit (LL)	The value below the TV of each measured characteristic that defines the lower limit of acceptable production (Table 3)
Upper Quality Index (QU)	QU = (UL - AVE)/s
Lower Quality Index (QL)	QL = (AVE - LL)/s
Percentage of Lot Within UL (PU)	Determined by entering Table 4 with QU.
Percentage of Lot Within LL (PL)	Determined by entering Table 4 with QL.
Total Percentage of Lot (PL) Within UL and LL (PT)	PT = (PU + PL) - 100
Incentive/Disincentive	Determined by entering Table 1 and 2 with PT or PL.

All values for AVE, s, QU, and QL will be calculated to two decimal place accuracy which will be carried through all further calculations. Rounding to lower accuracy is not allowed.

10. Any lot rejected based on either gradation or binder content will not be eligible for any incentive.

D. Thickness

1. Verify the thickness with a depth probe and take corrective action if necessary.
   a. Minimum thickness: Plan depth minus 1/4 inch.

E. Smoothness

1. Determine acceptance and correct in accordance with Section 01452.

PART 2 PRODUCTS

2.1 ASPHALT MATERIAL

A. As specified, and following Section 02745.

B. Sampling procedure: UDOT Quality Management Plan - 509 Asphalt Binder.

2.2 HYDRATED LIME

A. Meet the requirements of Section 02746.

2.3 AGGREGATE MATERIALS

A. Refer to the UDOT Minimum Sample and Testing Requirements, Section 1, Tabulation of Acceptance Sampling and Testing.

B. Crusher processed virgin aggregate material consisting of crushed stone, gravel, or slag.

C. Meet the following requirements, including Table 3, to determine the acceptability of the aggregate.

1. Coarse aggregate:
   a. Retained on # 4 sieve.

2. Fine aggregate:
   a. Clean, hard grained, and angular.
   b. Passing the # 4 sieve.

Table 6		
Aggregate Properties		
Properties	**Test Method**	**Test Requirement**
One Fractured Face	ASTM D 5821	95 percent min.
Two Fractured Face	ASTM D 5821	90 percent min.
Fine Aggregate Angularity	AASHTO T 304	45 min.
Flat and Elongated (1 to 3 ratio)	ASTM D 4791 (Based on 3/8 inch and above)	10 % max.
L.A. Wear	AASHTO T 96	30 % max.
Sand Equivalent	AASHTO T 176	60 min.
Plasticity Index	AASHTO T 89 and T 90	0
Polish Test	AASHTO T 278 & T 279	31 min.
Soundnes\s (sodium sulfate)	AASHTO T 104	12 % max. loss with five cycles
Clay Lumps and Friable Particles	AASHTO T 112	2 % max.
Standard Test Method for Insoluble Residue in Carbonate Aggregates	ASTM D 3042	30 % max.
Natural Fines	None	None

D. Meet the following gradation:

Table 7	
Aggregate Gradation (Percent Passing by Dry Weight of Aggregate - AASHTO T11, T27)	
Sieve Size	**Percent**
½ inch	100
3/8 inch	90 - 100
# 4	35 - 45
# 8	14 - 20
# 200	2 - 4

2.4 JOB-MIX

A. Obtain approval for job mix gradation:
   1. Submit at least 10 working days before paving.
   2. Show definite single values for the percentage of aggregate passing each sieve based on the dry weight of aggregate.
   3. Stay within the single value gradation limits of Table 4.
   4. Add Hydrated Lime:
      a. Method A, Lime Slurry; or Method B, Lime Slurry Marination.
      b. Refer to Section 02746.
      c. Incorporate minimum hydrated lime by dry weight of aggregate into all mixtures. (1 percent for Method A; 1- 1/2 percent for Method B).

B. Binder Content
   1. The Engineer determines the binder content and supplies samples to determine the correction factor.

C. Changes in job mix gradation:
   1. Submit a written request for a change in a job-mix gradation.
   2. Give the Engineer 5 working days to review and approve the changes and to readjust the quantity of asphalt binder to be used.

PART 3 EXECUTION

3.1 MIXING

A. Mix as specified in Section 02741. The mineral aggregate coating will be considered satisfactory when all particles are coated.

3.2 SURFACE PLACEMENT

A. Apply the tack coat at a uniform rate of 0.10 gal/yd^2 undiluted emulsion or 0.15 gal/yd^2 2:1 diluted emulsion. Note: 2:1 diluted emulsion represents 2 parts undiluted emulsion and 1 part water. Refer to Section 02748.

B. Maintain a steady paver speed

C. Roll sufficiently to seat without fracturing aggregate.

D. Bring all passes up even transversely at the end of each working day.

E. Construct longitudinal joints within 6 inches of lane lines.

F. Remove slick spots as directed by the Engineer.

3.3 LIMITATIONS

A. Place between May 1 and September 15 and only when both the air temperature in the shade and the pavement surface temperature are above 60 degrees F and rising.

B. Obtain written approval from the Engineer before placing OGSC after September 15.

C. Do not place when it is determined by the Engineer that excessive moisture may be present in the pavement structure.

D. Do not place during rain, when the surface is wet, or during other adverse weather conditions.

END OF SECTION

SECTION 02812

PRESSURIZED IRRIGATION SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aboveground, underground, and drip irrigation systems complete with heads, valves, controls, and accessories.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

1.3 REFERENCES

A. ASTM B 88: Copper Pipe

B. ASTM B 687: Brass, Copper, and Chromium-Plated Pipe Nipples

C. ASTM D 1784: Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated poly (Vinyl Chloride) (CPVC) Compounds

D. ASTM D 1785: Poly (Vinyl Chloride) PVC Plastic Pipe, Schedules 40, 80, and 120

E. ASTM D 2464: Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings; Schedule 80

F. ASTM D 2466: Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings; Schedule 40

G. ASTM D 2672: Joints for IPS PVC Pipe Using Solvent Cement

H. ASTM F 656: Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

I. ASSE 1013, 1015: Backflow Preventers, Pressure Reducers

1.4 PERFORMANCE REQUIREMENTS

A. Location of sprinkler heads: Design location is approximate.
   1. Adjust as necessary to avoid existing plants and other obstructions.
   2. At no time should the number of heads or valves for example be less than that indicated on the plans.

B. Water Coverage:
   1. Head to head coverage in turf and other planting areas (100 percent).
   2. Do not increase or decrease number of heads or size of pipe indicated unless approved by Engineer.

C. PVC Pipe: Must be stamped with certified NFS.

D. If work is to continue after November 1, or resume before April 15, drain the system at the end of each work day. Do not permit water to remain in pipe overnight.

E. Verify and have marked the location of all utilities and underground obstructions.

1.5 DEFINITIONS

A. Mainline: The system of pipes that carry water from the Point of Connection (POC) to the valves.

B. Lateral Lines: The system of pipes that carry water from the valves to the sprinkler heads and/or emitters.

1.6 SUBMITTALS

A. Product Data: Manufacturer's technical data and installation instructions.

B. Certificates of compliance to Engineer prior to installation.

C. As-Built Drawings: Red-lined plan layout and details illustrating mainline and lateral lines location, size, and assembly. Include type and coverage of heads, type of valves, controllers, fittings and accessories.

D. Operating and Maintenance Data:
   1. Instructions covering full operation, care, and maintenance of system (and controls) and manufacturers parts catalog. Include drain procedures, blow out features for example.

2. Instruct maintenance personnel in proper adjustment of sprinkler heads and use of special tools for adjustments.

E. Keys:
1. Gate Valve Key.
2. Stop and Waste Valve Key: "T" handle, rigid steel, 5 ft long minimum, key end to fit the stop and waste valve nut.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

A. Mainline: Solvent welded schedule 40 PVC through 1-1/2 inch, then Class 200 PVC. ASTM D 1784 and ASTM D 1785.

B. Lateral line: Solvent welded schedule 40 PVC through 1-1/2 inch, then Class 200 PVC. Meet ASTM D 1784 and ASTM D 1785.

C. Pipe Fittings: Solvent welded schedule 40 PVC. Meet ASTM D 2466.

D. Valve Fittings: Solvent welded schedule 40 PVC. Meet ASTM D 2464.

E. Risers: Threaded schedule 80 PVC. Meet ASTM D 2464.

F. Copper Pipe: Type K as specified in ASTM B 88.

G. Copper Fittings: Wrought or cast as specified in ASTM B 687.

2.2 VALVES

A. Automatic Control Valve:
1. Body made of high-strength, non-corrosive PVC material.
2. Pressure regulating (set at 50,750 psi).
3. Slow and smooth opening and closing with a manual flow control and internal bleed screw.
4. Highly efficient, totally encapsulated 24 VAC solenoid.
5. High-strength rubber or synthetic rubber diaphragm.

B. Gate Valve: Threaded brass construction, 200 psi rated (minimum) and sized according to main line.

C. Manual Drain Valve: 3/4 inch bronze body, angle valve with replaceable seat disc and brass cross handle.

2.3 BACKFLOW PREVENTER

A. Body and caps constructed of bronze with wear and corrosion resistant internal parts complete with bronze quarter turn ball valves.

B. Reduced Pressure Principle Device (RP) as specified in ASSE 1013.

C. Double Check Valve (DCV) as specified in ASSE 1015.

D. Capable of being tested and serviced without removal of device from the line.

2.4 AUTOMATIC CONTROLLER

A. General: A commercial grade controller manufactured expressly for control of automatic valves and underground irrigation systems and equipped with the following minimum features.
   1. Twelve hour duration for any or all stations.
   2. Four programs, with eight start times each.
   3. Two master valve terminals, one programmable by station.
   4. Three hundred sixty-five day calendar with leap year intelligence.
   5. Event day off option.
   6. Programmable rain delay.
   7. Water budget by program with adjustments from 0 to 300 percent in one percent increments.
   8. Capable of having total run time split into usable cycles.
   9. Manual or automatic operation.
   10. Non-volatile.
   11. Battery backup.
   12. Heavy-duty electrical surge protection.
   13. UL listed; CSA, CE approved

B. Transformer: Capable of converting service voltage to control voltage in accordance with manufacturer's recommendations.

2.5 PEDESTAL

A. Free-standing unit with a weather resistant coating typically specified for the controller. Hardware included.

2.6 SPRINKLER HEADS

A. Fixed Riser
   1. Half inch x 24 inch schedule 80 riser Male Pipe Threads (MPT).
   2. Half inch shrub head adaptor Female Pipe Threads (FPT) x MPT.
   3. Half inch FPT barbed swing pipe adapter.

B. Pop-up Spray Head
   1. Made of plastic and stainless steel materials.
   2. Pop-up risers of 4 inch, 6 inch, and 12 inch.
   3. Stainless steel retraction spring.
   4. Ratcheting mechanism.
   5. Side and bottom inlets on 6 inch and 12 inch heads.

C. Rotary Head
   1. High-impact plastic construction with stainless steel ratcheting riser.
   2. Four-inch minimum pop-up with water-lubricated gear driven design.
   3. Integral rubber cover.
   4. Heavy-duty, stainless steel retraction spring.
   5. Built-in check valve.

D. Pop-up Impact Head
   1. High-impact plastic construction with plastic clapper.
   2. Four-inch pop-up design with internal wiper seals.
   3. Heavy-duty, stainless steel retraction spring.
   4. Built in check valve required when used with more than 3 feet of elevation change on the lateral line.
   5. Plastic Sprinkler Nozzles
      a. Interchangeable.
      b. Matched precipitation.
   6. Three quarter inch side or bottom inlet.

E. Above-ground Impact
   1. Brass construction with stainless steel clapper.
   2. Mounted above ground with no pop-up features.
   3. Four-inch riser mounted impact.
   4. Three quarter inch MPT inlet.
   5. Brass Sprinkler Nozzles.
      a. Interchangeable.
      b. Matched precipitation.

2.7 PLASTIC NOZZLES

A. Fixed Spray
   1. Radius patterns and gal/min as shown on plans.
   2. Matched precipitation rates.
   3. Stainless steel adjustment screw.
   4. FPT to match 1/2 inch shrub head adapter.
   5. Pressure regulating: (Required when the psi at the sprinkler does not fall within the range recommended for its use.) See manufacturer's specifications.
   6. Filter screen.

B. Bubbler
   1. Made of high-impact plastic.
   2. Pressure compensating with adjustable flow and radius as shown on plans.
   3. Half inch FPT.
   4. Attach to fixed riser or pop-up spray.
   5. Filter screen.

2.8 DRIP TUBING

A. Self cleaning, pressure compensating, polyethylene dripperline.

B. Dripper discharge: 0.6 gal/hr to 0.9 gal/hr and choice of 12 inch, 18 inch, or 24 inch spacing.

C. Pressure compensation range from 8 psi to 60 psi.

D. 0.63 inch ("0.01 inch) outside diameter; 0.54 inch ("0.01 inch) inside diameter.

2.9 LINE FLUSHING VALVE

A. Made of high impact plastic.

B. Maximum flow rate per flush valve: 15 gal/min.

C. Automatic cleaning operation.

D. Can be disassembled allowing for winterization blow-out.

E. Half inch MPT threads.

2.10 AIR/VACUUM RELIEF VALVE

A. Brass body and cap and rated to 200 psi.

B. Temperature resistant silicone disc seat.

2.11 DISK FILTER

A. Corrosion resistant thermoplastic design.

B. Multiple disk filter design: 120 mesh.

C. One inch MPT threads.

D. Shut-off valve.

E. Constructed of durable, non-corrosive components and equipped with O-ring seals.

2.12 "Y" FILTER

A. One inch threaded inlet and outlet.

B. One hundred mesh polyester filter screen.

C. Constructed of durable, non-corrosive components and equipped with an O-ring seal.

D. Operating flow range of 1 gal/min to 15 gal/min with a pressure range of 10 psi to 150 psi.

E. Easy removable cap and screen.

2.13 SWING PIPE

A. Flexible Polyethylene Pipe: Maximum flow 6.0 gal/min. Inside diameter of 1/2 inch ("0.01 inch) with a wall thickness of 3/32 inch ("0.01 inch) and 80 psi rated.

B. Flexible Polyethylene Pipe: For flows exceeding 6 gal/min. Inside diameter of 15/16 inch ("0.01 inch) with a wall thickness of 3/32 inch ("0.01 inch) and 80 psi rated.

C. Half inch Barbed Male Elbow: Plastic

D. Three quarter inch Barbed Male Elbow: Plastic

E. One inch Barbed Male Elbow: Plastic

2.14 VALVE BOX

A. Precast concrete or plastic with adequate hand room to operate small tools and provisions for locking cover to frame.

2.15 WIRE

A. Provide wire for connecting remote control valves to the automatic controllers that is Type "UF", 600 V, stranded or solid copper, single conductor wire with PVC insulation and bearing UL approval for direct underground burial feeder cable.
   1. Make all connections with UL approved type seal to make a waterproof connection.
   2. Where possible, bury wires in the same trench as the pipe.

B. Provide wire with 0.060 inches insulation, minimum covering of ICC-100 compound for positive weatherproofing protection.
   1. For wire sizes 14, 12, 10, and 8 use a single conductor solid copper wire, and for sizes 6 and 4 use stranded copper wire.
   2. Make control or "hot" wires red and all common or "ground" wires white.

2.16 QUICK COUPLER

A. Constructed of heavy duty brass with a 3/4 inch one-piece body design.

B. Operating flow range of 10 gal/min to 50 gal/min with a pressure range of 5,000 psi to 101,500 psi.

C. Three quarter inch brass valve key.

D. Three quarter inch brass swivel hose ell.

E. Stainless steel spring.

2.17 WASHED AGGREGATE

A. 1-1/2 inch maximum with 100 percent retained on a No. 4 sieve.

2.18 JOINT PRIMER AND SOLVENT CEMENT

A. As specified in references. ASTM F 656, and ASTM D 2672.

2.19 ACCESS SLEEVE

A. Two inch, Schedule 40 PVC with a yellow rubber cap.

2.20 TEFLON TAPE

A. For use on threaded joints. Quality grade, 0.004 inch (" 0.001) and domestically made.

2.21 CLASS B CONCRETE

A. Refer to Section 03055.

PART 3 EXECUTION

3.1 EXCAVATION

A. Stake pipe and sprinkler locations for approval.

B. Excavate trenches for sprinkler system pipe to provide 18 inches of cover over main lines and 9 inches over lateral lines.
   1. Where trenching is required in proximity to trees that are to remain, do not damage roots.

C. Barricade trenches within the clear zone and along pedestrian routes that are left open overnight.

3.2 INSTALLATION

A. General: Plans are diagrammatic. Proceed with installation in accordance with the following:
   1. Install stop and waste valves, backflow preventors and other equipment required by local authorities according to Utah Laws and Regulations to make system complete.
   2. Install main line, automatic control valves, lateral lines, fittings, and heads/drip line as specified.
   3. Thoroughly flush main lines before installing automatic control valves, and laterals before installing sprinklers. Flush supply lines thoroughly before installing backflow preventers or other regulating devices.
   4. After completion of grading, seeding or sodding, and rolling of grass areas, adjust heads to be plumb and flush with finished grades (flush is even with top of soil level or top of material level).

B. Piping: Assemble all mainline and lateral lines in accordance with manufacturer's recommendations with no cul-de-sacs.
   1. At wall penetrations, pack the opening around the pipe with non-shrink grout. At exterior face, fill perimeter slot with backer rod and sealant. Repair below grade waterproofing and make penetration watertight.
   2. Install PVC pipe in dry weather above 40 degrees F as specified by manufacturer’s recommendations. Allow joints to cure a minimum of 8 hours before testing.

C. Sleeving: Coordinate sleeving installation before placing pavement.

D. Control Valves:
   1. Install at plan locations and according to detail. Use Schedule 80 PVC pipe for nipples on valve header, length as necessary. Install valves two maximum per each standard, plastic valve box and provide 12 inches of expansion loop slack wire at all connections inside valve box.

E. Manual Drains: Install at locations indicated on plans and according to detail.

F. Quick-Coupling Valves: Install using 3/4 inch Schedule 80 PVC nipples for risers and elbows. Locations as indicated on plans.

G. Backflow Preventers:
   1. Install assembly using the detail.
   2. In below grade installations, provide washed aggregate drain sump.

H. Valve Access Boxes:
1. Install over all automatic control valves, manual control valves, or zone shutoff valves and sized to provide adequate room for maintenance.
2. Install valve boxes flush with finish grade and place parallel or perpendicular to adjacent curbs, sidewalks, or driveways.
3. Imprint a valve control number on each valve box cover that corresponds to the valve controller (clock). Print the valve box number one inch high (minimum) in a permanent and legible manner.
4. Place washed aggregate in sump as shown on plans.

I. Automatic Controller:
1. Stake or mark controller location for approval.
2. Mount the panel enclosure so the operator can conveniently make adjustments.
3. Properly ground controller in accordance with Utah Laws and Regulations. Make all control wire connections to automatic controllers. Coordinate controller installation with electrical work.
4. If pedestal controller is used, pour the concrete pedestal base with inserted conduits and bolts.
5. Provide a laminated copy of the irrigation plan indicating valve station numbers and field locations and attach it inside the controller.
6. Program the controller to provide the appropriate amount of water for each station.
7. Supply the Engineer with manufacturer's warranties and operating instructions for the controller.

J. Wire and Electrical Work:
1. Use electrical control and ground wire suitable for sprinkler control cable of size indicated on plans.
2. Tape control wires to underside of pipe at 15 ft intervals.

K. Spray Heads, Fixed Risers and Bubblers:
1. Install as per plans.
2. Adjust sprinkler nozzles to allow for adequate coverage and minimize overspray onto walks, roads, driveways, and buildings.

3.3 TESTING

A. Notify the Engineer 24 hours in advance of pressure testing the main line.

B. Before backfilling and after air pockets have been vented from the lines, subject all supply and pressure irrigation lines to a hydrostatic pressure test by maintaining full supply line water pressure for three consecutive hours.

C. Test connections for leaks prior to backfilling and repair all leaks. Lateral lines may be tested in sections to expedite backfilling work.

3.4 BACKFILLING OPERATION

A. Bed all pipe 2 inch (minimum) surrounding the pipe with native material excavated from the trench and passing through a 1/2 inch sieve.

B. Prevent soil, rocks, or debris from entering pipes or sleeves.

C. Compact backfilled trenches thoroughly to prevent settling damage to grades or plant materials. Repair irrigation system and plants at no additional cost to Department.

3.5 IRRIGATION INSTALLATION INSPECTION

A. Notify the Engineer to schedule the inspection with the Region Landscape Architect after the irrigation system is completely installed and fully functional.

B. Make the required field adjustments and changes after the inspection.

END OF SECTION

SECTION 02821

CHAIN LINK FENCING AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing chain link fencing and gates.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 181: Chain Link Fence

C. AASHTO M 232: Zinc Coating (Hot Dip) on Iron and Steel Hardware

D. AASHTO M 280: Zinc-Coated (Galvanized) Steel Barbed Wire

E. AASHTO M 305: Aluminum Coated Steel Barbed Wire

F. ASTM A 392: Zinc-Coated Steel Chain-Link Fence Fabric

G. ASTM A 491: Aluminum-Coated Steel Chain-Link Fence Fabric

H. ASTM F 1083: Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

PART 2 PRODUCTS

2.1 GENERAL

A. Class B Concrete. Refer to Section 03055.

2.2 POSTS, CAPS, RAILS, COUPLINGS

A. Pipe posts and rails:
   1. Schedule 40, hot-dip galvanized coated pipe. ASTM F 1083.

B. Fitting: malleable cast iron or pressed steel coated as specified. AASHTO M 232.

C. Caps: AASHTO M 232
   1. Equip all pipe posts with a galvanized steel or malleable iron weather-resistant cap, designed to fit securely over the posts and carry an apron around the outside of the post.
   2. Where top rail is used, provide cap to permit passage of top rail.

2.3 CHAIN LINK FABRIC

A. Provide either Type I zinc-coated steel or Type II aluminum-coated steel fence fabric as specified. Refer to AASHTO M 181, ASTM A 392, and ASTM A 491.

B. Use 0.148 inch diameter wire for fence fabric 6 ft or higher and 0.120 inch diameter wire for fabric less than 6 ft high.

C. Provide 0.177 inch diameter spiral material for tension wires.

D. Tie fabric to supporting members of the same diameter as the fence fabric.

2.4 BARBED WIRE

A. Provide zinc-coated barbed wire when zinc-coated fence is used. Refer to AASHTO M 280.

B. Use 0.099 inch diameter barbed wire with 0.080 inch diameter 4-point barbs on 5 inch centers.

C. Provide aluminum-coated barbed wire when aluminum-coated fence is used. Refer to AASHTO M 305.

D. Support arm on the fence for barbed wire must support a 200 lb vertical load at the end of the arm without causing permanent deflection.

2.5 GATES

A. Construct gate posts and frames of the sizes following FG series Standard Drawings.
   1. Fasten gate frame corners together with pressed steel or malleable iron corner ells, riveted or welded as shown.
   2. Galvanize welded steel gate frames after fabrication as specified. AASHTO M 111.
   3. Do not use closed cells that would prohibit dipping to galvanizing tanks.

B. Follow the same standards for chain link fence fabric for covering the gate frames as for other fence fabric.

C. Furnish each gate with the appropriate hinges, latch, and drop-bar locking device.

PART 3 EXECUTION

3.1 INSTALLING POSTS

A. Install following FG series Standard Drawings.

B. Do not exceed the following spacing requirements when placing posts:

Radii of Curve	Maximum Post Spacing
Tangent or 500 ft	10 ft
200 ft to 500 ft	8 ft
100 ft to 200 ft	6 ft
0 ft to 100 ft	5 ft

C. Install brace posts at maximum 500 ft intervals or at angle points of 30 degrees or more.

D. Set posts in concrete walls or masonry where required.
   1. Set posts or post sockets in concrete walls to a minimum 18 in depth.
   2. Use 0.048 inch thick galvanized metal pipe sleeve socket with an inside diameter that allows post to fit loosely.
   3. Coat the inside of the socket and the outside of the posts with bituminous paint.
   4. Use sulfur caulk or other expansive grout to fasten the post in the socket.

E. Set posts in concrete bases.
   1. Place concrete a minimum of 6 inches below each post.

2. Construct at least 12 inch diameter bases for end posts, pull posts, corner posts, gate posts, and line posts.

3.2 INSTALLING FENCE FABRIC

A. Place fence fabric on the roadway side of posts unless otherwise specified.
   1. Place fabric approximately 1 inch above the ground.
   2. Maintain a straight grade between posts by excavating high points of the ground.
   3. Fill depression in the natural ground to within 1 inch of the bottom of fence.

B. Stretch the fabric taut and securely fasten to fence posts.
   1. Use stretch bars and metal bands to fasten material to end, gate, corner, and pull posts.
   2. Space metal bands at 1 ft intervals along the post.
   3. Cut the fabric at all pull and corner posts.
   4. Fasten fabric to line posts with tie wires or metal bands at 14 inch intervals.
   5. Attach the top edge of fabric to the top rail or tension cable with wire ties at approximately 24 inch intervals.
   6. Attach bottom of fabric to bottom tension wire, and the bottom edge of the fabric to the bottom tension wire with wire ties spaced at 24 inch intervals.

3.3 INSTALLING GATES

A. Install single gate or double gate as specified. Install plumb, level, and secure for full opening without interference.

B. Install ground-set items in concrete for anchorage as shown in the Standard Drawing or as recommended by the fence manufacturer. Adjust hardware for smooth operation.

C. Set gate openings according to manufacturer's dimensions.

D. Fabric description numbers:
   1. First number indicates height.
   2. Second number indicates width of fabric opening.

END OF SECTION

SECTION 02822

RIGHT-OF-WAY FENCE AND GATE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing right-of-way fences and gates.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 06055: Timber and Timber Treatment

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 232: Zinc Coating (Hot-Dip) on Iron and Steel Hardware

C. AASHTO M 279: Zinc Coated (Galvanized) Steel Woven Wire Fence Fabric

D. AASHTO M 280: Zinc-Coated (Galvanized) Steel Barbed Wire

E. ASTM A 641: Zinc-Coated (Galvanized) Carbon Steel Wire

F. ASTM A 702: Steel Fence Posts and Assemblies, Hot Wrought

G. National Electric Code (NEC)

PART 2 PRODUCTS

2.1 WIRE MESH FENCING

A. As specified in AASHTO M 279.

B. Grade 60, nominal 0.099 inch farm grade wire mesh fencing with a 6 inch vertical wire spacing.

C. Class I zinc coating.

2.2 BARBED WIRE

A. Galvanized barbed wire as specified. AASHTO M 280.

B. Two strands of nominal 0.099 inch diameter wire twisted with a four-point nominal 0.080 inch barbs no more than 5 inches on center.

2.3 UNTREATED WOOD POSTS FOR LINES, GATES, ENDS AND CORNERS

A. Native juniper or approved equal.

B. Line posts must have a minimum circumference of 10 inches.

C. Gate, brace, and corner posts much have a minimum circumference of 12 inches.

D. All posts must be sound, free of decay or defects, and structurally suitable.

2.4 TREATED WOOD POSTS AND WOOD BRACE RAILS

A. Sound Douglas fir, hemlock, or pine that is free from decay, splits, multiple cracks or any other defect, and structurally suitable.

B. Round or sawed rectangular post and braces.
   1. Round posts must have a minimum circumference of 10 inches.
   2. Gate brace and corner posts much have a minimum circumference of 12 inches.
   3. Rectangular posts must have a minimum normal cross section area of 12 square inches.
   4. Square members may be rough sawn or S4S.
   5. A line drawn between the centers of the butt and tip of each post and brace rail must be inside of the actual longitudinal centerline of the post or rail within 1.67 percent of its length.
   6. Taper (diameter differential) in round members must not exceed 2 inches in 10 ft.
   7. Fabricate posts and brace rails before pressure treatment of the wood members.
   8. Field drill only after all exposed untreated surfaces of members are field treated with two coats of the same material as they were originally treated.
   9. Treat post and brace rail following Section 06055.

10. Keep round posts free of bark, protruding knots, or other irregularities.

2.5 METAL POSTS AND BRACES (BRACE POSTS)

A. As Specified. ASTM A 702.

B. Coat fasteners as specified for Class 1 Coating. ASTM A 641.
   1. Omit anchor plate only if the post is set in a concrete footing with a minimum cross sectional dimension of 4 inches and a depth equal to full penetration of the post.
   2. Galvanized posts may be used in the place of painted posts if the galvanizing is a hot-dipped process that meets requirements as stated in AASHTO M 111.

2.6 TUBULAR-STEEL FRAME GATE WITH WIRE FABRIC

A. 1 inch diameter pipe gate frames as specified.

B. Place pipe braces vertically in each drive gate to provide uniform size panels.
   1. 10 ft and 12 ft gates must have 1 vertical support.
   2. 14 ft and 16 ft gates must have 2 vertical supports.

C. Dimension shown on the plans and in the specifications are the minimum clear openings between gate posts. The supplier must provide a gate with fittings to fill the opening.

D. Use galvanized woven fabric on the mesh wire fences of the same type and quality as specified for the fence and gates.
   1. Space horizontal wires corresponding to that of the fence.
   2. Provide an adjustable truss rod of 3/8 inch minimum diameter to prevent sagging on gates 10 ft or more in length.

E. Supply hot-dipped galvanized steel fittings as specified. AASHTO M 232.

F. Pintles for 10 ft and wider gates must be 5/8 inches in diameter or larger.

G. Frame and walk gates must be made of 1 inch galvanized steel tubing.

H. Fastener and single gates must be a 18 inch length of galvanized chain secured to the gate at one end and fitted with a snap fastener on the loose end.

I. All double drive gates must have a center latch in place of a chain fastener. A pin from the latch must fit in a socket embedded in concrete.

2.7 STAPLES

A. Galvanized No. 9 wire staples at least 1-1/2 inches in length.

2.8 ORNAMENTAL FENCE

A. Galvanized fabric for a Class 1 Coating as specified in AASHTO M 279.

B. Galvanized posts, frames and fittings as specified in AASHTO M 232.

C. Fabricate following FG series Standard Drawings.

2.9 CONCRETE

A. Class B(AE) concrete. Refer to Section 03055.

B. Contractor may substitute higher class of concrete.

PART 3 EXECUTION

3.1 PREPARATION

A. Clear and grade a minimum area to permit proper fence installation.

3.2 INSTALLATION

A. Install end-braced posts in existing cross fences when intersected by the new right-of-way fence.

B. Brace corner post in two directions.

C. Brace end and gate posts in one direction.

D. Compact backfill material around post.

E. Cut wood posts to the designated height and slant top at an approximate 30 degree angle.

F. Use a 3/8 inch diameter x 8 inch long galvanized steel dowels to connect wood braces to the adjacent posts.

G. Tension brace wires until installation is rigid.

H. Bolt or butt weld metal braces to the metal posts.

I. Support each timber brace with two No. 6 gauge galvanized iron wires fastened to the wood posts.

J. Remove all sags from wire mesh fabric without causing tension crimps to fail.
   1. Every alternate lateral wire in the mesh fabric.
   2. Each strand of barbed wire to the post.

K. Install grounds anywhere electric transmission, distribution, or secondary lines cross a wood post fence, conforming to industry standard. (National Electric Safety Code, Section 9).

L. Install fence fabric and barbed wire on the side of the post away from the roadway.

M. Install ornamental fence following FG series Standard Drawings.

END OF SECTION

SECTION 02825

CATTLE GUARD

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing Precast Cattle Guard.

1.2 RELATED SECTIONS

A. Section 02056: Common Fill

B. Section 02316: Roadway Excavation

C. Section 02324: Compaction

D. Section 03055: Portland Cement Concrete

E. Section 03211: Reinforcing Steel and Welded Wire

F. Section 05120: Structural Steel

PART 2 PRODUCTS

2.1 CATTLE GUARD

A. Refer to SW series Standard Drawings.

2.2 CONCRETE

A. Class AA(AE). Refer to Section 03055.

2.3 STEEL

A. Reinforcing: Refer to Section 03211.

B. Structural: Refer to Section 05120.

2.4 AGGREGATE

A. Granular Backfill Borrow. Refer to Section 02056.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove and replace unacceptable material following Section 02316.

B. Compact existing materials to a minimum 1 ft depth in compliance with Sections 02056 and 02324.

C. Cover properly excavated foundation with 2 ft of granular backfill borrow.
   1. Hand screed to the required grade utilizing properly placed screed rails.
   2. Refer to SW series Standards Drawings.

D. Place the Precast Concrete Cattle Guard on the granular backfill borrow.

E. Construct welded end guard unit following SW series Standard Drawing.

END OF SECTION

SECTION 02841

W-BEAM GUARDRAIL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. W- Beam guardrail, post and blocks, W-Beam guardrail transition element, W-Beam guardrail anchors, W-beam buried in back slope terminals, W-Beam curved guardrail elements, W-Beam nested guardrail, W-Beam guardrail delineation and certification requirements for installation of W-Beam guardrail systems.

1.2 RELATED SECTIONS

A. Section 01554: Traffic Control

B. Section 02324: Compaction

C. Section 02842: Delineators

D. Section 03055: Portland Cement Concrete

E. Section 03211: Reinforcing Steel and welded Wire

F. Section 06055: Timber and Timber Treatment

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. AASHTO M 160: General Requirements for Rolled Structural Steel Bars, Plates, Shapes and Sheet Piling

C. AASHTO M 180: Corrugated Sheet Steel Beams for Highway Guardrail

D. AASHTO M 232: Zinc Coating (Hot-Dip) on Iron and Steel Hardware

E. AASHTO M 270: Carbon and High Strength Low Alloy Structural Steel, Shapes, Plates and Bars and Quenched-and Tempered Alloy Structural Steel Plates for Bridges.

F. AASHTO M 298: Coatings of Zinc Mechanically Deposited on Iron and Steel

G. ASTM A 500: Cold Formed Welded and Seamless Carbon Steel Structure tubing in Rounds and Shapes

PART 2 PRODUCTS

2.1 W-BEAM GUARDRAIL AND HARDWARE

A. W-Beam Rail:
   1. Meet AASHTO M 180, Type 1, Class A

B. Bottom W-Beam rail or steel rub rail:
   1. W-Beam: meet requirements, of this section.
   2. Channel rub rail: meet AASHTO M 160 and AASHTO M 270
      a. Meet AASHTO M 111 after all punching and cutting is complete.

C. Hardware:
   1. Manufacturer: meet AASHTO M 180
   2. Coatings: meet AASHTO M 232 or M 298

2.2 W-BEAM GUARDRAIL POSTS AND OFFSET BLOCKS

A. All elements as per BA Series Standard Drawings.
   1. Steel post: meet AASHTO M 270 and AASHTO M 160.
      a. Meet AASHTO M 111 after all punching and cutting is complete
   2. Wood Post and wood blocks: Refer to Section 06055
   3. Composite or plastic offset blocks for steel post installations
      a. Certify as to meeting NCHRP 350 test requirements
   4. Visually inspected and accepted by the Engineer

2.3 TRANSITION ELEMENTS

A. All elements as per BA Series Standard Drawings.
   1. Meet the requirements of this section for W-Beam guardrail, posts, blocks, and hardware.

B. Chose appropriate curb section per plan requirement and BA Series Standard Drawings.

2.4 ANCHOR ELEMENTS

A. All elements as per BA Series Standard Drawings.
   1. Meet the requirements of this section for W-Beam guardrail, posts, blocks, and hardware.
   2. Anchor Plate: meet AASHTO M 270.
      a. Meet AASHTO M 111 after all punching, drilling and cutting is complete.
   3. Bearing Plate: Meet AASHTO M 270
      a. Meet AASHTO M 111 after all punching drilling and cutting is complete.
   4. Anchor Post Foundation Tube and Plate:
      a. Tube: Meet ASTM A 500
      b. Plate: Meet AASHTO M 270
      c. Meet AASHTO M 111 after all punching, drilling, cutting and welding is complete.

2.5 W-BEAM BURIED-IN-BACKSLOPE TERMINALS

A. All elements as per BA Series Standard Drawings.
   1. See plan set for terminal requirement.
   2. See BA Series Standard Drawings for Buried-In-Backslope Terminal Anchor options.
      a. Steel Post with plate: meet AASHTO M 270 and AASHTO M 160. Meet AASHTO M 111 after all punching, drilling, cutting and welding is complete.
      b. Concrete Block: Use Class A (AE) concrete, Refer to Section 03055. Refer to Section 03211 for reinforcement bar requirement.

2.6 W-BEAM CURVED GUARDRAIL

A. All elements as per BA Series Standard Drawings.
   1. See plan set for radius requirements
   2. Shop bend all curves.
   3. Meet of this section for w-beam guardrail and anchor system.
   4. CTR Post: meet wood post and blocks requirements of this section.
      a. Drill two 3½-inch holes center of post, 29 inches and 45 inches from top of post.

2.7 W-BEAM NESTED GUARDRAIL

A. All elements as per BA Series Standard Drawings.
   1. W-Beam: meet requirements of this section
   2. CTR Post: meet wood post and blocks requirements of this section.
      a. Drill two 3½-inch holes center of post, 29 inches and 45 inches from top of post.

2.8 W-BEAM MEDIAN BARRIER

A. All elements as per BA Series Standard Drawings.
   1. Meet of this section for W-Beam guardrail, posts, blocks and hardware.

2.9 TRAINING REQUIREMENT

A. Attended the Utah Department of Transportation Guardrail Installation Training Course (GRIT) and pass the UDOT Guardrail Installer Training Final Examination.
   1. Alternative to UDOT Grit Course is the American Traffic Safety Services Association (ATSSA) Guardrail Installation Training.

2.10 BARRIER DELINEATION

A. Sheeting: Refer to Section 02842.

B. Hardware: Refer to GW Series Standard Drawings.

PART 3 EXECUTION

3.1 TRAINING REQUIREMENT

A. Supply Guardrail & Crash Cushion Training Certificate to the Engineer prior to starting installation.
   1. Submit original, copy, and have copies made for project files.

B. Have an installer who has attended one of the approved training courses on the job site at all times when guardrail or elements of a w-beam guardrail system are being installed.

3.2 PREPARATION

A. Site considerations:
   1. Complete grading requirements prior to installation of guardrail and crash cushions.
   2. Protect work area when removing traffic barriers and crash cushions until the barriers and crash cushion are reconstructed or the hazard is mitigated. Refer to Section 01554.

3.3 POSTS AND BLOCKS

A. Drill all required holes in posts and blocks as per BA series Standard Drawings prior to installation.
   1. Field drilling post is acceptable when installing the bottom rail.
      a. Coat all field drilled steel post with a field-applied cold zinc material.

B. Drive post if satisfactory results are obtained without damaging the post.
   1. Do not drive posts through asphalt.

C. Excavate postholes when not driven.
   1. If hole is over excavated, compact approved backfill material into bottom of hole.
   2. Compact backfill material around post to a minimum of 96 percent of maximum laboratory density and dispose of excess material. Refer Section 02324.

3.4 RAIL ELEMENTS

A. Drill or punch all required holes as per BA Series Standard Drawings prior to installation.
   1. Field drilled holes in rail element permitted when required.
      a. Coat all field drilled rail elements with a field-applied cold zinc material.

B. Shop bend all curved sections as required in BA Series Standard Drawings.

3.5 DELINEATION HARDWARE

A. Supply Barrier Reflectors: Refer to Section 02842 and GW Series Standard Drawings.

B. Attach Barrier Reflectors: Refer to BA Series Standard Drawings.

C. Application: Refer to GW Series Standard Drawings.

END OF SECTION

SECTION 02842

DELINEATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Delineators, Type I and Type II.

B. Culvert and maintenance markers.

C. Freeway turnaround markers.

1.2 RELATED SECTIONS

A. Section 02765: Pavement Marking Paint

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 268: Retroreflective Sheeting for Traffic Control

C. ASTM A 570: Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality

D. ASTM D 638: Tensile Properties of Plastics

E. ASTM G 23: Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

F. Military Specification MIL-M 43719B

G. Standard Specifications for Construction of Road and Bridges on Federal Highway Projects, FP-92, Type III

PART 2 PRODUCTS

2.1 STEEL POSTS

A. Supply and galvanize posts as specified. ASTM A 570, Grade C, and AASHTO M 111.

B. Use flanged, channel-shaped steel posts that weight 2 lbs/ft.

C. Make all cuts before galvanizing posts. Follow GW series Standard Drawings.

2.2 FLEXIBLE POSTS

A. Free of burns, discoloration, contamination, and other defects.

B. Remains flexible at temperatures from -5 degrees F to +140 degrees F.

C. Capable of being driven into an earth shoulder with or without a pilot hole.

D. Tensile strength of 1100 psi. ASTM D 638.

2.3 QUALITY CONTROL - FLEXIBLE POST TESTING

A. Meet Cold Bend Test:
   1. Subject two posts to a temperature of -10 degrees F, "5 degrees F for at least four hours.
   2. Immediately bend each post four times through a 90 degree angle around a 2 inch mandrel.
   3. Each post must return to its original straight configuration within a "10 degree angle within five minutes at the end of the four bends.
   4. Any cracking or significant loss of rigidity are grounds for failure.

B. Meet Hot Bend Test:
   1. Subject two posts to a temperature of 100 degrees F "5 degrees F for at least four hours.
   2. Satisfy all bending and physical requirements specified in the Cold Bend Test.

C. Meet Impact Resistance Test:
   1. Subject post to impacts by a typical sedan as follows:
      a. Three hits - 0 degree angle at 0 degrees F.
      b. Three hits - 0 degree angle at 100 degrees F.

c. Ten hits - 0 degree angle at 35 mph.
d. Five hits - 15 degree angle at 55 mph.

2. Acceptable results:
   a. Installed post remain intact, securely anchored and within " 10 degrees of vertical orientation.
   b. Installed post shows minimal signs of cracking or loss of rigidity.
   c. Installed post retains at least 50 percent of its reflective sheeting.
   d. Impact vehicle suffers little or no damage during the impact test.

D. Exposure:
   1. Expose the specimens for 500 hours in a carbon arc-type apparatus following ASTM G 23, Method 1.
   2. Acceptable results:
      a. Exposure does not result in delamination, distress, or discoloration.
      b. Sheeting is not removable from the specimens without damage.
      c. Post is resistant to ultraviolet light, ozone, hydrocarbons, and other weathering.

2.4 SHEETING

A. Select from Accepted Products Listing (APL) maintained by the UDOT Research Division.

B. Reflective sheeting: Encapsulated lens sheeting or encapsulated lens (flexible) as specified. Standard Specifications for Construction of Road and Bridges on Federal Highway Projects, FP-92, Type III. Refer to AASHTO M 268.

C. Non-reflective sheeting: As specified. Military Specification MIL-M 43719B, Type I, Class I.

2.5 PAINT

A. Refer to Section 02765.

PART 3 EXECUTION

3.1 INSTALLATION

A. Posts: visibly free of bends or twists both before and after installation.

END OF SECTION

SECTION 02843

CRASH CUSHIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install crash cushions
   1. Reference Standard Drawings
      a. Types A, B, & D: CC 4
      b. Type C: CC 5
      c. Type E: CC 6
      d. Type F: CC 7
      e. Type G: CC 7
      f. Type H: CC 8

B. Furnish and install crash cushion markings
   1. Reference Standard Drawing: CC 1

1.2 RELATED SECTIONS

A. Section 02891: Traffic Signs

1.3 REFERENCES

A. UDOT Guidelines for Crash Cushions

1.4 SUBMITTALS

A. Installer Certification.
   1. Manufacturer certified installer.
   2. Provide proof of certification prior to installation.

B. Provide a letter of certification for each system location, affirming that each system is installed according to Department's and the manufacturer's specifications.
   1. Location as per Project Number and Station Number and indicating median, left or right shoulder or gore area application.

PART 2 PRODUCTS

2.1 CRASH CUSHION

A. Select from the current approved products list, UDOT Guidelines for Crash Cushions.

1. Refer to the current UDOT Guidelines for Crash Cushions, Maintained by the Division of Traffic and Safety available through the UDOT Internet home page. Refer to http://www.udot.utah.gov/index.php/m=c/tid=719.

B. Types:

1. Type A:
   a. Protect fixed hazards greater than 3 ft wide within 15 ft of traveled way, with less than 100 ft. of longitudinal space in front of the hazard.
   b. Use to protect concrete barrier ends, bridge parapets or piers, and other hazards as a stand alone system.
   c. Use a transition element when used in conjunction with single or double faced guardrail. Use two transition elements when installed with double faced guardrail.
   d. Use on shoulders or in medians where a recover area behind system and hazard is unattainable.
   e. Use in areas where minimal impacts are anticipated, one impact every three or more years.
   f. Refer to CC series Standard Drawings.
2. Type B:
   a. To protect fixed hazards up to 3 ft wide or less and within 15 ft. of traveled way, with less than 100 ft of longitudinal space in front of the hazard.
   b. Use to protect concrete barrier ends, bridge parapets or piers, and other hazards as a stand alone system.
   c. Use a transition element when used in conjunction with single or double faced guardrail. Use two transition elements when installed with double faced guardrail.
   d. Use on shoulders or in medians where a recover area behind system and hazard is unattainable.
   e. Use in areas where minimal impacts are anticipated, one impact every three or more years.
   f. Refer to CC series Standard Drawings.
3. Type C:
   a. To protect fixed objects 3 ft wide or less within 15 ft of traveled way, and longitudinal space in front of the hazard greater than 100 ft.

b. Use with single or double faced guardrail, transition element(s) required for concrete barrier or bridge parapet.
c. May be used on shoulders. Shoulder application requires a recovery area of 75 ft by 20 ft.
d. Can be used on medians as per CC series Standard Drawings.
e. Use in area where minimal impacts are anticipated, one impact every three or more years.

4. Type D:
   a. To protect fixed hazards within 15 ft of traveled way.
   b. Use to protect concrete barrier ends, bridge parapets or piers, or other hazards as a stand alone system.
   c. Use a transition element when used in conjunction with single or double faced guardrail. Use two transition elements when installed with double faced guardrail.
   d. Can be used on shoulders or in medians.
   e. Use in areas where one impact per year is anticipated or when repair history indicates two or more impacts over a three year period.
   f. Refer to CC series Standard Drawings.
5. Type E - Sand Barrel Arrays:
   a. To protect fixed hazards outside 15 ft of traveled way and there is an unlimited amount of space.
   b. Can be configured to meet most width requirements.
   c. For use to protect concrete barrier ends, bridge parapets or piers, or other hazards as a stand alone system.
   d. Refer to CC series Standard Drawings.
6. Type F:
   a. Use to protect concrete barrier or bridge parapets with less than 125 ft of longitudinal space in front of the hazard.
   b. Refer to CC series Standard Drawings Type F Detail.
7. Type G:
   a. Use to protect the approach end of single face w-beam guardrail.
   b. Use to protect concrete barrier or bridge parapet with unlimited longitudinal space (greater than 125 ft) in front of the hazard with transition element, and is installed where a tangent system is desired.
   c. Use with guardrail systems running tangent to the roadway.
   d. Refer to CC series Standard Drawings Type G Detail.
8. Type H:
   a. Use to protect the approach end of single face w-beam guardrail.
   b. Use to protect concrete barrier or bridge parapet with unlimited longitudinal space (greater than 125 ft) in front of the hazard with transition element, and is installed where a flared system is desired.
   c. Use with flared guardrail systems.
   d. Refer to CC series Standard Drawings Type H Detail.

2.2 CRASH CUSHION MARKINGS

A. Marker Plate: Standard Drawing CC 1.
   1. Construct marker plate 18 inches X 18 inches using 0.032 gage aluminum with appropriate object marker sheeting.
      a. Type C systems require a 24 inches X 14 inches object marker plate. Sheeting will be in compliance with Section 02891.
         1) Drill four 7/16-inch holes in each corner of plate.
      b. Self adhesive object marker sheeting 18 inches X 18 inches or 24 inches X 14 inches may be substituted.
   2. Marker Post: CC series Standard Drawings.
      a. Construct marker post, 60 inches long and 2 inches OD, using black polyethylene material.
         1) Apply three 4-inch bands of yellow sheeting.
         2) Drill three 7/16-inch mounting holes.
         3) Close top of marker post.

PART 3 EXECUTION

3.1 INSTALLATION

A. Complete all site preparation prior to installation.
   1. Construct approach areas and recover areas to meet UDOT Standards and system requirements.
      a. See CC series Standard Drawings for system type being installed.
   2. Construct concrete pad to meet system requirements.
      a. Use manufactures specification for concrete pad construction.

B. Install in accordance with:
   1. The Department's Guidelines for Crash Cushions
   2. Manufacturer's specifications and recommendations.
   3. Use manufacturer certified installer to perform the installation.

C. Complete repair or replacement of any crash cushion damaged during construction within 24 hours of notification of damage.
   1. Contractor is responsible for the cost of any repair or replacements until completion of the project.

END OF SECTION

SECTION 02844

CONCRETE BARRIER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Precast concrete barriers: standard, half, and terminal section.

B. Cast-in-place concrete barriers.

1.2 RELATED SECTIONS

A. Section 01554: Traffic Control

B. Section 02842: Delineators

C. Section 03055: Portland Cement Concrete

D. Section 03211: Reinforcing Steel and Welded Wire

E. Section 03390: Concrete Curing

F. Section 03392: Penetrating Concrete Sealer

1.3 REFERENCES

A. ASTM A 36: Carbon Structural Steel

B. UDOT Quality Management Plan

PART 2 PRODUCTS

2.1 CONCRETE

A. Class AA(AE). Refer to Section 03055.

2.2 STEEL

A. Connection pins, connection loops, and stabilization pins. Refer to ASTM A 36.

2.3 REINFORCING STEEL AND WELDED WIRE FABRIC

A. As specified, refer to Section 03211.

2.4 BARRIER SEAL (FOR PRECAST CONCRETE BARRIER)

A. Polyester polyurethane open-cell foam 100 percent impregnated with asphalt.

B. Foam unit weight requirements:
   1. Before impregnation: 68 lbs/yd^3 to 85 lbs/yd^3.
   2. After impregnation: 252 lbs/yd^3 to 270 lbs/yd^3.

C. Impregnated asphalt foam should return to 95 percent of its original volume when compressed to 25 percent of its volume and released.

D. Impregnated asphalt foam must remain stable at temperatures ranging from -40 degrees F to +150 degrees F.

2.5 CONCRETE BARRIERS

A. Use the specified reinforcing steel as per applicable BA Series Standard Drawings, as the reinforcing component. Refer to Section 03211.

B. Hot and cold weather limitations. Refer to Section 03055.

2.6 PRE-CAST CONCRETE BARRIER

A. Pre-qualify the fabricator as a supplier of pre-cast concrete products in accordance with the Quality Management Plan: Precast-Prestressed Concrete Structures.

B. Mark each barrier with 1½ inch numbers indicating the date of casting and identification number supplied by the inspector. Impress ¼ inch deep into the top center of the barrier.

C. Prevent cracking or damage during handling and storage of precast units. Replace cracked or damaged precast units at no additional cost to the Department.

D. Accept for shipment when:
   1. 28-day compressive strength acquired.
   2. Cured and sealed according to specification.
   3. Visually inspected and accepted by the Engineer.

2.7 BARRIER DELINEATION

A. Sheeting: Refer to Section 02842.

B. Hardware: Refer to GW Series Standard Drawings.

2.8 SURFACE SEALING MATERIAL (CAST-IN-PLACE CONSTANT SLOPE BARRIER)

A. Refer to Section 03392.

2.9 EXTRUSION AND SLIP FORM MACHINES FOR CAST-IN-PLACE CONSTANT SLOPE BARRIER

A. Capable of vertical adjustment to the grade line while in forward motion.

B. Equipment with an attached grade line gauge or pointer to make a continual comparison with the barrier being place and the offset guideline.

PART 3 EXECUTION

3.1 PREPARATION

A. Site considerations:
   1. Protect work area when removing traffic barriers and crash cushions until the barriers and crash cushion are reconstructed or the hazard is mitigated. Refer to Section 01554.
   2. Precast Concrete Barrier: Complete grading requirements and place any required paved surfaces as per BA Series Standard Drawings before installing barrier. Complete grading requirements prior to installation of barrier or crash cushions reference CC Series Standard Drawings.

B. For cast-in-place constant slope protection:
   1. Before applying curing compound, give the surface a final soft brush finish with strokes parallel to the line of barriers.
   2. Do not finish with a brush application of grout.
   3. Refer to Section 03392.

4. Complete grading requirements prior to installation of crash cushions reference CC Series Standard Drawings.

3.2 PRE-CAST CONCRETE BARRIERS

A. Installation includes moving, stockpiling, and placing all barriers.

B. Place seal between each barrier unit so that enough pressure is exerted on the sealing material to form and maintain a permanent bond.

3.3 CAST-IN-PLACE CONSTANT SLOPE BARRIER

A. Obtain approval from the Engineer before placing the material.

B. Conform to BA Series Standard Drawings.

C. Fixed forms: Do not use precast mortar blocks to support the reinforcing steel.

D. Constant slope barrier placed by extrusion or slip form:
   1. Provide an offset guideline for the extrusion or slip form machine to maintain the predetermined grade.
   2. Feed concrete to the extrusion or slip form machine at a uniform rate.
   3. Operate machine, uniformly restraining forward motion.
      a. Produce well-compacted, dense concrete with consistency that maintains the shape of the barrier without support.
      b. Produce a well-compacted mass of concrete free from surface pits larger than 1 inch in diameter and requiring no further finishing.
   4. Saw or form joints before applying curing compound.

E. Curing: Refer to Section 03390.

F. Coating:
   1. Application rate based on resident content at a coverage rate of 0.11 lbs/yd^2.
   2. Apply according to the manufacturer's recommendation for horizontal, vertical, and overhead surfaces.
   3. Select a sealer with maximum drying time of 1½ hour.

3.4 DELINEATION HARDWARE

A. Concrete Barrier: Attach L Barrier Reflector. Refer to GW Series Standard Drawings.

B. Attachment Location: Refer to BA Series Standard Drawings.

C. Application: Refer to GW Series Standard Drawings.

END OF SECTION

SECTION 02861

PRECAST RETAINING/NOISE WALLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing Precast Retaining/Noise Wall.

1.2 RELATED SECTIONS

A. Section 01571: Temporary Environmental Controls

B. Section 02061: Select Aggregates

C. Section 03055: Portland Cement Concrete

D. Section 03152: Concrete Joint Control

E. Section 03211: Reinforcing Steel and Welded Wire

F. Section 03390: Concrete Curing

1.3 REFERENCES

A. AASHTO Standard Specifications for Highway Bridges

B. UDOT Quality Management Plans

1.4 SUBMITTALS

A. Lifting devices: Submit calculations and shop drawings for approval.

B. Precast Concrete Panels: Submit for approval samples of the exposed aggregate finish before casting the panels.

1.5 HANDLING, SHIPPING, AND STORAGE

A. Shipment Acceptance: Panels or posts may be accepted for shipment and marked with an orange UDOT sticker if they:
   1. Meet the 28 day compression test.
   2. Are cured and sealed according to specification.
   3. Are not cracked or damaged.

B. Do not ship any panel or post that does not satisfy strength requirements.

PART 2 PRODUCTS

2.1 MATERIALS FOR PRECAST NOISE WALLS AND RETAINING WALLS

A. Precast Wall Panels and Posts:
   1. Concrete Class AA(AE). Refer to Section 03055.
   2. Type II cement.
   3. Slump requirement need not be met.
   4. 28 day minimum compressive strength of 5,000 psi.

B. Post Hole Concrete: Concrete Class B(AE). Refer to Section 03055.

C. Reinforcing Steel: Coated Grade 60. Refer to Section 03211.

D. Welded Wire Fabric: Coated. Refer to Section 03211.

E. Curing Compound: Type I, Class A. Refer to Section 03390.

F. Gravel for Post Holes: Free Draining Granular Backfill Borrow. Follow Section 02061.

G. Elastomeric Bearing Pad: 60 hardness. As specified in AASHTO Standard Specifications for Highway Bridges, Division II, Article 18.2.

H. Backer Rod: Refer to Section 03152.

I. Construction Adhesive: Select from the Performance Data Products Listing (PDPL) maintained by the UDOT Research Division.

J. Wood Shims: Any grade fir.

2.2 ADDITIONAL MATERIALS FOR RETAINING WALLS

A. Composite Drainage Material: Two-layer composite, consisting of non-woven silt fence geotextile and matting surface that are heat bonded together.
   1. Polyester non-woven fabric. Follow Section 01571.
   2. Compression resistant matting of three-dimensional construction capable of multidirectional flow.

2.3 LIFTING DEVICES

A. Galvanized flush-type that do not project beyond the edge of the panels.

B. Capable of lifting the maximum size of panels (11.5 ft x 7 ft x 5 inches) and of tilting them from horizontal position to vertical position.

C. Shear factor of safety of 2.66:1 for lifting from a flat position and a tension factor of safety of 4:1 for lifting from a vertical position.

D. Designed for shear so that the panels can be lifted from either side.

E. Provide a sealing cover.

2.4 CONCRETE POSTS

A. Cast posts in metal forms.

B. Permanently mark each post with date of casting and post the identification number supplied by the inspector. Place markings in fresh concrete in the portion of the post that will be embedded in soil.

C. Department accepts posts if they:
   1. Meet the 28 day compressive strength.
   2. Are cured and sealed according to specification.
   3. Have been visually inspected and accepted by the Engineer.
   4. Have sides that do not deviate from a straight line by more than 3/8 inch per post height.

D. Replace posts that are:
   1. Cracked or damaged.
   2. Not permanently marked.

2.5 PRECAST CONCRETE PANELS

A. Fabricator will be pre-qualified as a supplier of pre-cast concrete products in accordance with the Quality Management Plan.

B. Cast the panels to required tolerances regarding all dimensions.
   1. Cast in metal forms.
   2. Do not use coloring additives.
   3. Make panels match in contrast.

C. Permanently stamp panel identification number supplied by Engineer in the top surface of one lifting device prior to casting.

D. Expose the aggregate on both sides. Remove all residue from exposed surfaces.

E. Department accepts panels when they:
   1. Meet the 28 day compressive strength.
   2. Are cured and sealed according to specification.
   3. Have been visually inspected and accepted by the Engineer.
   4. Have sides that do not deviate from a straight line by more than1/8 inch.

F. Replace panels that:
   1. Are cracked or damaged.
   2. Do not match in contrast.
   3. Are not permanently marked.

PART 3 EXECUTION

3.1 LIMITATIONS

A. Refer to Section 03055 for hot and cold weather limitations.

3.2 CURING

A. Refer to Section 03390.

3.3 POST HOLES

A. Refer to SW series Standard Drawings.

B. Place edge of post holes no nearer than 2 ft from any underground utility.

3.4 LIFTING DEVICES

A. Place waterproof caps in the lifting devices after the panels are permanently placed.

3.5 CONCRETE POSTS

A. Set true to line and grade. Reject and replace posts more than 1/2 inch out of plumb in exposed length.

B. Replace posts that do not adequately support or accept insertion of the precast panels.

C. Replace cracked or damaged posts.

D. Glue elastomeric bearing pads to the concrete post for Precast Retaining/Noise Wall, following the manufacturer's recommendations.

3.6 PRECAST CONCRETE PANEL PLACEMENT

A. Set elevations in the field for Engineer's acceptance. Stake elevations to the bottom of the bottom panel. Align as shown on the plans.

B. Place the panels in the posts with the form side facing the highway.

3.7 RETAINING WALLS

A. Follow SW series Standard Drawings.

B. Composite drainage material:
   1. Place behind the wall panels at each weep hole location.
   2. Place the fabric side of the material against the fill. Extend the length of the material from the bottom of the wall panel to the top of the fill.

C. Filter Fabric: Place around the back side of the posts as shown in the plans. Extend the material from the bottom of the wall panel to the top of the fill.

D. Free Draining Granular Backfill Borrow: Place and tamp down behind the wall panels, between the posts to the fill height and length, and at the locations shown on the plans.

END OF SECTION

SECTION 02891

TRAFFIC SIGNS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing traffic signs.

1.2 RELATED SECTIONS

A. Section 02317: Structural Excavation

B. Section 03055: Portland Cement Concrete

C. Section 03211: Reinforcing Steel and Welded Wire

D. Section 05120: Structural Steel

E. Section 06055: Timber and Timber Treatment

1.3 REFERENCES

A. ASTM A 153: Zinc Coating (Hot-Dip) on Iron and Steel Hardware

B. ASTM A 314: Stainless Steel Billets and Bars for Forging

C. ASTM A 500: Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

D. ASTM A 513: Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing

E. ASTM A 653: Steel, Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process

F. ASTM A 1011: Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

G. ASTM B 209: Aluminum and Aluminum-Alloy Sheet and Plate

H. APA: American Plywood Association Product Standard

I. Military Specification MIL-M 4371B

1.4 TRAFFIC SIGN COMPONENTS

A. Substrate: The base material, usually plywood or aluminum, upon which the background sheeting is attached.

B. Panel: Assembly of substrate and attached sheeting. Several panels may be necessary to complete one sign. Panel types are:
   1. Type
      a. A: Reflective sheeting on sheet aluminum.
      b. PW: Reflective sheeting on plywood.
   2. Legend:
      a. 1 With non-reflective legend, symbols, and borders.
      b. 2 With reflective legend, symbols, and borders.

C. Sheeting: The reflective or non-reflective material that comprises the background legend, border, and symbols.

D. Sign: A complete assembly comprised of post, frame, and panel.

E. Auxiliary Sign: A sign including frame, if required, attached and supplemental to a complete sign assembly.

F. Panel replacement: Removing the existing panel and attaching a new panel to the frame.

G. Panel Overlay: Attaching new panels to all or part of an existing panel.

H. Size: Horizontal x vertical

1.5 SIGN CODES

A. New Sign: N

B. Auxiliary Sign: Aux

C. Relocation: R

D. Removal: X
E. Panel Replacement: PR

F. Panel Overlay: PO

1.6 SUBMITTALS

A. Submit 3 sets of drawings for overhead structures for prefabrication approval. Allow 14 calendar days for approval.

PART 2 PRODUCTS

2.1 MATERIALS

A. Fabricate sign and posts as specified per SN series Standard Drawings.

B. Substrate: 0.080 inch thick. ASTM B 209 alloy 6061-T6, or 5052-H38.

C. Plywood as specified below and which meets the American Plywood Association product standard 1 PSI-83, Group 1, 5/8 inch thick.
   1. 90/90, high density BB exterior (Douglas Fir) B Grade.
   2. Plugged-core (Douglas Fir) with 1/2 inch maximum gaps.
   3. Use acrylic laminate that is compatible with the reflective sheeting adhesive, and that does not require the removal of the release agents before applying the sheeting.

D. Posts:
   1. Timber Sign Post (P1)
      a. Follow Section 06055
   2. Tubular Steel Sign Post (P2)
      a. Post: ASTM A 513
      b. Finish: Galvanize ASTM A 653
      c. Shape: As shown, wall thickness 0.080
      d. Color: Powder coated as required
   3. Square Steel Sign Post (P3)
      a. Post: ASTM A 1011Grade 50
      b. Finish: Galvanize ASTM A 653
      c. Shape: 12 gauge or 10 gauge steel
      d. Color: Powder coated as required
   4. Slip Base Tubular Steel Sign Post (P4)
      a. Post ASTM A 500 Grade C; 46,000 psi minimum yield
      b. Finish: Galvanize ASTM A 153
      c. Shape: As shown; schedule 80
      d. Color: Powder coated as required
   5. Steel Sign Post (P5)

a. Follow Section 05120

E. Reflective Sheeting:
1. Encapsulated lens sheeting or encapsulated lens (flexible) as specified.
2. Meet Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects FP-92, Type III.

F. Nonreflective Sheeting: As specified. Meet Military Specification MIL-M 4371B, Type I, Class I.

G. Fasteners: As specified. Meet ASTM A 314, Class 304, 18-8, Stainless Steel.

H. Foundation
1. Concrete: Class A (AE). Refer to Section 03055.
2. Reinforcing steel: Refer to Section 03211.
3. Anchor bolts: Refer to Section 05120.

I. Structural Steel: Structural Steel frame. Refer to Section 05120.

J. Temporary covering: Opaque material.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate utility location.

B. Excavate following Section 02317 requirements.

C. Install traffic control devices before work activities begin.

3.2 INSTALLATION - GENERAL

A. Furnish a daily record of the number and location of all traffic control devices in use.

B. Do not reverse screen sign larger than 7 square feet per color.

C. Do not remove a sign that is being replaced until the new sign is placed and uncovered.

D. Compact backfill to a density equal to surrounding materials.

E. Establish proper elevation and orientation of all signs, structures, and determine proper sign post lengths as dictated by construction slopes.

F. Cover signs that require temporary covering with an opaque material. Secure at the rear of the sign so that the sign is not damaged. Maintain covering until removed.

G. Construct signpost foundations with concrete conforming to indicated dimensions.

3.3 RELOCATING EXISTING SIGN

A. Retrofit as required to meet current standards.

B. Provide new posts and accessories as required.

C. Remove foundations to a minimum of 6 inches below the ground line, and backfill.

3.4 REMOVING EXISTING SIGN

A. Remove foundations to a minimum of 6 inches below the ground line and backfill.

END OF SECTION

SECTION 02892

TRAFFIC SIGNAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing traffic signals.

B. Materials and procedures for installing traffic counting loop detectors.

1.2 RELATED SECTIONS

A. Section 02741: Hot Mix Asphalt (HMA)

B. Section 02748: Prime Coat/Tack Coat

C. Section 03055: Portland Cement Concrete

D. Section 03211: Reinforcing Steel and Welded Wire

E. Section 03310: Structural Concrete

F. Section 03575: Flowable Fill

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. ASTM A 123: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

C. ASTM A 325: Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

D. ASTM A 307: Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

E. ASTM A 570: Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality

F. ASTM B 85: Aluminum-Alloy Die Castings

G. ASTM B 117: Operating Salt Spray (Fog) Apparatus

H. ASTM B 766: Electrodeposited Coatings of Cadmium

I. ASTM D 638: Tensile Properties of Plastic

J. ASTM D 2240: Rubber Property-Durometer Hardness

K. ASTM D 3005: Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

L. American Iron and Steel Institute (AISI)

M. American National Standards Institute (ANSI)

N. Electric Utility Service Equipment Requirements Committee (EUSERC)

O. Electronics Industries Association (EIA)

P. International Municipal Signal Association (IMSA) Standards

Q. Institute of Electrical and Electronics Engineers (IEEE)

R. Institute of Traffic Engineers (ITE), Technical Reports

S. Military Specifications

T. National Electric Code (NEC)

U. National Electrical Manufacturers Association (NEMA)

V. Pedestrian Traffic Control Signal Indicator (PTCSI) Standard

W. Rural Electrical Association (REA) Bulletin

X. Underwriters Laboratory (UL)

Y. Vehicle Traffic Control Signal Head (VTCSH) Standards

Z. 3M - 8982/Gel

1.4 SUBMITTALS

A. Certified test report of wire compliance as specified. IMSA 20-1, 50-2, 51-1, 51-3, 51-5, 51-7, 60-6.

B. Submit samples of materials for approval when requested.

C. Submit two copies of the following within 15 days after receiving a Notice to Proceed:
   1. List of equipment and materials (name of manufacturer, size, and identification number).
   2. Detailed shop drawing, wiring diagrams, and certifications.
   3. Manufacturers' warranties, guarantees, instruction sheets, and parts lists.

1.5 ACCEPTANCE

A. Signal Warranties and Guarantees
   1. The notice of acceptance for traffic signal work is not given until six months after the date of the inspection.
   2. During this period, all manufacturer's warranties and guarantees on Contractor- furnished electrical and mechanical equipment are enforced.
   3. At the end of the period and after all electrical and mechanical defects within the scope of warranties and guarantees are corrected, the Engineer makes written acceptance of the work completed and relieves the Contractor of further responsibility for that portion of the project.
   4. Partial acceptance does not void or alter any terms of the Contract

B. The six-month warranty period for signal work does not affect the processing of a semi-final estimate when the Contract is 95 percent or more complete, or after completion of work on the project.

C. Detector Loop Circuit: Conduct the following acceptance tests before and after backfill for approval by the Engineer.
   1. Loop Resistance Formula: $R_t = R_l + R_d$
      R_t= Resistance of loop as measured at pull box.
      R_l= Resistance of loop lead in wire (from the loop to junction box per meter) equals 0.0213 ohms, measured from loop to pull box splice.
      R_d = Resistance of Loop = $P.T.R_c$ (See Loop Resistance Table below)
      P = Perimeter of loop in meters.
      T= Number of turns in the loop.
      R_c= Resistance of #14 AWG copper wire per yard equals 0.0107 ohms.

Table 1

Loop Resistance			
Loop Type			R_d Loop Resistance (ohms)
Width (ft)	Length (ft)	Turns	
5	6	4	.29
5	10	4	.39
6	6	4	.31
6	10	4	.41
6	12	4	.47
6	14	3	.39
6	16	3	.43

2. A minimum reading between the conductor and ground of 100 MΩ when tested with a 500 V megger meter.
3. An inductance between 65 FH and 1000 FH.
4. Signal Power Circuits:
   a. Continuity of grounding conductors to maintain a 1000 W load at each pole to maintain less than 2 V drop.
   b. Insulations resistance of supply conductors to ground no less than 40 MΩ (500 V megger meter).

D. Video Detection Circuit: Provide cabling and install State-furnished video detection equipment to construct a complete video detection circuit at each intersection specified in the project and demonstrate each circuit operates per manufacturer's specifications.

PART 2 PRODUCTS

2.1 MATERIALS

A. Use electrical components as listed and defined by the National Electric Code (NEC).

2.2 SIGNAL POLE AND TRAFFIC SIGNAL LIGHT SUPPORT ARM

A. Post mounted Tapered Signals Pole: Standard Drawing SL 5.
   1. Steel, as specified. ASTM A 570, Grade 33.
      Allowable stresses: F_b = 21,750 psi (0.66F_y)
      F_V = 10,900 psi (0.33 F_y)
   2. Galvanized as specified. AASHTO M 111.

3. Wind load: 80 mph wind with 105 mph gusts.

B. Foundation:
1. Concrete: Class AA(AE) Concrete. Refer to Section 03055.
2. Reinforcing steel: Coated steel. Refer to Section 03211.

2.3 BOLTS AND NUTS

A. Anchor bolts and nuts: Follow Standard Drawing SL 5.
1. Steel as specified. ASTM A 307.
2. Zinc-plated or galvanized, as specified.
   a. Zinc-plated as specified. ASTM B 766.
   b. Galvanized steel: ASTM A 123.
3. Nuts: free running, by hand, for total thread length.

B. Slip Bolts as specified.
1. Zinc plated: ASTM B 766.
2. Steel: ASTM A 325.

2.4 WIRE

A. Copper, as specified. International Municipal Signal Association (IMSA)

B. Size as specified. American Wire Gauge (AWG)

C. Service Cable:
1. Single-conductor, as specified. Type THWN, THW, THHW.

D. Interconnect cable:
1. Twisted pair filled shielded cable, as specified.
2. IMSA 60-6.

E. Signal Cable:
1. Multi-colored cables, as specified.
2. IMSA 20-1

F. Ground Wire:
1. Solid, bare, soft-drawn, copper wire, as specified.
2. NEC 250-1.

G. Splice Sealing: Rural Electrical Association (REA) Bulletin 17551-100.
1. Rigid body re-enterable gel-filled enclosure. Meet 3M-8982/gel, or equivalent.
2. Mastic rubber pads and overwrap with vinyl electric tape.

3. ASTM D 3005, Type I or II. UL 510.

H. Color Coding Tape:
1. Vinyl electric tape, as specified.
2. UL 510.

I. Video Detection Circuit:
1. Camera circuit cable - Belden 8281 or equivalent, coaxial cable, RG 59/U Type 20 AWG.
2. Camera power circuit - 4-conductor, 14AWG SJOW cable, IMSA specification 20-1.

2.5 TRAFFIC SIGNAL HEAD

A. Use SL series Standard Drawings.

B. 12 inch vehicular signal heads:
1. With tunnel hoods and mounting brackets, square doors,
2. Capable of adjusting a full 360 degrees around a vertical axis in one direction.

C. Assembly:
1. LED Ball and Arrow Vehicle Signal Modules:
   a. Modules fit into existing housing built to the VTCSH standard without modification to the modules or housing.
   b. Arrow modules have at least three rows of LEDs. Balls must be full field design. Both ball and arrow modules must be capable of installation in signal head with reflector in place.
   c. Ensure the measured chromaticity coordinates of modules is between 500 nm and 650 nm, conforming to the chromaticity requirements of the VTCSH standard.
2. Sections Heads:
   a. Separate, interchangeable, and expandable without tie rods.
   b. Stainless steel bolts, screws hinge pins, and door-locking devices in any exposed sections.
   c. Die-cast aluminum parts, including the doors, as specified: ASTM B 85. Clean, smooth parts free from flaws, cracks, blow holes, or other imperfections.
   d. Moisture and dust resistant.
   e. All surfaces inside and out of signal housing, door, and outside of visor are painted with electrostatically-applied, fused-polyester paint in Highway Yellow. Inside of visor is painted flat black.
   f. Integrally round serrated boss openings in the top and bottom of each section that receives 1.5-inch supporting pipe frame.

g. Rain-tight top opening and an ornamental cap for closing the bottom opening.
h. Visor securely mounted at a minimum of four points.

D. Optical Unit:
1. Watertight and dust resistant, mounted so various parts swing open for easy access. Provide and install green, amber, and red LED modules. Install each LED signal module in the door frame of a standard traffic signal head housing. Remove the lamp socket, reflector, reflector holder, and lens used with an incandescent lamp. Do not use with the LED signal module. Remove socket, reflector, reflector holder, and lens and wire the LED module to the traffic signal heads.

E. Louvered back plate
1. Constructed from minimum 18-gage aluminum.
2. Both sides primed and painted flat black.
3. Designed to be attached to the signal head used.

2.6 PEDESTRIAN SIGNAL HEAD

A. Follow SL series Standard Drawings.

B. Includes a housing, swing down door assembly, parabolic reflector, message lens, sunshield, two signal lamps and two sockets.
1. Housing:
a. Dustproof and weatherproof.
b. Die cast, single piece aluminum allot.
c. 1-1/2 inch top and bottom openings with integrally-cast shurlock boss when used with pipe mount brackets.
d. Use stainless steel screws springs, and assembly hardware.
2. Swing down door assembly:
a. Capable of being opened without tools.
b. Made of a single piece aluminum alloy, die cast with two hinge lugs at the bottom and two latch slots at the top of the door.
3. Install each LED pedestrian head in the door frame of a standard pedestrian head housing. The lamp socket, reflector, reflector holder, and lens used with an incandescent lamp must be removed and not used with the LED pedestrian modules. Remove lamp socket, reflector, reflector holder, and lens and wire the LED module to the pedestrian heads.
4. Sunshield:
a. Eggcrate-type with 15 vertical and 26 horizontal members.
b. Two anti-vandal, integral locking strips.
c. Minimum thickness of 20-gage.
d. Finish: 100 percent impregnated black, polycarbonate plastic, with a flat finish on both sides.

5. Electrostatically apply synthetic enamel as specified.
   a. Gloss black case and door frame.
   b. Flat black sunshield.
   c. Oven-cure finish for a minimum of 20 minutes at 350 degrees F.
6. Pedestrian Display Signal Module
   a. Use LED Pedestrian Signal Modules that are a retrofit replacement for the message bearing surface of a 16 inch x 18 inch pedestrian traffic signal housing built to the Pedestrian Traffic Control Signal Indicator (PTCSI) Standard. The message-bearing surface of the module shall be supplied with "HAND" and "MAN" symbol that complies with PTCSI standard for this symbol. This message-bearing surface is designed so that it can be removed from the sealed unit for replacement without further damage to the module.
   b. Ensure the exterior of the lens of the LED Pedestrian Signal Module is smooth and frosted to prevent sun phantom.
   c. Ensure all Portland Orange LEDs utilize "AlInGap" technology or equivalent, and rated for 100,000 hours or more at 77 degree F and 20 mA.
   d. Ensure the LED Pedestrian Signal Module is designed so that when operated over the specified ambient temperature and voltage range, the signal will attract the attention of, and be readable to a viewer (both day and night) at all distances from 10 ft to full width of the area to be crossed. Use a minimum of 150 LEDs in the Portland orange hand symbol and 100 LEDs in the white man symbol.
   e. Ensure the measured chromaticity coordinates of the LED Pedestrian Signal Module conforms to the chromaticity requirements of the PTCSI Standard.
   f. Ensure the LED pedestrian signal module is operationally compatible with the currently used controller assemblies and conflict monitors.

C. Ensure symbol messages blank out under ambient light conditions when the pedestrian signal is not energized.

2.7 ELECTRICAL CONDUIT

A. Conduit and fittings:
   1. Schedule 40 PVC rated at 190 degrees F as specified. NEMA TC-2, TC-3. UL Listed.
   2. Rigid steel as specified. UL 6.
   3. Galvanized as specified. ANSI C80.1.

B. Casing: Smooth steel with a minimum 1/4 inch wall thickness as specified.

2.8 DETECTOR CIRCUIT

A. Wire:
   1. Detector Lead-In Wire (feeder): as specified. IMSA 50-2.
   2. PVC Sensor Loop Wire - No. 14, single-conductor, stranded wire as specified. IMSA 51-3.
   3. Saw Cut Sensor Loop Wire.
   4. No. 14, single-conductor, stranded wire encased in a polyethylene tube as specified. IMSA 51-7.

B. Traffic loop embedding sealant:
   1. Isophthalic, acid-based, unsaturated, polyester resin.
   2. With sufficient adhesion, strength, and flexibility to:
      a. Withstand normal movement in asphaltic and concrete pavements
      b. Protect the loop wire from moisture penetration, fracture and shear.
   3. Cured sealant resistant to motor oils, gasoline, anti-freeze solution, brake fluid, and de-icing chemicals.
   4. Meet the physical property requirements in Table 2.

Table 2

Traffic Loop Embedding Sealant		
Physical Properties	**Test**	
Shore D Hardness	ASTM D 2240	74
Specific Gravity		1.13 - 1.20
Styrene Monomer, percent		28 - 32
Viscosity: PaAs	Brookfield Model LVF #3 Spindle @ 60 rpm	0.7-0.9
Gel Time	MEK Peroxide 46-709	11 - 15 minutes
Tensile Elongation, % @ Break	ASTM D 638	50
Pot life, minimum		5 minutes
Tensile Strength	ASTM D 638	2,000 psi

2.9 LUMINAIRE

A. Housing:
   1. Die-cast aluminum
   2. Reflectors, sockets, mounting cradles, and clamps fitted to the upper housing.

B. Integral ballast: Pre-wired with quick disconnect plugs mounted on a removable, hinged power door.

C. Power Door: Ballast assembly interchangeable with all luminaires, regardless of wattage.

D. Optical assembly: Formed aluminum reflectors with a chemically bonded, non-breakable, glass finish on both the inside and outside surfaces.

E. Mogul base sockets:
   1. Adjustable with split-shell, tempered-brass lamp grips.
   2. Free-floating, spring loaded center contacts.
   3. Heat- and impact-resistant glass prismatic refractors.

F. Mounting adjustment:
   1. Ten degrees above horizontal for the reflector and refractor.
   2. Five degrees adjustment from vertical on the bracket arm.

G. Weight: no more than 75 lbs.

H. Projected area: no more than 3 square feet.

I. Ballast: high pressure sodium type that will:
   1. Maintain a minimum power factor of 90 percent.
   2. Maintain lamp wattage of not more than five percent for nominal line and lamp voltage.
   3. Maintain regulation of not more than 35 percent for a 10 percent line voltage variation.
   4. Start and operate the lamp at ambient temperatures down to -40 degrees F.
   5. Sustain lamp operation for a minimum of four seconds at a voltage dip of 35 percent.

J. Lamp: high pressure sodium lamp that uses clear bulbs and has:
   1. Apparent color temperature of 2100 K.
   2. CIE chromaticity of X = 0.512, Y = 0.420.
   3. Rated-life of not less than 24,000 hours per 10 hour start.

2.10 GROUND ROD

A. Copper-coated steel as specified.

B. ANSI/UL 467.

2.11 MESSENGER

A. 3/8 inch diameter galvanized, stranded steel cable.

B. Minimum breaking strength of 10,800 lbs. as specified.

C. ASTM A 123.

2.12 MOUNTING BANDS AND BUCKLES

A. As specified.

B. American Iron and Steel Institute, (AISI) Type 201.

2.13 POWER SOURCE

A. Pole Mount: SL series Standard Drawings.
   1. Service disconnect:
      a. Single pole 40 amp 120 volt AC metered for signal.
      b. Double pole 20 amp 240 volt un-metered for lighting.
   2. Provide a manual Electrical Utility Service Equipment Requirements Committee (EUSERC) approved circuit closing link by-pass release meter socket.
   3. Unmetered street lighting circuit.

B. Underground Service Pedestal: As specified. ASTM B 117, and ASTM A 123 (Cabinet). UL E 50076
   1. Enclosure: 0.120 inch galvanized steel or anodized aluminum.
      a. 0.080 inch galvanized steel or anodized aluminum covers.
      b. Finished surface with an environmental green, baked enamel over zinc-chromate primer as specified, or anodized aluminum. ASTM B 117.
      c. Bottom access opening.
      d. EUSERC approved circuit-closing by-pass release meter socket.
      e. Baffled ventilation louvers.

C. Circuit Breaker: Main Breaker
   1. Six space metered.
   2. Six space unmetered bus.

D. Detachable, pad-mount base.

2.14 FLOWABLE FILL

A. Refer to Section 03575.

2.15 HOT MIX ASPHALT

A. Half inch maximum. Refer to Section 02741.

2.16 LED TRAFFIC SIGNAL HEAD MODULE

A. Regulations and Codes. Use new modules that conform to the applicable requirements of the Underwriters Laboratory Incorporated (UL), the Institute of Electrical and Electronics Engineers (IEEE), the Electronics Industries Association (EIA), the National Electronic Code (NEC), the American Society of Testing and Materials (ATMS), the American National Standards Institute (ANSI), and the applicable standards, specifications, and regulations of the UDOT.

B. Ensure certification to NEMA, ITE and VTCSH Standards. Ensure LED TSMs meet current applicable NEMA standards. Bidders are required to supply a certified letter from an independent testing laboratory stating the module(s) has been tested and meets NEMA environmental standards and test procedures.

C. Physical and Mechanical Requirements
   1. Retrofit Requirements
      a. Use retrofit module replacements for existing signal lamps that do not require special tools for installation. Use modules that fit into existing traffic signal housing without modification to the housing.
      b. Use retrofit replacement modules that only require removal of the existing optical unit components, i.e., lens, lamp module, gaskets, and reflector. The module is weather tight and fits securely in the housing, and connects directly to existing electrical wiring. Screw-in modules are not acceptable.
      c. Use retrofit module that includes all necessary components to complete the conversion, including a one-piece gasket.
   2. Optical Unit - Use modules capable of replacing the optical unit.
   3. Tinting - Use tinted lens or transparent film or materials with similar characteristics.
   4. Lens - Use module lens that is a field replaceable part without the need to replace the complete module.

D. Environmental Requirements

1. Use modules rated for use in the ambient operating temperature range, measured at the exposed rear of the module, of -40 degrees F to +165 degrees F. Use modules that incorporate temperature compensated LED technology to operate in the above mentioned temperature ranges.
2. Use modules protected against dust and moisture intrusion per the requirements of NEMA Standard 250-1991, sections 4.7.2.1 and 4.7.3.2, for Type 4 enclosures to protect all internal LED, electronic, and electrical components.
3. Use polycarbonate module lens that is UV stabilized and is a minimum of 1/4 inch thick.

E. Construction

1. Use modules that are a single, self-contained device, not requiring on-site assembly for installation into an existing traffic signal housing, with the power supply integrated into the module.
2. Use modules that have an assembly and manufacturing process designed to assure all internal LED and electronic components are adequately supported to withstand mechanical shock and vibration from high winds and other sources.
3. Use modules that are repairable by a bench technician.

F. Materials

1. Use materials for the lens and signal modules construction that conform to ASTM specifications for the materials where applicable.
2. Use enclosures containing either the power supply or electronic components of the signal module constructed of UL94VO flame retardant materials. The signal module lenses are excluded from this requirement.

G. Module Identification - Identify each individual module for warranty purposes.

1. Identify each module on the backside with the manufacturer's name and serial numbers.
2. Identify the following operating characteristics: nominal operating voltage, power consumption, and Volt-Ampere.
3. Use modules that have a prominent and permanent vertical indexing indicator, i.e., UP ARROW or the word UP or TOP, for correct indexing and orientation inside a signal housing.
4. Use modules conforming to this specification that have the following statement: "Manufactured in Conformance with the Interim Purchase Specification of the ITE for LED Vehicle Traffic Signal Modules" on an attached label.

H. Photometric Requirements

1. Luminous Intensity And Distribution

a. Ensure the maintained minimum luminous intensity values for modules throughout the warranty period, under the operating conditions defined in Articles D and I-2a, and at the end of the warranty period, are not be less than the values shown in Table 3.

Table 3

Maintained Minimum Luminous Intensity for LED Signal Modules Candlepower Values (candelas [cd])				
Vertical Angle Down	Horizontal Angle Left & Right	Red (12-inch)	Yellow (12-inch)	Green (12-inch)
(degrees)	(degrees)	(cd)	(cd)	(cd)
2.5	2.5	339	1571	678
	7.5	251	1159	501
	12.5	141	655	283
	17.5	77	355	154
7.5	2.5	226	1047	452
	7.5	202	935	404
	12.5	145	673	291
	17.5	89	411	178
	22.5	38	178	77
	27.5	16	75	32
12.5	2.5	50	234	101
	7.5	48	224	97
	12.5	44	206	89
	17.5	34	159	69
	22.5	22	103	44
	27.5	16	75	32
17.5	2.5	22	103	44
	7.5	22	103	44
	12.5	22	103	44
	17.5	22	103	44
	22.5	20	94	41
	27.5	16	75	32

b. Ensure the maximum luminous intensity for 12-inch signals do not exceed 800 candelas for the Red, 1,600 candelas for the Green, 3,700 candelas for the Yellow when operating within the temperature specified in Articles D-1 during the warranty period.

2. Color and Brightness - Use modules that meet all ITE color and brightness specifications.

3. Photometric Maintenance - Ensure the manufacturer has a process to test compliance of minimum intensity values in a controlled and independent laboratory during anytime in the warranty period. Alternately, ensure the manufacturer has available a portable, calibrated light meter to allow for field measurement of luminous intensity of Modules.

I. Electrical Requirements

1. General - Ensure all wiring and terminal blocks meet the requirements of Section 13.02 of the VTCSH standard. Two secured, color coded, 36-inch long, 600V, 16 AWG minimum, insulated wires, conforming to the NEC, rated for service at 220 degrees F, and spaded lugs, are provided for electrical connection.
2. Voltage Range.
   a. Ensure modules operate from a 60±3 cycle ac line power over a voltage range from 80V rms to 135V rms. The current draw shall be sufficient to ensure compatibility and proper triggering and operation of load current switches and conflict monitors in the signal controller units the Department has in use.
   b. Ensure nominal operating voltage for all measurements is 120±3 volts rms.
   c. Ensure fluctuations in voltage over the range of 80V rms to 135V rms do not affect luminous intensity by more than ±10 percent.
   d. Ensure the LED circuitry prevents flicker at less than 100 Hz over the voltage specified in Articles I-2a.
3. Transient Voltage Protection - Ensure module on-board circuitry includes voltage surge protection to withstand high-repetition noise transients and low-repetition, high-energy transients as stated in Section 2.1.6, NEMA Standard TS-2, 1992
4. LED Drive Circuitry - Ensure individual LED light sources are wired so that a catastrophic failure of one LED light source will result in the loss of not more than 20 percent of the signal module light output.
5. Electronic Noise - Ensure the LED signal and associated onboard circuitry meets Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.
6. Power Factor (Pf) and AC Harmonics:
   a. Ensure modules provide a power factor of 0.90 or greater when operated at nominal operating voltage, and 77 degrees F.
   b. Ensure total harmonic distortion induced into an ac power line by a Module, operated at nominal operating voltage, with power consumption equal to or greater than 15 watts at 77 degrees F does not exceed 20 percent.
   c. Ensure total harmonic distortion induced into an ac power line by a Module, operated at nominal operating voltage, with a power consumption equal to or less than 15 watts at 77 degrees F does not exceed 40 percent.

7. Failed State Impedance – Ensure modules are designed to sense a loss of light output due to catastrophic LED failures of between 25 to 40 percent. Loss of light output due to LED failure is not detected of losses of less than 25 percent but is detected for any loss of light greater than 40 percent. Ensure the unit, upon sensing a valid loss of light, presents an impedance of 500 K ohms to the ac line.
8. Electronics Technology – Ensure modules use the latest 0.20-inch (5 mm) electronics technology.

J. Manufacturers Certification of Compliance and Warranty Provisions:
1. Certificate of Compliance – Ensure manufacturers provide a Certificate of Compliance to this specification for each shipment of Modules. Identify each Module per Section G.
2. Warranty Provisions - Ensure Bidder provides the following minimum warranty provisions:
   a. Replace or repair module if it fails to function as intended due to workmanship or material defects within the first 84 months from the date of delivery. If repaired, the warranty covers all parts and labor necessary or incidental to the repair.
   b. Ensure the period of guarantee coverage, in no case, is less than the manufacturers usual and customary guarantee period. Provide all guarantees that are customarily issued by the Bidder and/or manufacturer to the State of Utah.
   c. The Bidder may elect to have UDOT make minor repairs or their appointee, with the consent of the manufacturer. Make all other repairs under warranty by the manufacturer. The manufacturer bears all costs including labor, parts, and shipping charges.
   d. Replace or repair all LED Vehicle Traffic Signal Modules that exhibit luminous intensities less than the minimum values specified in Article H-1a within the first 60 months of the date of delivery.

2.17 VIDEO DETECTION CIRCUIT

A. Provide conduit, cabling and lighting, and install State-Furnished video detection equipment as shown in the plans to construct a complete and operational video detection circuit at each intersection.

B. Provide all additional mounting brackets, termination boxes, and other equipment, material and labor necessary to construct a complete and operational video detection circuit per manufacturer recommendations.

PART 3 EXECUTION

3.1 PREPARATION

A. Conform to the National Electrical Code (NEC).

B. Pick up State-furnished materials at the Department's Central Warehouse, 4501 South 2700 West, Salt Lake City, UT.

C. Saw cut concrete or other improved surfaces to be removed in the sidewalk area, and replace with in-kind materials to match the existing grade.

D. Attach brackets with a banding machine with stainless steel bands. Do not drill holes in poles except as shown on the plans. Follow SL series Standard Drawings.

E. Do not disconnect or remove an existing signal system until the replacement system is functioning.

F. Contact power company at least 30 days before the connection date, and verify the exact location, voltage, procedure, and materials required by the power company.

3.2 CONSTRUCT POLE FOUNDATION

A. Follow SL series Standard Drawings.

B. Concrete: AA(AE) required. Refer to Section 03055.

C. Structural Concrete: Refer to Section 03310.

D. Reinforcing Steel and Welded Wire: Refer to Section 03211.

E. Do not weld reinforcing steel, anchor bolts, or conduit.
   1. Use tie wire to secure conduit.
   2. Use template to align and secure anchor bolts.

F. Place the concrete directly into the excavation, and use minimum forming above ground.

3.3 TRENCH FOR CONDUIT

A. Paved Surface (asphalt concrete):
   1. Do not use backhoe.
   2. Make the trench 6 inches wide or less.
   3. Use flowable fill to within 3 inches of the existing roadway surface.
   4. Evenly apply tack coat before final backfill.
   5. Match the composition, density, and elevation (" 3/16 inch) of the existing surface in the final 3 inches of backfill.

B. Unpaved Surface:
   1. Use backfill that matches the composition, density, and elevation (" 3/16 inch) of the existing surface.
   2. Install conduits that cross finished curbs and gutters, sidewalks, concrete flatwork, textured or decorative surfaces by jacking, drilling, or pushing. Entirely replace any damaged section at no additional cost to Department.
   3. Dispose of surplus material daily.

C. Trenching under Railroad (Subject to agreement with railroad):
   1. Install smooth steel casing a minimum depth of 4 ft under railroad track to house conduit.
   2. Six inch diameter casing with a minimum 7/32 inch wall thickness, and a minimum yield strength of 34,950 psi.

D. Minimum cover of conduit:
   1. Minimum cover for all roadway crossings: 2 ft.
   2. Minimum cover off roadway without concrete encasement or capping: 18 inches.
   3. Minimum cover off roadway with concrete encasement or capping with minimum thickness of 2 inches: 12 inches.

3.4 INSTALL CONDUIT

A. Place all conduits in the same trench before surfacing.

B. Above ground use galvanized rigid steel; under ground use PVC.

C. Seal uncapped conduit ends inside junction box with at least 2 inches of duct caulking.

D. In future-use conduit, install No. 14 single conductor copper, type THHN pull wire.
   1. On each end of conduit install cap with 7/32 inch hole for pull wire.

2. Leave 20 inches of wire outside of the cap, fastened securely.
3. Place future-use conduit in top portion of trench for easier access later.

E. Secure conduit on structures with standard galvanized iron conduit clamps using at least 5/16 inch diameter concrete expansion anchors at maximum 5 ft spacing.

F. Use conduit expansion fittings at structure expansion joint crossings.

3.5 INSTALL WIRING

A. Conductors:
1. Clean and dry the inside of the conduit before installing conductors.
2. Install grounding conductor in all power circuit conduits.
3. Use powered soapstone, talc or other approved lubricants when pulling conductors in conduit.
4. Tape the ends of unused conductors and label them as spares.
5. Use conductors that are color coded as specified. Meet IMSA 20-1.

B. Ground wire:
1. In all non-metallic conduit, a ground wire must run continuously and be grounded at each junction box, except in those conduits used solely for interconnect and detector circuits.
2. Bond the ground wire to the ground rod in each junction box except in circuits with less than 50 V.

C. Neatly arrange wiring within cabinets, junction boxes, fixtures, etc.

D. Terminate all terminal connections by a mechanical (spade) connector.

E. Wire splicing:
1. Splice wires only in detection circuits where the wire type changes in the junction boxes.
2. Mechanically secure or solder, individually insulate, and water seal all splices. Encapsulate in a rigid body re-enterable gel filled enclosure, or cover with mastic rubber pads and overwrap with vinyl electric tape.

F. Mark cabinet cables with vinyl electrical color coding tape as specified according to Table 4. Meet UL 510.

Table 4

Cables Marked with Colored Tape				
	Northbound P2	**Southbound P3**	**Eastbound P4**	**Westbound P1**
Signal Circuit	Blue	Red	Yellow	Orange
Detector Circuit	Blue	Red	Yellow	Orange
	Circuit Coding One band, Through, 2 bands, Left Turn, 3 bands, "Q's", Four bands, Dilemma			
Pedestrian	Blue & Green	Red & Green	Yellow & Green	Orange & Green
Pedestrian Button Circuit (3)	Blue & White	Red & White	Yellow & White	Orange & White

G. Connect conductors according to Table 5.

Table 5

Color-Coded Conductors		
	North-South	**East-West**
Seven-Conductor Pedestrian Circuit	Red - Don't Walk Green -Walk White – Neutral	Black - Spare Orange - Don't Walk Blue - Walk White with Black Tracer - Neutral
Three-Conductor Pedestrian Head Circuit	Red - Pedestrian Call White - Common	Black - Pedestrian Call White - Common
Seven-Conductor Signal Circuit	White - Neutral Red - Red Through Orange - Yellow Through Green - Green Through Blue - Green Arrow White with Black Tracer - Yellow Left Black - Left red or spare	

3.6 INSTALL DETECTOR LOOPS

A. Follow SL series Standard Drawings.

B. One turn is once around the perimeter of the loop with the same conductor.
   1. Use number of turns as specified in Table 1 (Loop Resistance Table).

2. Do not allow twists in the loop.

C. Loop lead-in from loop to junction box:
1. Minimum of 3 twists per yard in saw cut.
2. Minimum of 10 twists per yard for conduit.
3. Do not interweave with other loop lead-ins.
4. Each lead-in requires a separate conduit.

D. For Detector Lead-in (feeder) from the junction box to controller cabinet, carry shield across all splices.

E. Saw cut loop:
1. Round the corners with a minimum of 2 inch drill.
2. Remove all loose material and wash and dry all saw cuts.
3. Place all loop wire in a 1/4 inch polyethylene tube.
4. Seat the conductor with no damage at the bottom of the slot.
5. Fill the saw cut with embedding sealant, surround the polyethylene tube to the level of the existing roadway surface " 1/4 inch. Remove any excess embedding sealant.

F. PVC loop:
1. Trench 2 inch maximum width with 4 inch minimum to 6 inch maximum cover.
2. Anchor sensor loops to prevent movement or floating.
3. Apply a tack coat to the sides and the bottom of the remaining 3 inches of trench and backfill with hot mix asphalt. Refer to Sections 02741 and 02748.
4. Loops in new pavement preformed and placed 1 3/4 inches below the surface of the base course and backfill with surrounding material.

3.7 INSTALL POWER SOURCE

A. Verify the exact location, voltage, procedure, and materials required by the power company.

B. Follow SL series Standard Drawings.

3.8 INSTALL LUMINAIRE

A. As specified.

B. Follow SL series Standard Drawings.

3.9 INSTALL SIGNAL HEAD

A. Do not install signal heads at the intersection until ready for operation.

B. If turn on is not immediate, completely cover the signal heads with non-transparent, non-paper material tied securely around head.

C. Install directed and veiled optically-programmed signals following the manufacturer's instructions. Mask each section of the signal with prescribed materials.

D. Use louvered back plates on all signal heads except Type V and VI. Use a minimum of four 1/8 inch stainless steel screws per section to mount the back plates, or according to manufacturer's instructions.

3.10 REMOVE AND SALVAGE EXISTING EQUIPMENT

A. Light poles, signal poles, messenger cable, signal and pedestrian heads, controller cabinets, other items as specified on the plans remain the property of the Department.

B. Transport items to the specified location.

C. Remove foundations to a depth of at least 6 inches below the existing surface.

D. Backfill all holes with local material and compact to the density of the surrounding area.

3.11 INSTALL VIDEO DETECTION

A. Install all video detection components in accordance with the manufacturer specifications.

B. Mount each video detection camera on the signal mast arm using the State-Furnished 46-inch extension pole and mounting bracket.

C. Aim and set camera position and program detection areas as directed by the Engineer.

END OF SECTION

SECTION 02896

BOUNDARY SURVEY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide boundary survey, and plat.

B. Furnish and set right-of-way markers.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

1.3 REFERENCES

A. ASTM A 53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

B. Utah Code 17-23-17

PART 2 PRODUCTS

2.1 RIGHT-OF-WAY MARKERS

A. Pipe: As shown in GW series Standard Drawings. Meet ASTM A 53, Schedule 40, Galvanized.

B. Cast bronze cap: Free from defects and constructed as shown in GW series Standard Drawings.

2.2 CONCRETE

A. Class B concrete per Section 03055.

B. May substitute higher class of concrete.

PART 3 EXECUTION

3.1 RIGHT-OF-WAY MARKERS

A. Place Right-of-Way Markers in accordance with GW series Standard Drawings, including stamping onto each Right-of-Way Marker:
   1. Control Line station
   2. Elevation (To 2 decimal places)
   3. Professional Land Surveyor's License Number
   4. Year
   5. Exact control point location to within 0.01 feet

B. Tightly rivet cap to the pipe.

3.2 BOUNDARY SURVEY

A. Provide record of survey plat by Utah licensed surveyor.

B. File mylar copy of plat with county surveyor, region, and Central Right-of Way offices of Department.

C. Accuracy: Third Order, and Class I (1/10,000).

3.3 PLAT COMPLIANCE REQUIREMENTS

A. Refer to Utah Code 17-23-17.

B. Department procedure Design Process.

C. Show on the survey plat:
   1. Survey coordinates accurate to 5 decimal places and elevations accurate to 2 decimal places on all right-of way markers.
   2. Right-of-Way markers.
   3. Adjacent quarter corners and section corners with bearings and distances along the section line to the control line from each adjacent corner.
   4. Original highway control points (right-of-way markers).
   5. Local city or county monuments.
   6. Control line geometric information with references ties to section and quarter corners.

D. Compute and draw plat, stationing, and coordinates to the same units as the project drawings.

E. Deliver a copy of the survey plat to Engineer on a 3-1/2 inch disk in MicroStation format.

F. Correction Factor: Show state plane to ground correction factor.

G. Show the latitude and longitude of the control line at the beginning and end of the project.

END OF SECTION

SECTION 02911

MULCH

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Types of mulch and application requirements.

1.2 SUBMITTALS

A. The manufacturer's specifications and recommended installation requirements.

B. If straw mulch is required, submit a certificate from the Utah Department of Agriculture indicating the straw has been obtained from a weed-free field.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in original wrapping showing the name of the manufacturer and product description.

PART 2 PRODUCTS

2.1 WOOD FIBER MULCHES

A. Contact UDOT's Region Landscape Architect for Approved List of Wood Fiber Mulches. Approved list is updated annually.

2.2 STRAW MULCH

A. Clean, cereal straw from a field certified by the Utah Department of Agriculture as weed-free and noxious weed-free.

B. Air dried with maximum moisture content of 18 percent.

2.3 TACKIFIER A

A. A dry powder mixture of three hydrocolloids from natural plant sources, which has been combined with a crosslinking agent.

B. Will hydrate when incorporated in a water slurry and resist rewetting when dry on the soil surface, but allow moisture penetration into the soil.

C. Viability of six to nine months.

D. Biodegradable and nontoxic to animal and plant life.

2.4 TACKIFIER B

A. A dry powder produced from grinding the outer coating (psyllium) of the seed collected from the plant, insular plantago.

B. Will hydrate when incorporated in a water slurry and forms a firm, resilient, rewettable membrane on the soil surface.

C. Organic, non-toxic, and safe for animals and plants.

PART 3 EXECUTION

3.1 PREPARATION

A. Complete all required grading and seeding before applying mulch.

B. Apply the mulch within 24 hours after seeding or before precipitation falls. If the mulch is not installed and a precipitation event occurs creating soil erosion, replace eroded material, rework the soil, and reseed before applying the mulch.

3.2 APPLYING MULCH

A. Wood Fiber Mulch

1. Apply wood fiber mulch, tackifier A or B, and water at the following rates per acre:

a.	Mulch:	2,000 lbs
b.	Tackifier A:	40 lbs
	Tackifier B:	150 lbs
c.	Water:	5,000 gal

2. Mix water, tackifier, and wood fiber mulch in a hydroseeder, following manufacturer's directions.
3. Apply mulch to form an even cover over the seeded areas.
4. On cut slopes, extend the mulch over the top of the slope to cover all disturbed areas.

B. Straw Mulch
1. Apply 2,500 lbs of straw (having moisture content less than 18 percent) per acre.
2. Apply straw uniformly using a blower-type mulching machine.
3. Begin application at the top of the slope working in a downward direction.
4. On cut slopes, extend straw mulch over the top of the slope and tie in to existing vegetation.

C. Straw Anchoring
1. Demonstrate and obtain approval of the crimping procedure from the Engineer.
2. On accessible slopes, crimp the straw into the soil using a sheep's foot roller, a dull edged disk-type roller or other approved equipment that will anchor the straw into the soil without slicing the straw. Apply water to compacted or dry soils before crimping.
3. On slopes inaccessible to crimping equipment, inject a tackifier at the rate indicated above into the straw as it leaves the blower or apply a tackifier after straw is placed using a hydromulcher. Mix tackifier at rate indicated above, 5,000 gallons of water and 250 lbs. of wood fiber mulch per acre.

END OF SECTION

SECTION 02912

TOPSOIL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and spread topsoil on prepared areas.

B. Strip topsoil from on-site locations and place in stockpile.

C. Spread stockpiled topsoil on prepared areas.

1.2 REFERENCES

A. AASHTO T 194: Determination of Organic Matter in Soils by Wet Combustion

B. Textural Triangle National Soils Handbook

1.3 SUBMITTALS

A. For Contractor-furnished topsoil: A minimum of 7 working days before delivery of soil, submit to the Engineer the laboratory test results from each topsoil source to be used.

PART 2 PRODUCTS

2.1 CONTRACTOR FURNISHED TOPSOIL

A. Determine PH, EC, and SAR with a saturated soil paste or 1:1 soil/water testing method. Meet the following:
   1. **PH**: 6.0 to 8.0
   2. **EC**: (Electrical Conductivity): less than 4 ds/m
   3. **SAR**: (Sodium Adsorption Ratio): less than 10.

B. Organic matter:
   1. 1 to 20 percent.
   2. Determined by the release upon combustion, Walkley-Black or modified Walkley-Black testing method. AASHTO T 194.

C. Textural classification:
   1. Loam, sandy loam, silt loam or sandy clay loam not exceeding the following percentiles. Refer to Textural Triangle National Soils Handbook, Part 603-5.

Soil component	**Percentile Range**
Sand	20 to 70
Silt	20 to 70
Clay	10 to 30

   2. Determine particle size analysis by the hydrometer testing method.

D. Topsoil free of:
   1. Subsoils (no B or C horizon soils)
   2. Coarse sand and gravel
   3. Stiff clay, hard clods or hard pan soils
   4. Rock larger than 3 inches in any dimension
   5. Trash, litter or refuse
   6. Noxious weeds and weed seeds.

E. Topsoil may contain a maximum of 5 percent rock smaller than 3 inches.

2.2 SOURCE QUALITY CONTROL - CONTRACTOR FURNISHED MATERIAL

A. Obtaining Soil Samples:
   1. Obtain soil samples while the Engineer is present. Provide no less than 0.5 lb per soil sample.
   2. Obtain samples from a thin slice of soil cut from the side of a freshly dug hole or by using a soil auger or sampling tube.
   3. Mix the several small samples taken from various places around the source together to produce a composite sample.
   4. More than one composite sample may be required if the topsoil horizon changes significantly across the source.
   5. Store samples in a clean container at room temperature and out of direct sunlight.
   6. Label the location and date on each sample container.

7. Provide additional soil samples for verification if requested by the Engineer.

B. Soil testing: Engineer will submit soil samples to an approved independent soil testing laboratory capable of performing the tests listed in this section, article 2.1, Contractor Furnished Topsoil. A partial list of acceptable testing laboratories includes:

Brigham Young University
Soil and Plant Analysis Laboratory
255 WIDB
Provo, UT 84602
(801) 378-2760

USU Extension - Soil Lab
University Hill
Logan, Utah 84322-4820
(435) 797-2233

QA Consulting and Testing, LLC
PO Box 627
645 South 240 East
Salem, UT 84653
(801) 423-1116
(800) 743-1501
(801) 423-1813 (fax)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Complete final grading, trench settling and surface preparation before placing topsoil.

B. On steep cut slopes steeper than 2:1 and higher than 16 feet that require the placement of topsoil, place and spread topsoil as the slope is being constructed. Finish according to this Section, article 3.3, Spread Stockpiled and Contractor-Furnished Topsoil, paragraph D.

C. On the remaining topsoiled areas not covered under this article, paragraph B, Contractor is responsible for providing a suitable topsoil surface just before seeding. Suitable topsoil surface is:

1. Non-compacted surface finished according to this Section, article 3.3, Spread Stockpiled and Contractor-Furnished Topsoil.
2. Weed free.
3. Finish grade provides a uniform surface with smooth transitions between grade changes and disturbed areas.

D. Do not strip or handle wet topsoil.

E. Establish finish grade at 1 inch below the top of all walks, curbs, mow strips and other hard surfaces for areas receiving seed or turf seed and 1-1/2 inch for areas receiving turf sod.

3.2 STRIP AND STOCKPILE TOPSOIL

A. Strip the topsoil
1. Only from areas identified on the plans or approved by Engineer.
2. To a depth approved by the Engineer.

B. Remove and dispose of any roots larger than 2 inches in diameter or 12 inches in length.

C. Stockpile stripped topsoil:
1. At locations acceptable to the Engineer.
2. So that placement or activity around the stockpile does not damage or impact any existing trees, shrubs or environmentally sensitive areas. Obtain appropriate clearances if such impacts are unavoidable.

D. Grade to minimize erosion on and around the stockpiles.

3.3 SPREAD STOCKPILED AND CONTRACTOR-FURNISHED TOPSOIL

A. Clear area to receive topsoil of all trash, debris, weeds, and rock 3 inches or larger, and dispose of objectionable material in an approved manner.

B. Place and spread the stockpiled topsoil over the prepared slopes to the plan depths.

C. On slopes 3:1 and flatter, disc or harrow the placed topsoil along the contour, or cat-track the slopes to create continuous cleat tracks that run parallel with the contours.

D. On slopes steeper than 3:1, cat-track the slopes to create continuous cleat tracks that run parallel with the contours.

END OF SECTION

SECTION 02922

SEED, TURF SEED, AND TURF SOD

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Seed, turf seed, and turf sod requirements and application.

B. Surface preparation.

1.2 RELATED SECTIONS

A. Section 02912: Topsoil

1.3 REFERENCES

A. Utah Seed Law

1.4 SUBMITTALS

A. Copy of the purchase order to the Engineer documenting that all seeds, including substitutions, have been acquired before the seeding window begins.
   1. For seeding schedule, refer to this Section, article 1.6, Scheduling.
   2. The purchase order should list the common and botanical name for each seed species.

B. Certification that turf sod is nursery grown and contains a minimum of three varieties of Kentucky Blue Grass.

C. Certification indicating the date and time sod was cut at the nursery.

D. Furnish fertilizer labels to Engineer.

E. Through the Engineer, supply legible copy of Seed Certification Reports to Region Landscape Architect.

F. Seed certification: Include the following on seed certification reports and labels:
   1. Botanical name (include variety if applicable).
   2. Common name.
   3. Name of seed testing laboratory.
   4. Lot number and address of the seed company.
   5. Weed seed (percent).
   6. Other crop seed (percent).
   7. Inert matter (percent).
   8. Pure live seed (percent).
   9. Noxious weed seed (name and rate of occurrence).
   10. Date tested (month and year).
   11. Germination (percent).
   12. Hard seed (percent).
   13. Net weight (do not include container weight).
   14. Pure live seed weight.
   15. Collection locations for native shrub and tree species (state, county, elevation).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Mixing Seed:
   1. Notify Engineer seven calendar days prior to seed mixing.
   2. Engineer will verify that the seed certification report or label represents the seed lot from which the seed is furnished.
   3. Mix the different seed varieties to provide an even blend.
   4. Bag the mixed seed, seal the container, and attach a signed UDOT label to the exterior.

B. Deliver seed or turf seed to job site in original containers showing analysis of seed mixture, net weight, and date and location of packaging. Damaged packages are not acceptable.

C. Strip turf sod from nursery no more than 24 hours before laying.

D. Deliver fertilizer in containers showing weight, chemical analysis, and name of manufacturer. Store fertilizer in a weatherproof location.

1.6 SCHEDULING

A. Pre-measure the area to be seeded before ordering seed from supplier. The Engineer must approve the measuring technique and determined quantity.

B. Seeding Window: Complete all general roadside seeding within the appropriate seeding window.
   1. If the seeding is not completed within the given window, postpone seeding until the following year.
   2. Under certain conditions, an exception to this window may be obtained through the Region Landscape Architect. The Engineer approves exceptions.

Elevation	Seeding Window
Below 4000 ft	Oct. 1 to Dec. 31
4000 to 6000 ft	Sept. 15 to Dec 1
Above 6000 ft	Sept. 1 to Nov 15

C. Turf seed and turf sod can be placed only after irrigation system is installed and operational.

D. Topsoil: Refer to Section 02912.
   1. Place topsoil just before seeding to eliminate competition from weeds.
   2. Coordinate topsoil placement with the above seeding window.

PART 2 PRODUCTS

2.1 SEED AND TURF SEED

A. Meet the Utah Seed Law: Utah Code - Title 4, Chapter 16.

B. Supply seed on a pure live seed (PLS) basis.

C. Obtain seed from lots that have been tested by a state certified seed testing laboratory. (Association of Seed Analyst (AOSA) or Society of Commercial Seed Technologists (SCST).
   1. Seed germination test older than 18 months for grass seed, and nine months for forb, shrub, or tree seed are not acceptable.
   2. Based on the amount or type of seed required on a project, UDOT may require additional testing by the Department of Agriculture.

D. Do not use wet, moldy, or otherwise damaged seed.

E. Seed Substitutions
   1. Before requesting a seed substitution, contact the major seed brokers in the state to verify that the seed is unavailable.
   2. Have the Engineer contact the Region Landscape Architect to verify the seed is unavailable and to recommend a seed substitution.

3. Replace originally specified seed with seed of equal or greater cost.

2.2 TURF SOD

A. Healthy and well-rooted nursery grown Kentucky Blue Grass sod comprised of a minimum of three varieties and free of weeds.

B. Machine cut in straight, uniform strips or rolls, cut at a depth between 3/4 inch and 1 inch.

2.3 FERTILIZER (For turf sod and turf seed areas only)

A. Uniform in composition, dry and free flowing.
   1. For turf seed or turf sod: Elemental nitrogen in granular form. Phosphorus, and potassium are optional and may be applied with nitrogen in granules. A minimum of 50 percent of nitrogen shall be in a slow release form such as sulfur coated urea or urea formaldehyde.
   2. If hydroseeding method is used, apply elemental nitrogen with a concentration ranging from 21-34 percent.

PART 3 EXECUTION

3.1 PREPARATION

A. Complete all final grading, trench settling, topsoil placement, surface preparation, and irrigation work before seeding begins.

B. Prepare General Seedbed (for all seeded and sodded areas).
   1. Before any seed or sod work begins, properly prepare the topsoil surface and have it approved by the Engineer. Refer to Section 02912.
   2. Do not work topsoil or seed when the soil is saturated or frozen.

C. Prepare Turf Seedbed:
   1. Review finish grade to confirm that topsoil is 1 inch below the top of all walk, curbs, mow strips and other had surfaces.
   2. Apply fertilizer at the rate of 2 lbs/100 yd^2 and mix thoroughly into upper 2 inches of topsoil.
   3. Do not apply fertilizer and seed at the same time in the same machine.

D. Prepare Turf Sod Surface:
   1. Review finish grade to confirm that topsoil is 1-1/2 inch blow the top of all walks, curbs, mow strips and other hard surfaces.
   2. Apply fertilizer at the rate of 2 lbs/100 yd^2 and mix thoroughly into upper 2 inches of topsoil.
   3. Level and roll seeded areas using a 21 gal water-filled hand roller containing 8 gallons to 10 gallons of water.
   4. Just before laying the sod, lightly rake and dampen with water the top 1/8 to 5/8 inches of soil.

3.2 SEEDING

A. Notify the Engineer seven working days before seeding.

B. Apply seed at the rate indicated in the Seed Schedule shown in the plans.

3.3 DRILL METHOD

A. Use the drill method of seeding on accessible slopes 3:1 and flatter.

B. Use a rangeland type drill for non-turf areas or a Brillion type drill for turf areas equipped with the following:
   1. Depth band
   2. Seed box agitator
   3. Seed metering device
   4. Furrow opener
   5. Packer wheels or drag chains

C. Provide the Engineer a copy of the manufacturer's directions on drill calibration two working days before seeding.

D. Using the drill manufacturer's directions, and in the presence of the Engineer, calibrate the drill to apply seed at the rate indicated in the seeding schedule.

E. Space drill rows a minimum of 6 inches and a maximum of 8 inches.

F. Fill the seed box/boxes no more than half full when drilling on a slope.

G. Set depth bands to drill seeds to a 1/2 inch depth.

H. Drill along the contour.

I. Maintain the drill at the calibrated setting throughout the seeding operation.

J. Allow the furrows that are created by the drill to remain.

3.4 BROADCAST METHOD

A. Use the broadcast method of seeding under the following conditions:
   1. Slopes steeper than 3:1.
   2. Slopes 3:1 and flatter where the area to be seeded is inaccessible to drill.
   3. Where the area to be seeded is not large enough to justify using a drill.
   4. Where rocky surface conditions would damage a drill.

B. Obtain approval of the broadcast method by demonstrating the procedure on a 100 yd^2 area.

C. Broadcast the seed and rice hull carrier (if needed).
   1. Evenly in one direction with a cyclone seeder or other approved mechanical seeder.
   2. Or, using a hydroseeder, apply seed, water and 300 lbs of cellulose fiber mulch (tracer) per acre.

D. Do not seed during windy weather or when soil is saturated.

E. Incorporate the seed into the soil by one of three methods:
   1. Cat-tracking, running the dozer up and down the slope, creating continuous cleat tracks that run parallel with the contours.
   2. Hand raking the seed in 1/2 inch deep and along the contours of the slope.
   3. Slope chaining by pulling the chain along the contour until the seed is covered.

3.5 TURF SEEDING

A. Apply turf seed. Refer to this Section, article 3.3, Drill Method and article 3.4, Broadcast Method, paragraph C 2.

B. Roll seeded areas using a hand roller half filled with water. Rolling is not necessary if a Brillion type seeder is used.

C. Lightly water and program the irrigation system to maintain a moist seedbed.

D. Along walkways, rope-off newly seeded areas using bright plastic ribbon tape attached to stakes.

3.6 LAYING SOD

A. Refer to this Section, article 1.6, Scheduling, paragraph C for timing.

B. Place sod with all edges and joints tightly butted.
   1. Do not stretch or overlap sod.
   2. Keep length seams in a straight line.

C. Lay turf sod with staggered joints and trim off excess material along the edges.

D. Roll sod immediately after placing using a hand roller half filled with water.
   1. Re-roll if depressions still remain.
   2. Thoroughly water with a fine spray to a depth sufficient that the underside of the new sod and soil immediately below the sod are thoroughly wet.

END OF SECTION

SECTION 02931

POLE PLANTINGS/WILLOW CUTTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Collecting and installing pole plantings and/or willow cuttings.

1.2 REFERENCES

A. International Society of Arboriculture: Current Standards for Pruning

1.3 SCHEDULING

A. Install poles and cuttings in the fall after October 15, and before the ground becomes frozen or in the spring after the ground thaws and before April 15.

PART 2 PRODUCTS

2.1 POLES AND CUTTINGS

A. Collect poles and cuttings from live native stands of the species listed from October 15, to February 15.

B. Obtain poles and cuttings from live trees and shrubs that will be destroyed due to highway construction, from areas adjacent to the project or from locations that are ecologically matched in climate and elevation.

C. Before collecting poles and cuttings outside the right-of-way, obtain necessary permits from appropriate regulatory agency or permission from land owner.

D. When collecting poles and cuttings from trees or shrubs that will remain, prune branches using current standards from the International Society of Arboriculture.

E. When obtaining poles and cuttings from vegetation that will remain within the right-of-way, remove no more than 1/3 of the branches from any tree or shrub.

F. Size of poles and cuttings, as determined by the Engineer:
   1. Pole: Cut branches at a 45 degree angle, 6 ft long and 1 inch to 3 inches in diameter from one to three-year-old growth.
   2. Willow Cutting: Cut stems at a 45 degree angle, 3 ft long and 3/8 to 3/4 inch in diameter from one to two-year-old growth.

PART 3 EXECUTION

3.1 STORING

A. If dormant poles and cuttings are acquired but not planted in the fall, store until the ground thaws.

B. Store in plastic bags at temperatures between 32 degrees F to 41 degrees F, or outside in snow-filled plastic bags.

C. Do not allow the poles or cuttings to dry out or break bud while being stored.

3.2 INSTALLING

A. Stake poles and cuttings at plan locations for approval or as directed.

B. Dig a hole deep enough to accommodate 90 percent of the length of the cutting.

C. Just before planting, remove 1 inch from the basal end of the pole or cutting.

D. Place the pole or cutting in the hole (basal end first).

E. Backfill and compact around the pole or cutting to eliminate air pockets.

F. Water the pole or cutting and add more backfill if settling occurs.

END OF SECTION

SECTION 02932

TREES, SHRUBS, AND GROUNDCOVERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnishing and installing plant material.

1.2 RELATED SECTIONS

A. Section 02912: Topsoil

B. Section 02936: Vegetation Establishment Period

1.3 REFERENCES

A. ANSI Z 60.1: American Standard for Nursery Stock

1.4 SUBMITTALS

A. A copy of the plant purchase order indicating plant names, sizes, quantities, and unit prices. Submit within 90 calendar days from the Notice to Proceed.

B. Plant substitutions:
   1. Obtain a signed statement from three wholesale nurseries, noted for stocking the specified plant(s), indicating that the plant(s) is unavailable.
   2. Submit to the Engineer the signed statements and a written request indicating the size and species of the unavailable plants and their suggested replacements.
   3. Substitutions will not be approved after 120 calendar days from the Notice to Proceed.

C. All necessary inspection certificates for each shipment of plants as required by Utah Laws and Regulations.

1.5 QUALITY ASSURANCE

A. Reject plants not meeting ANSI specifications.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Secure required plants at a nursery within 60 calendar days from the Notice to Proceed.

B. Before site delivery, grow plants under full exposure to climatic conditions for a minimum of 60 calendar days.

C. Notify the Engineer at least 14 calendar days before delivering the plants to the site.

D. Deliver plant materials to the work site in covered vehicles just before placement.

E. Maintain delivered plants in a healthy condition.
   1. Replace all wilted, windburned or stressed plants at no additional cost to the Department.
   2. Protect balled and burlapped rootballs from sun and wind by covering with soil or other suitable material if not planted immediately upon delivery.

1.7 PLANT INSPECTION AND ACCEPTANCE

A. Replace unacceptable plant material within 14 days after notification from the Engineer.

B. The plant inspection only occurs after all plant materials have been installed.

C. The Engineer schedules the inspection date.

D. Make the required field adjustments and changes following the inspection.

1.8 SCHEDULING

A. Install irrigated plants using the following schedule:

Elevation	Planting Season
Below 4000 ft*	March 1 - December 1
3940 to 6000 ft	April 15 - October 15
Above 6000 ft	May 1 - July 1

* No planting in July or August.

B. Install non-irrigated plants in the fall after the plant is dormant and before the ground freezes.

PART 2 PRODUCTS

2.1 PLANTS

A. Supply healthy plants of the species and size specified, true to form, free from disfiguring knots, sunscald, frost cracks, abrasions of the bark, and all forms of infestation and disease.

B. Provide legible labels attached to all plants, flats, bundles, or other containers indicating botanical genus, species, and size.

C. Supply trees with straight central leaders capable of standing upright without the support of stakes or guys.

D. Establish fully in the container, container supplied plants.

E. Use no balled and burlapped plants if the ball of earth surrounding roots has been cracked or broken or if the burlap is not secure.

F. Use bare-root plant material as approved by the Engineer.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that area prepared to receive plants is graded properly as per plan, all work is completed in the area, and that topsoil has been placed. Refer to Section 02912.

B. Have the irrigation system installed and fully operational before installing plants.

C. Stake or delineate locations of plants for approval before installation.

3.2 INSTALLATION

A. General
   1. Install plants so that the top of the rootball is flush with the surrounding finished grade.
   2. Within one hour of installation, water the plants to saturate the rootball to a minimum of 4 inches below and around the plant hole. Add more backfill if settling occurs.

B. Containerized Plants
   1. Excavate plant holes to twice the diameter and the same depth of the rootball.
   2. Carefully remove the plant from its container, scarify the sides and bottom of the rootball if needed and place it in the prepared hole.
   3. Place excavated soil in 4 inch lifts around the rootball and eliminate voids by tamping the soil between each lift.

C. Balled and Burlapped Plants
   1. Excavate plant holes to twice the diameter and the same depth of the rootball.
   2. With burlap securely intact, gently place the plant in the prepared hole.
   3. Reject mishandled or plants with broken root balls.
   4. Remove the top half of the burlap without disturbing the root ball.

D. Tubeling Plants
   1. Auger a hole the same size as the tube.
   2. Immediately following excavation of the hole, gently place watered tubeling in the prepared plant pit so that the roots are not tangled, compacted, or curled up at the ends.
   3. Compress the soil at the base of the tubeling to eliminate voids between the rootball and existing soil.

3.3 CLEANING AND MAINTENANCE

A. Remove from site foreign materials such as containers, burlap, and twine collected during installation.

B. Remove any tags, labels, or other items attached to the plant material after final plant inspection.

C. Water and maintain the plants in a healthy condition until the final plant inspection. Refer to Section 02936 for vegetation establishment period.

END OF SECTION

SECTION 02936

VEGETATION ESTABLISHMENT PERIOD

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Establish and care for plantings requiring watering.

1.2 ESTABLISHMENT PERIOD

A. A length of time during which the Contractor is responsible for caring for and establishing plant material installed on the project.

B. The establishment period begins after the irrigation system and plant installation inspections and acceptance have been completed and continues for one calendar year, or as otherwise specified in the contract.

1.3 PAYMENT PROCEDURES

A. When there is no bid item included in the proposal for "Vegetation Establishment Period:"
   1. This work is considered incidental to other items of work and no separate measurement or payment will be made.
   2. Include all costs in other items of work.

1.4 QUALITY ASSURANCE

A. The Department conducts three inspections to determine if the Contractor is satisfactorily performing work under the Establishment Period. The inspections occur at the Engineer's discretion.

B. Replace in kind any dead or unacceptable plant or sod within four weeks of notification at no additional cost to the Department.

C. At the end of the establishment period and after all unacceptable plants have been replaced, the Engineer accepts the plants in writing and relieves the Contractor of further responsibility for that portion of the project.

PART 2 PRODUCTS Not Used.

PART 3 EXECUTION

3.1 INSTALLATION

A. Establish healthy trees, shrubs, groundcovers, and turf installed on the project.

B. Replace any plant or sod that dies or is unacceptable during the establishment period with an identical plant at no additional cost to the Department.

C. Not be held responsible for plants damaged due to acts of nature, vandalism, or errant vehicles. Immediately notify the Engineer if such an event occurs.

3.2 PLANT CARE

A. Watering:
   1. Pressurized irrigation system: When a pressurized irrigation system has been installed to establish plant material or turf, set the controller to apply the appropriate amount of water and make seasonal adjustments as necessary.
   2. Hand watering: If a pressurized irrigation system is not included in the project, hand-water the plant to provide healthy plant material through the establishment period.

B. Maintain weed-free plant basins or areas where mulch has been placed.

C. Prune broken, dead, or diseased branches to the next lead.

D. Repair any non-functional water basins.

3.3 LAWN CARE

A. Apply a 16-0-0 (NPK ratio) fertilizer once in the fall following manufacturer's recommendation.

B. Control broadleaf weeds using a selective herbicide as required.

C. Repair and reseed or resod areas showing rodent or erosion damage.

3.4 LAWN MOWING AND TRIMMING

A. When turf has established, begin mowing lawn a minimum of one time per week during the morning (7:00 a.m. to 11:00 a.m.) or evening (5:00 p.m. to 8:00 p.m.)

B. Set mower to cut the grass at a 3-inch height. Keep mower blades sharp.

C. Bag all grass clippings unless a mulching mower is used.

D. After mowing, trim along sidewalks, curbs and mow strips. Trim to the same height as the mower cuts (3 inches).

3.5 PRESSURIZED IRRIGATION SYSTEM

A. If an irrigation system is installed to establish plant materials or turf, the following is required:
   1. Repair or replace any component that does not allow the irrigation system to operate properly. Use replacement parts of the same type and make.
   2. Repair any erosion caused by leaking or broken irrigation equipment.
   3. Repair any settling occurring around valve boxes or trenches.
   4. If irrigation breaks or subsequent repairs damage installed plants, sod, or seeded areas, replace according to plan.
   5. Winterize the system in the fall by turning off the water and blowing out all supply, main, and lateral lines using an air compressor with a maximum 100 psi, and following established procedures. Coordinate with the Engineer.
   6. Replace at Contractor's expense any irrigation system component that breaks as a result of improper winterization.

END OF SECTION

SECTION 02938

TREE PRUNING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Selectively remove and dispose of tree limbs.

1.2 RELATED SECTIONS

A. Section 02231: Site Clearing and Grubbing.

1.3 REFERENCES

A. ANSI Z 133.1: Pruning, Trimming, Repairing, Maintaining, and Removing Trees, and Cutting Brush- Safety Requirements.

B. Current standards for pruning - International Society of Arboriculture. (ISA).

1.4 SUBMITTALS

A. Obtain necessary permits from the municipality and/or city forester in which the work is performed and submit a copy of the permits to the Engineer seven calendar days before work begins.

B. A copy of the arborist's certificate from I.S.A.

1.5 QUALITY ASSURANCE

A. Contractor must provide an I.S.A. certified arborist to supervise tree pruning.

PART 2 PRODUCTS

2.1 DISINFECTANT

A. Chlorine based.

PART 3 EXECUTION

3.1 TREE PRUNING

A. Conform to ANSI A 133.1.

B. Prune trees following listed references.

C. Remove tree branches extending over the roadway to provide a clear height of 15 ft above the paved surface and 10 ft above sidewalks.

D. Spray pruning equipment with disinfectant after coming in contact with diseased plant material.

E. Use the “Natural Target” or “Drop Crotch” pruning method when removing limbs.

F. Do not top, pollard, stub, or dehorn any tree.

G. Make all pruning cuts sufficiently close to the trunk or parent limbs without cutting into or removing the branch collar or the branch bark ridge.

H. Prune trees to make them shapely, symmetrical, and typical of the natural form of the species being pruned.

I. Do not remove branches that will deform the appearance of the tree.

3.2 BRANCH DISPOSAL

A. Shred removed branches into wood chips 6 inches or smaller.

B. Remove all wood chips larger than 6 inches.

C. Where feasible and where placement will not be detrimental to vegetation growth, broadcast shredded branches over and around the site where trees are being pruned or removed. Refer to Section 02231.

END OF SECTION

SECTION 02961

ROTOMILLING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mill the existing bituminous surface at the location and to the depth specified in the plans.

1.2 RELATED SECTIONS

A. Section 01355: Environmental Protection

B. Section 02968: Optional Use of Reclaimed Asphalt Pavement

C. Section 02969: Optional Use of Reclaimed Asphalt Pavement (PG Grade Project Only)

PART 2 PRODUCTS

2.1 MATERIALS

A. Use the milled material obtained from the rotomill process passing a 2-inch sieve as optional use of Reclaimed Asphalt Pavement (RAP) following Section 02968 or Section 02969.

2.2 EQUIPMENT

A. Use power-operated track propelled planing machine or grinder:
   1. Capable of milling to plan cross slope.
   2. Self-propelled with sufficient power, traction, and stability to maintain accurate depth of cut.
   3. Maximum of 5/8-inch between the cutting teeth on the mandrel.

B. Use appropriate cleaning equipment capable of sweeping and picking up millings to clean up after milling operation.

PART 3 EXECUTION

3.1 PROCEDURE

A. Rotomill existing bituminous pavement surface to the width and depth shown on the plans to an accuracy of ± 1/4-inch of plan depth, measured from original surface to the top of the ridge.

B. Rotomill the area directly surrounding manholes, catch basins, water meters, water valves or any other permanent fixtures to the specified depth.

C. The Engineer:
   1. Measures and records rotomilling depths, taking two random measurements every 1,000 ft of each pass of the milling machine.
   2. May adjust the depth of the milling operation to remove unacceptable material or to improve ride.

D. Maintain grade control using 50-foot ski, wire guide, or other approved grade control methods to control the profile grade of the rotomill.

E. Load the reclaimed material from milling operation into a truck in one operation. Milled material is the property of the Contractor, unless specified otherwise by the Engineer.

3.2 CLEANING AND REPAIR

A. Remove and clean all millings from the surface daily. Control dust created by the cutting action. Clean rotomilled surface after milling operation and prior to opening to traffic. Meet environmental regulations following Section 01355 for cleaning process.

B. Remove and replace, or repair damage caused by the Contractor's operation outside of the widths and depths shown in the plans. Repair at Contractor's expense. Damage to traffic due to loose material on milled surface repaired at Contractor's expense.

C. Dispose of the milled material in a manner approved by the Engineer and in accordance with Section 01355.

END OF SECTION

SECTION 02962

IN-PLACE COLD RECYCLED ASPHALTIC BASE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mill existing asphalt material to required depth and width.

B. Mix with emulsified asphalt, quick lime slurry, and water if required, place to line and grade and compact.

1.2 RELATED SECTIONS

A. Section 02745: Asphalt Material

1.3 PAYMENT PROCEDURES

A. Include all costs for quick lime slurry in the item In-Place Cold Recycled Asphaltic Base.

1.4 REFERENCES

A. AASHTO T 26: Quality of Water to be Used in Concrete

B. AASHTO T 166: Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens

C. AASHTO T 245: Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus

D. ASTM C 110: Standard Test Methods for Physical Testing of Quicklime, Hydrated Lime, and Limestone

E. ASTM C 977: Standard Specification for Quicklime and Hydrated Lime for Soil Stabilization

F. ASTM D 2950: Test Method for Density of Bituminous Concrete in Place by Nuclear Method

G. UDOT Materials Manual of Instruction

1.5 SUBMITTALS

A. Submit mix design for ENGINEER'S approval prior to commencing cold recycling operation.

B. Provide a Manufacturer's Certificate of Compliance for Quick Lime.

1.6 ACCEPTANCE

A. The Department runs five density tests on each test lot.
   1. A test lot is defined as the amount of cold recycled material placed during one full day's production.
   2. Each density test consists of the mean of three in-place nuclear wet density tests. ASTM D 2950.
   3. Establish the target density by obtaining a sample of loose material from the roadway just ahead of the rolling operation.
      a. Heat sample in oven at 140 degrees F for two hours maximum.
      b. Compact mix immediately using standard 50 blow Marshall procedure. AASHTO T 245.
      c. The target for roadway compaction is 96 percent of the mean of 3 Marshall briquettes for each test lot. AASHTO T 166.

B. The Engineer verifies the surface with a 10-ft straightedge at selected sites. Correct surface variations in excess of 3/8-inch by removing or adding material.

PART 2 PRODUCTS

2.1 MATERIALS

A. In-Place Cold Recycled Asphaltic Base gradation:

Sieve Size	Percent Passing
1-1/2 inch	100

B. Use asphalt emulsion as shown on the plans. Refer to Section 02745.

C. Use high calcium pebble quick lime (Hot hydrated lime slurry) that has a minimum dry solids content of 35 percent by weight and that is a pumpable suspension of solids in water. Quick lime slurry must conform to ASTM C 977 using test method ASTM C 110.

D. Use 1.5 percent quick lime by weight of cold recycled base.

E. Use potable water for the quick lime slurry. AASHTO T 26.

2.2 EQUIPMENT

A. Use self-propelled equipment with sufficient power, traction and stability to maintain an accurate depth of cut.

B. Use equipment that will process full depth and lane width in one pass, with screening and crushing capability.

C. Use a machine capable of mixing the pulverized material, emulsified binding agent, and quick lime slurry to a homogeneous mixture.

D. Provide lime slurry equipment that accurately proportions quick lime and water, mixes these ingredients to obtain proper slaking, and maintains a uniform, homogenous slurry. Agitate slurry sufficiently to prevent separation while transporting. Add the lime slurry to the pulverized surfacing by a spray bar at the cutting head on the mill. Accurately meter the slurry into the recycled materials.

E. Use a mixing machine capable of placing the mixed material into a windrow or directly into the hopper of a paver.

F. Separate machinery may be used for mixing.

G. Use a positive displacement pump capable of accurately metering the required quantity of additive down to a minimum rate of 4 gallons per minute.

H. Use a mixing machine that has a meter capable of measuring the flow and total delivery of the additive.

I. When a pick-up machine is used to feed the paver, it must be capable of picking up the entire windrow.

J. Use 30-ton minimum pneumatic rollers.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean or clear away all debris and vegetation within 1 ft of pavement edge.

3.2 RECLAIMED MATERIALS

A. Mill pavement to required depth and width.

B. Control dust created by the cutting action.

C. Crush or screen the reclaimed material to pass a 1-1/2 inch sieve.

D. Reclaimed material must be free of organic materials, soil, or other foreign substances.

3.3 PLACEMENT

A. Place the mixed material with a self-propelled asphalt paver.

B. Adjust emulsion content as pavement conditions change. Repair reclaimed materials when surface ruts or ravels before placement of final wearing surface.

C. Use watering device to prevent materials from adhering to the tires for breakdown or intermediate rolling.

D. Add water to milled material as necessary to facilitate uniform mixing.

E. Continue breakdown rolling until no displacement is noted.

F. Use steel wheel rollers in static or vibratory mode as required for final rolling.

G. Wait 72 hours after a rain or confirm that moisture content is less than 1.5 percent before placing flush, tack, or final surfacing on cold recycled material.

3.4 LIMITATIONS

A. Do not disturb underlying crushed aggregate base.

B. Do not heat screed.

C. Do not park roller or leave idle on uncompacted recycled surface.

D. Perform recycling operations when ambient temperature exceeds 50 degrees F in the shade and pavement temperature exceeds 70 degrees F. Stop recycling operations when weather is foggy or rainy.

E. Prohibit traffic on compacted recycled material for 2 hours after compacting is completed. Remove all loose aggregates by power brooming before allowing traffic on the compacted recycled material.

END OF SECTION

SECTION 02963

PROFILE ROTOMILLING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mill the existing bituminous surface at the location and to the profile and cross-slope specified in the plans.

1.2 RELATED SECTIONS

A. Section 01355: Environmental Protection

B. Section 02968: Optional Use of Reclaimed Asphalt Pavement

C. Section 02969: Optional Use of Reclaimed Asphalt Pavement (PG Grade Project Only)

PART 2 PRODUCTS

2.1 MATERIALS

A. Use the milled material obtained from the rotomill process passing a 2 inch sieve as optional use of Reclaimed Asphalt Pavement (RAP) following Section 02968 or Section 02969.

2.2 EQUIPMENT

A. Use power-operated track propelled planing machine or grinder:
   1. Capable of milling to the plan cross slope.
   2. Self-propelled with sufficient power, traction, and stability to maintain accurate depth of cut.
   3. Maximum of 5/8 inch between the cutting teeth on the mandrel.

B. Use appropriate cleaning equipment capable of sweeping and picking up millings to clean up after milling operation.

PART 3 EXECUTION

3.1 PREPARATION

A. The Engineer measures and records profile grades during rotomilling operation:
   1. Use a means that provides the required accuracy.
   2. Take two random measurements for every 1,000 ft of each pass.

B. Achieve a rotomilled depth in the field of plan depth " 1/4 inch, measured from original surface to the top of the ridge.

C. Rotomill existing bituminous pavement surface to a depth below final profile and cross slope grade, as shown on the plans.

D. Clean rotomilled surface after milling operation and prior to opening to traffic. Meet environmental regulations following Section 01355 for cleaning process.

E. Remove and replace, or repair damage by the Contractor's operation outside of the widths and depths shown in the plans. Repair at Contractor's expense. Damage to traffic due to loose material on milled surface repaired at Contractor's expense.

F. Use a wire guide or other approved grade control methods to control the profile grade and cross slope of the rotomill.

G. Load the reclaimed material from milling operation into a truck in one operation. Remove and clean all millings from the surface daily. Control dust created by the cutting action.

H. Milled material is the property of the Contractor, unless specified otherwise by the Engineer.

I. Dispose of the milled material in a manner approved by the Engineer and in accordance to Section 01355.

J. Rotomill the area directly surrounding manholes, catch basins, water meters, water valves or any other permanent fixtures to the specified depth.

END OF SECTION

SECTION 02966

RECYCLED SURFACE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for recycling the existing surface by heating, scarifying, screeding, and compacting the existing surface.

1.2 RELATED SECTIONS

A. Section 02741: Hot Mix Asphalt

B. Section 02745: Asphalt Material

1.3 REFERENCES

A. AASHTO T 48: Flash and Fire Points by Cleveland Open Cup

B. AASHTO T 59: Testing Emulsified Asphalt

C. AASHTO T 201: Kinematic Viscosity of Asphalts

D. AASHTO T 240: Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin Film Oven Test)

E. ASTM D 244: Emulsified Asphalts

F. ASTM D 2006-71: Rostler Test Method

G. ASTM D 2007: Characteristics Groups in Rubber Extender and Processing Oils and Other Petroleum-Derived Oils by the Clay-Gel Absorption Chromatographic Method

PART 2 PRODUCTS

2.1 HEATER/SCARIFYING EQUIPMENT

A. Heating unit
   1. Enclosed combustion area.
   2. No open flame to come in direct contact with asphalt surface.
   3. Burn only clean burning fuels (propane, butane, etc.).
   4. The Utah State Fire Marshal inspects and approves units that use liquified natural gas at least annually.
   5. Use equipment meeting the requirements of the Utah State Liquified Petroleum Gas Board.

B. Safety Shut-off Switch for the Heat Exchanger
   1. Clearly marked and easily operated.
   2. Controlled from both the ground and the operator's station.
   3. Instantaneously turn off the heat exchanger and the fuel supply.

C. Scarifier Unit
   1. Have at least two rows of spring equalized scarifier rakes (hydraulic or pneumatic leveling).
   2. Removable teeth in the rakes.
   3. Spring release for manhole and valve protection.

D. Screed
   1. Heated to maintain specified surface temperature.
   2. Have reversible augers to move material left or right.
   3. Vibratory or oscillating screed.

2.2 ASPHALT REJUVENATING AGENT

A. Petroleum resin oil base emulsified with water and conforming to the requirements in Table 1.

B. Asphalt Materials: Refer to Section 02745.

Table 1

Asphalt Rejuvinating Agent				
Test on Emulsion	**ASTM**	**AASHTO**	**Min.**	**Max.**
Viscosity at 77 degrees F, SFS		T 59	15	85
Residue, percent		T 59	60	
Cement Mixing Test, percent		T 59		2.0
Sieve Test, percent		T 59[2]		0.1
Particle Charge Test		T 59	Pos.	Pos.
Test on Residue Oil				
Original				
Viscosity at 140 degrees F, cst		T 201	80	500
Flash point, COC, degrees F		T 48	752	
Saturates, percent	D 2007			3.0
Asphaltenes, percent	D 2007			1.0
PC/S Ratio[4]	D 2007			1.5
Maltenes Distribution[4]	D 2006-71		0.5	
Ratio[4]	D 2006-71		0.2	1.0
$(PC + A_1)(A + A_2)$				
Test on Residue From RTFO				
Oven Test at 325 degrees F		T 240		
Viscosity Ratio[5]		T 201		3.0
RTFO Oven Weight Change		T 240		6.5

[1]ASTM D 244 Modified Evaporation Test of percent residue is made by heating a 50 g sample to 284 degrees F until foaming ceases, then cool immediately and calculate results.
[2]Test procedures identical with ASTM D 244 except that distilled water will be used in place of two percent sodium oleate solution.
[3]ASTM D 2006-71 can be used for the determination of saturates.
[4]In the Maltenes Distribution Ratio Test by ASTM Method D 2006-71.
PC = Polar Compounds A_1 = First Acidaffins
A_2 = Second Acidaffins S_1 = Saturates
[5]Viscosity Ratio = $\frac{\text{RTF O Viscosity of Residue at 140 degree F, Cst}}{\text{Original Viscosity at 140 degrees F, Cst}}$

PART 3 EXECUTION

3.1 REPARATION

A. Broom all loose material off the pavement surface before starting heater/scarifying operations.

3.2 HEATER/SCARIFYING OPERATIONS

A. Temperature Control
   1. Regulate burners to produce the required scarification without charring the asphalt surface or breaking aggregate particles.
   2. Keep the temperature of the scarified material behind the screed between 230 degrees F and 315 degrees F.

B. Width and Depth
   1. Heat the surface to be recycled 6 inches to 12 inches wider than the width to be processed.
   2. Scarify to a sufficient depth to yield at least 84 lb/yd^2.
   3. When a subsequent pass is made adjacent to a previously recycled surface, extend the longitudinal joint at least 2 inches into the previously recycled surface.

3.3 DISTRIBUTION OF MATERIAL

A. Uniformly distribute materials across the width being processed.

B. Level to produce a smooth surface and uniform cross section.

3.4 COMPACTION

A. Use at least two rollers.
   1. One double drum steel vibratory for breakdown rolling.
   2. One pneumatic (13 Ton or more) for finishing rolling.

B. Complete rolling before temperature of material drops below 185 degrees F.

C. Conform to Section 02741 and Measurement and Payment in the Bid Book, except that it will be based on the Marshall Method.

3.5 APPLYING REJUVENATING AGENT

A. During scarifying:
   1. Mount applicator on the scarifier.
   2. Synchronize with the scarifier's forward speed so that the application rate is within " 5 percent of the rate specified.

B. After rolling:
   1. Apply before the surface temperature drops below 150 degrees F.
   2. Apply with a distributor truck equipped with a metering device.
   3. Maintain application rate " 5 percent of that specified.

3.6 FIELD QUALITY CONTROL

A. Sampling and testing: Engineer makes at least one weight and one temperature determination randomly within each 20-minute interval during scarifying operations.

B. Corrective action:
   1. Reprocess the surface from the last acceptable test, when a test yields less then 84 lbs/yd^2.
   2. A failing test will be cause for suspension of work.
   3. Corrective action includes one or more of the following:
      a. Increase the number of heater/scarifiers.
      b. Reduce the speed of travel.
      c. Adjust the burner(s).

END OF SECTION

SECTION 02967

SURFACE REPAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Soften, scarify, rejuvenate, mix, and level reclaimed material.

B. Furnish and place new surfacing material.

C. Place and compact reclaimed and new material in one operation to produce a monolithic pavement.

1.2 RELATED SECTIONS

A. Section 02741: Hot Mix Asphalt

B. Section 02745: Asphalt Material

C. Section 02786: Plant Mix Seal Coat (Open-graded)

D. Section 02966: Recycled Surface

1.3 REFERENCES

A. AASHTO T 48: Flash and Fire Points by Cleveland Open Cup

B. AASHTO T 59: Testing Emulsified Asphalt

C. AASHTO T 201: Kinematic Viscosity of Asphalts (Bitumens)

D. AASHTO T 227: Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method

E. AASHTO T 228: Specific Gravity of Semi-Solid Bituminous Materials

F. AASHTO T 240: Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin Film Oven Test)

G. ASTM D 2006-71: Rostler Test Method

1.4 SUBMITTALS

A. Written sequence of operations. Submit at least two weeks prior to start of operations for approval by the Engineer.

PART 2 PRODUCTS

2.1 MATERIALS

A. Asphalt Concrete Pavement: Refer to Section 02741.

B. Plant Mix Seal Coat: Refer to Section 02786.

C. Asphalt Cement: Refer to Section 02745.

2.2 EQUIPMENT

A. Indicate at the Preconstruction Meeting the type of repaving equipment to be used.

B. Use equipment capable of processing hot mix asphalt or plant mix seal coat.

C. Have the equipment on the project in operating condition prior to beginning work and with sufficient time for the Engineer to evaluate.

2.3 HEATING UNIT

A. May or may not be an integral part of the scarification unit.

B. Adequate in number and type to heat the pavement.

C. For specific requirements, refer to Section 02966.

2.4 RECYCLING UNIT

A. Single piece of equipment.

B. Self-contained, self-propelled, automated unit capable of scarifying to the depth required.

C. Capable of automatically applying a rejuvenating agent when required to within ± 5 percent of the rate specified.

D. Capable of mixing, redistributing to a uniform depth over the width being processed, and leveling the reclaimed material in one pass.

E. Capable of applying a new asphalt concrete pavement immediately on the reclaimed material.

F. Incorporate a spring release for manhole and valve box protection.

G. Screed to have automatic controls to produce a surface of uniform slope, grade, and texture.

2.5 ASPHALT REJUVENATING AGENT

A. Composed of a petroleum base resin oil uniformly emulsified with water or non-emulsified agent and conforming to Table 1.

Table 1

Asphalt Rejuvenating Agent			
Non-Emulsified Agent	**AASHTO**	**Minimum**	**Maximum**
Viscosity at 140 degrees F, CST	T 201	50	150
Flash point, COC, C	T 48	425	--
Saturates, Wt., percent	ASTM Rostler method	--	25
Test on Residue from RFTO, 325 degrees F	T 240	--	--
Viscosity Ratio [2]	T 240	--	3
Wt. Change, ±, percent	T 240		4
Specific Gravity	T 228, T 227	Report	Report
Emulsified Agent	**AASHTO**	**Min.**	**Max.**
Viscosity at 77 degrees F, SFS	T 59	15	85
Residue, percent	T 59	60	--
Cement Mixing Test, percent	T 59	--	2.0
Sieve Test, percent	T 59	Pos.	Pos.
Particle Charge Test	T 59	Pos.	Pos.
BASE OIL [1, 2]			
Recovered From Emulsified Agent	**AASHTO**	**Min.**	**Max.**
Viscosity at 140 degrees F, CST	T 201	50	150
Flash Point, COC, C	T 48	425	--
Saturates, Wt., percent	ASTM Rostler Method	--	25
Test on Resident from RFTO, 325 EF	R 240		
Viscosity Ratio [2]	T 240	--	3
Wt. Change, ±, percent	T 240	--	4
Specific Gravity	T 228, T 227	Report	Report
1 Values obtained on the emulsion's residue may vary from the emulsified rejuvenating agent.			
2 Viscosity Ratio = Viscosity of Residue RTFO, 140 EF, CST / Original Viscosity 140 FE, CST			

2.6 QUALITY CONTROL - SCARIFIER TEST

A. Adding rejuvenating agent, mixing, and leveling of reclaimed material or placing of new surfacing is not required during the test as only the depth of scarification is being tested.

B. Unlimited testing and retesting is not allowed.
   1. Adjust as necessary if after two successive control section tests, the results are inconclusive or not in specification.
   2. The Engineer conducts one additional test. If the results of this test are inconclusive or out of specification, do not use the equipment or processes.

C. Demonstrate the ability to heat and scarify to the required depth in a 6 inch control section at no additional cost to the Department.
   1. Divide control section into four sublots.
   2. The Engineer determines the depth of scarification (by differential leveling) at one (at least) location (randomly selected) in each sublot.
   3. Operate heaters and scarifiers at the same speed and in the same manner during the test as during actual paving operations.
   4. Record the following data during the test:
      a. Air temperature (in the shade).
      b. Pavement temperature.
      c. Wind speed.
      d. Cloud cover.
      e. Speed of equipment (feet/minute).
      f. Spacing of equipment.
      g. Number of burners operating.
      h. Pressure on scarifier.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean the pavement of all loose dirt, leaves, and other materials.

B. Protect from head damage the area on and adjacent to the work.

C. Not more than 24 hours before the start of operations, have all appropriate utility companies and city or county service functions (including but not limited to gas and sanitary sewer) check all valve boxes, manholes, and other service openings for dangerous concentrations of flammable or explosive gases or liquids to determine if they are within safe limits.

D. Obtain approval for equipment, processes, operating conditions, and methods of construction before operations begin.

3.2 REPAVING OPERATION

A. Sequence of Operations: Process ramps, cross reads, and secondary routes before the primary route.

B. With a single piece of equipment, scarify, add rejuvenating agent when required, mix, level, and place new surfacing.

C. Repave the surface at the same or slower speed, spacing of equipment, and manner of operation as used during the successful test.

D. Cut back the edge of the previous, adjacent pass a minimum of 2 inches during the subsequent pass.

E. Place the new surface on top of the recycled mix when the temperature of the recycled mix is between 200 degrees F and 250 degrees F.

F. Complete compaction of the surfacing before the temperature of the mix drops below 200 degrees F.

3.3 FIELD QUALITY CONTROL

A. Engineer samples and tests gradation, asphalt content, density, and smoothness of the new material under Section 02741, or Section 02786.
   1. Engineer obtains samples from laydown hopper or screed auger.

B. Department determines thickness of the new surfacing or Plant Mix Seal coat for each sublot as described in Section 02741, by calculating the paver yield for two consecutive truck loads of paving mixture.
   1. The combined yield for two consecutive trucks constitutes a single test.
   2. A tolerance of ±15 percent of the designated thickness is allowed.
   3. The calculations, results, station, location and respective weigh ticket numbers are documented for each sublot.

END OF SECTION

SECTION 02968

OPTIONAL USE OF RECLAIMED ASPHALT PAVEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Option to incorporate Reclaimed Asphalt Pavement (RAP) materials into hot mix asphalt.

1.2 RELATED SECTIONS

A. Section 02741: Hot Mix Asphalt (HMA)

B. Section 02745: Asphalt Material

C. Section 02746: Hydrated Lime

1.3 REFERENCES

A. UDOT Materials Manual of Instruction

1.4 SUBMITTALS

A. Quality plan:
   1. Submit for Engineer's approval.
   2. Provide for independent extraction and gradation testing of the reclaimed material and the total mixture.

1.5 QUALITY CONTROL

A. Provide independent testing on commercial sources at no additional cost to the Department.

B. For project specific sites, the Department participates in the design.

PART 2 PRODUCTS

2.1 MIX DESIGN

A. Provide separately for each reclaimed, virgin, and combined portions:
   1. Gradation
   2. Viscosity 140 degrees F
   3. Penetration 77 degrees F
   4. Asphalt content

B. Recovered asphalt cement from combined mix must be the same as the grade specified for the hot mix asphalt. A recycling agent may be used.

C. Meet all requirements of Section 02741 and Section 02745 for combined virgin and RAP.

D. Specify the percent by weight of reclaimed material to be used in the combined mix.

E. May use up to 25 percent RAP by total weight in the hot mix asphalt.

F. May use up to 60 percent RAP only under special conditions and upon written approval.

PART 3 EXECUTION

3.1 RECLAIMED MATERIAL

A. Crush or screen the reclaimed material to pass a 1-1/2 inch sieve and to be retained on a No. 4 sieve.

B. Do not use material retained on the 1-1/2 inch sieve or passing the No. 4 sieve.

C. If 15 percent or less RAP is used, material passing the No. 4 sieve may be used as long as all other requirements are met.

D. The screened reclaimed material must be free of organic materials, soil, or other foreign substances.

3.2 LOTTMAN TEST

A. Engineer performs a Lottman test on the proposed job mix following UDOT Materials Manual, Procedure 8-957.

B. Engineer determines the percentage of lime to be used. Refer to Section 02746.

END OF SECTION

SECTION 02969

OPTIONAL USE OF RECLAIMED ASPHALT PAVEMENT (PG GRADE PROJECTS ONLY)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Option to incorporate Reclaimed Asphalt Pavement (RAP) materials into hot mix asphalt pavement, dense-graded material only.

1.2 RELATED SECTIONS

A. Section 02741: Hot Mix Asphalt (HMA)

B. Section 02745: Asphalt Materials

C. Section 02746: Hydrated Lime

D. Section 02961: Rotomilling

1.3 REFERENCES

A. UDOT Materials Manual of Instruction

1.4 SUBMITTALS

A. Quality plan.
   1. Submit for Engineer approval.
   2. Provide for independent testing of the reclaimed material and the total mixture at no additional cost to the Department.

PART 2 PRODUCTS

2.1 PG BINDER

A. Meet the cold end requirements of the design grade for a virgin mix.

B. The hot end of the PG grade may be one grade above the grade specified.

C. Reduction in the RAP content may be required if the low end of the PG grade for the binder does not meet the original grade specified. If a standard PG binder cannot meet the cold end requirement, then RAP will not be allowed.

D. A 5 percent or greater change in either the RAP or virgin materials requires a new mix design. Engineer approves changes in mix proportions.

E. Combined virgin and RAP material must meet all requirements of Sections 02741, and 02745 with the exception of the mix design that must meet SHRP requirements. RAP material does not have to be 100 percent crushed as outlined in the above sections.

F. May use up to 25 percent RAP by total weight in the hot mix asphalt. RAP may only be used if approved by the Engineer.

2.2 MIX DESIGN

A. Complete the mix design including the RAP material using a Materials Division approved independent laboratory following SHRP volumetric mix design procedures.

B. Provide separately the following for reclaimed portion and virgin portion:
   1. Gradation
   2. PG Grade
   3. Asphalt content

C. Provide the following for the combined portion:
   1. Gradation
   2. PG Grade
   3. Asphalt content
   4. RAP content

PART 3 EXECUTION

3.1 RECLAIMED MATERIAL

A. Remove the existing surface as outlined in Section 02961.

B. Only material rotomilled from 2 inches below the existing surface will be allowed to be recycled into the dense-graded asphalt concrete material.

C. Crush or screen the reclaimed material to be used for recycle to pass a 1-1/2 inch sieve.

D. Screen and separate the RAP to be used for recycle into two stockpiles.
   1. Stockpile: Material passing the 1-1/2 inch sieve and retained on the No. 4 sieve.
   2. Stockpile: Material passing the No. 4 sieve.
   3. Material retained on the No. 4 sieve will have no more than 10 percent override of the material passing the No. 4 sieve during the screening process.
   4. Use separate cold feed bins for each stockpile.

E. Use screened reclaimed material free of organic materials, soil, or other foreign substances.

3.2 LOTTMAN TEST

A. Engineer verifies a Lottman Test on the proposed job mix to determine the percentage of lime required.
   1. Complete and have approved the Lottman Test before the project paving begins.
   2. Eighty percent retained tensile strength is required.
   3. Lime slurry or marination of one or more stockpiles may be necessary to meet the strength requirement. Refer to Section 02746 and UDOT Materials Manual, procedure 8-957.

END OF SECTION

SECTION 03055

PORTLAND CEMENT CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for producing Portland Cement Concrete.

1.2 REFERENCES

A. AASHTO M 6: Fine Aggregate for Portland Cement Concrete

B. AASHTO M 80: Coarse Aggregate for Portland Cement Concrete

C. AASHTO M 92: Wire-Cloth Sieves for Testing Purposes

D. AASHTO M 154: Air-Entraining Admixtures for Concrete

E. AASHTO M 157: Ready Mixed Concrete

F. AASHTO M 194: Chemical Admixtures for Concrete

G. AASHTO M 241: Concrete Made by Volumetric Batching and Continuous Mixing

H. AASHTO T 23: Making and Curing Concrete Test Specimens in the Field

I. ASTM C 150: Portland Cement

J. ASTM C 595: Blended Hydraulic Cements

K. ASTM C 618: Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete

L. ASTM C 1157: Blended Hydraulic Cement

M. ASTM C 1240: Silica Fume for Use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar, and Grout

N. ASTM C 1260: Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

O. American Concrete Institute Standards

P. UDOT Quality Management Plan

1.3 ACCEPTANCE

A. When concrete is below specified strength:
   1. Department may accept item at a reduced price.
   2. The pay factor will be applied to the portion of the item that is represented by the strength tests that fall below specified strength.
   3. Department will calculate the pay factor as follows (based on 28 days):

Psi below specified strength:	**Pay Factor:**
1 – 100	0.98
101 – 200	0.94
201 – 300	0.88
301 – 400	0.80
More than 400	0.50 or Engineer may reject

PART 2 PRODUCTS

2.1 CEMENT

A. Use Type II Portland Cement, or Blended Portland Cement, unless otherwise specified.

B. Portland Cement, Type II.
   1. Follow Tables 1 and 3 in ASTM C 150.
   2. Follow the requirements of Table 2 of ASTM C 150 for low-alkali cement.

C. Blended Portland Cement.
   1. Type IP blended cement may be substituted for Type I cement. Conform to ASTM C 595.
   2. Type IP (MS) blended cement may be substituted for Type II cement.
   3. Type (HS) blended cement may be substituted for Type V cement, as specified in ASTM C 1157. Conform to requirements of ASTM C 595.
   4. When blended cement is used in conjunction with reactive aggregate, use Option R as specified in ASTM C 1157. Conform to requirements of ASTM C 595.

5. Pretest the cement aggregate mixture and meet the specified design criteria at no additional cost to the Department.
6. Do not use fly ash as a replacement for any blended cement.

D. Do not use cement that contains lumps or is partially set.

E. Use cement from the list of UDOT pre-qualified sources maintained by the UDOT Materials Quality Assurance Section.

F. Do not mix cement originating from different sources.

G. Do not use air-entrained cement.

H. Cement may be sampled and tested for compliance at any time.

2.2 COARSE AGGREGATE

A. As specified in AASHTO M 80, and as modified, using one of the gradations found in Table 1.

Table 1

Aggregate Gradations - Percent Passing (by weight)								
Aggregate or Sieve Size (inches)	**2-1/2**	**2**	**1-1/2**	**1**	**3/4**	**1/2**	**3/8**	**No. 4**
2 to No. 4	100	95-100		35-70		10-30		0-5
1-1/2 to No. 4		100	95-100		35-70		10-30	0-5
1 to No. 4			100	95-100		25-60		0-10
¾ to No. 4				100	90-100		20-55	0-10

B. Use sieve screens with square openings as specified. Meet AASHTO M 92.

C. Do not exceed percentages of deleterious substances as shown in AASHTO M 80, Table 1, for Class A aggregates.

D. Determine the suitability of coarse aggregate sources using the requirements for soundness, percentage of wear and potential reactivity as specified in AASHTO M 80.

2.3 FINE AGGREGATE

A. As specified using one of the gradations shown in Table 2. Meet AASHTO M 6.

Table 2

Sieve Size	Percent Passing (by weight)
3/8 inch	100
No. 4	95 to 100
No. 16	45 to 80
No. 50	10 to 30
No. 100	2 to 10

B. Do not exceed percentages of deleterious substances as outlined in AASHTO M 6 for class A aggregates, using b for material finer than the No. 200 sieve.

C. Soundness: As specified to determine suitability of fine aggregate. Meet AASHTO M 6.

2.4 CONTRACTOR FURNISHED AGGREGATE

A. Engineer evaluates aggregate from a non-state specified source.
   1. Proportion mix designs accordingly to mitigate any potential performance problems inherent to the aggregate source.
   2. Pay additional costs incurred from using a Contractor furnished source.

2.5 WATER

A. Potable, or water that meets the specified test standard in AASHTO M 241.

B. Screen out extraneous material when pumping water from streams, ponds, lakes, etc.

2.6 ADMIXTURES

A. Air Entrainment: as specified. Meet AASHTO M 154, including Section 5.
   1. Site-added air entraining admixtures.
      a. Utilize admixture in the trail batch.
      b. Use pre-measured admixtures only.
      c. Record amount used on batch ticket.
      d. Rotate the drum at least 30 revolutions at the mixing speed recommended by the manufacturer.

e. Maximum of 3 trucks in a row can be job-site dosed.

B. Water Reducing Agents: as specified. Meet AASHTO M 194.
1. The chlorides content (as Cl-) not exceeding 1 percent by weight of the admixtures.
2. Site-added water reducing agents will be added as in this Section, article 2.7, paragraph A 1.

C. Do not use calcium chloride.

D. Protect all admixtures from freezing.

2.7 POZZOLAN

A. Fly Ash:
1. Class F, as specified.
a. Unless specified otherwise, replace 20 percent of the Portland cement by weight.
b. Loss on Ignition (LOI): not to exceed 3 percent.
c. Maximum allowable CaO content: not to exceed 15 percent.
d. Conform to ASTM C 618, Class F.
e. Use the minimum cement content in the design formulas before replacement is made.
f. Use fly ash from the list of UDOT pre-qualified sources maintained by the UDOT Materials Quality Assurance.
g. Label the storage silo for fly ash to distinguish it from cement.
h. Use different size unloading hoses and fittings for cement and fly ash.
2. Fly ash may be sampled and tested for compliance at any time.

B. Natural Pozzolan (Class N)
1. Conform to ASTM C 618.
2. May use instead of fly ash provided that the 14-day expansion test (ASTM C 1260) with job aggregates and job cement does not exceed that for the same aggregates and cement with a UDOT approved Class F fly ash.

C. Silica Fume: Conform to ASTM C 1240.

2.8 MIX DESIGN

A. Furnish to the Engineer a mix design for each class of concrete to be used.
1. Do not change the mix design without written approval.

2. Base concrete mix designs for all "A" concrete classes on trial batch test results or on past history (same materials used in previous mix designs within the past year).
3. Use the same components in the trial batches that are to be used in the project including coarse and fine aggregate, water, source and type of cement, air-entraining agent, fly ash, etc., including any site-added admixtures intended to be used.
4. The Department or its representative witnesses the trial batch.
5. Mix concrete (trial batches) as specified.

PART 3 EXECUTION

3.1 PREPARATION

A. Aggregate stockpiles:
1. Clear, grub, smooth, and compact the site.
2. Construct stockpile platforms so that subgrades are prevented from intruding into aggregates.
3. Build stockpiles at least two days before use.
4. Provide an operator and front-end loader to help the Engineer take aggregate samples.
5. Acceptance is made in daily increments, but not more than 30 days before use.
6. Provide separate stockpiles for coarse and fine aggregate.
7. Construct stockpiles in thin layers (5 ft maximum) that have uniform thickness and a regular form.
   a. Do not build high, cone-shaped piles above the maximum height of 10 ft before distribution.
   b. Do not dump or spill aggregate over the sides of the stockpile.
   c. Minimize segregation of aggregate.
8. Allow washed aggregates to drain to a uniform moisture content before use (12 hours minimum).
9. Move conveyor continuously across the stockpile as aggregate is discharged.
10. Do not drop material more than 10 ft from conveyor.

B. Heating Aggregate and Water
1. Provide and operate heating devices at no additional cost to the Department when heated aggregates are required.
2. Aggregates must be free of ice.
3. Heat aggregates uniformly, when required. Avoid overheating or developing hot spots.
4. Meet temperature control requirements found in article 3.7, paragraph C.

5. Meet cold weather limitations found in this Section.
6. Use either steam or dry heat.
7. Do not allow the products of fuel combustion to contact the aggregate.
8. Heat the mixing water to between 70 degrees F and 180 degrees F when introduced into the mixer.

3.2 CONCRETE CLASSES AND MIX REQUIREMENTS

A. Meet the requirements in Table 3.

Table 3

Concrete Classes and Mix Requirements							
Class	**Coarse Aggregate or Sieve Size (inch)**	**Max. Water/ Cement Ratio**	**Min. Cement Content (lb/yd^3)**	**Slump (inch)**	**Air Content Percent (%)**	**Mix Design Compress *f*'cr (Psi)**	**28 Day Minimum Compress *f*'c (Psi)**
7A(AE)	**	**	**	**	**	10500	8000
6A(AE)	**	**	**	**	**	9000	7000
5A(AE)	**	**	**	**	**	7750	6000
4A(AE)	**	**	**	**	**	6500	5000
3A(AE)	2 to No. 4 1-1/2 to No. 4 1 to No. 4 3/4 to No. 4	0.44 0.44 0.44 0.44	611 611 658 658	0.5 to 3.5 0.5 to 3.5 0.5 to 3.5 0.5 to 3.5	4.0 - 7.0 4.5 - 7.5 5.0 - 7.5 5.0 - 7.5	5200 5200 5200 5200	4000 4000 4000 4000
AA(AE)	2 to No. 4 1-1/2 to No. 4 1 to No. 4 3/4 to No. 4	0.44 0.44 0.44 0.44	564 564 611 611	1 to 3.5 1 to 3.5 1 to 3.5 1 to 3.5	4.0 - 7.0 4.5 - 7.5 5.0 - 7.5 5.0 - 7.5	5200 5200 5200 5200	4000 4000 4000 4000
A or A(AE)	1-1/2 to No. 4 1 to No. 4 3/4 to No. 4	0.53 0.53 0.48	470 470 517	1 to 3.5 1 to 3.5 1 to 3.5	4.5-7.5 4.5-7.5 4.5-7.5	3900 3900 3900	3000 3000 3000
B or B(AE)		0 62	376	2 to 5	-- 3.0-6.0	3250	2500
C or C(AE)		0.70	376	2 to 5	-- 3.0-6.0	2600	2000

** Design and proportion mixes according to ACI 301 and project specific criteria.

B. Minimum strength is based on a coefficient of variation of 10 percent, and one test below the minimum strength per 100 tests.

C. Maximum nominal size of coarse aggregate:
   1. Not larger than 1/5 of the narrowest dimension between sides of forms.
   2. Not larger than 1/3 the depth of slabs.
   3. Not larger than 3/4 of the minimum clear distance between reinforcing bars or between bars and forms, whichever is least.

D. Do not exceed water/cement ratio.

E. When a Pozzolan is used in the mix, calculate the water/cement ratio (w/c) according to the following formula:

$$\frac{W}{C} = \frac{Water}{Cement\%pozzolan}$$

F. When concrete is deposited in water, use 94 lbs. more cement per cubic yard than the design requires for concrete placed above water.

G. When not using water-reducing admixtures, use Table 3 to determine the slump requirements.
   1. Slump requirements when using low range water reducers: 1 inch to 5 inches for all classes of concrete.
   2. Slump requirements when using high range water reducers: 4 inches to 9 inches for all classes of concrete.

3.3 ADDITIONAL REQUIREMENTS FOR USING HIGH RANGE WATER REDUCERS (SUPER PLASTICIZERS)

A. Establish the effective life of the High Range Water Reducer (HRWR) by trial batch.
   1. Trial batch will approximate field conditions including time of placement (Refer to article 3.7, paragraph A.), and concrete temperature.
   2. Engineer witnesses the trial batch.
   3. Slowly agitate the mix throughout the test period.
   4. Record and plot slump and mix temperature at 15-minute intervals. Maintain the required slump (4 to 9 inches) throughout the time allowed for placement. Re-dose if necessary.
   5. If re-dosing is required, record the time of re-dose and the amount of admixture added.
   6. Do not exceed any manufacturers recommendations for the use of the HRWR.
   7. Submit results of the trial batch to the Engineer.

B. High Range Water Reducer (HRWR) may be added at the job site.
   1. Record on the batch ticket, the time the HRWR was added.
   2. Maintain the mixing period for truck mixers between 70 and 100 revolutions at mixing speed.
   3. Engineer conducts a standard slump test before adding the HRWR to a transit mixer. Meet the requirements of Table 3.
   4. Engineer conducts additional slump tests at the job site after adding the HRWR.

C. If the HRWR is added to a central mixer, no preliminary slump test is required.

D. Show on batch tickets the amount of admixture used.

E. Do not exceed the requirements established by the trial batch.

F. Contractor is responsible for changes in placement and finishing operations due to the addition of admixtures.

3.4 ADDITIONAL REQUIREMENTS FOR USING SET RETARDING ADMIXTURES

A. If set retarding admixtures are specified due to haul times exceeding the time limitations in article 3.7, paragraph A, establish the effective life of the set-retarding admixture by trial batch.
   1. The trial batch will approximate field conditions including concrete mix temperature.
   2. Engineer witnesses the trial batch.
   3. Slowly agitate the mix throughout the test period.
   4. Record and plot slump and mix temperature at 15-minute intervals.
   5. Do not exceed any manufacturers recommendations for the use of the set-retarding admixture.
   6. Do not re-dose the concrete with additional set retarding admixture.
   7. Submit results of the trial batch to the Engineer.

B. Add set retarding admixture at the batch plant at the time of initial batching operations, or immediately after.

C. Show on batch tickets the amount of admixture used.

D. Time of placement is established by the trial batch and supersedes the requirements in article 3.7, paragraph A.

E. Do not exceed the requirements established by the trial batch.

F. Contractor is responsible for changes in placement and finishing operations due to the addition of admixtures.

3.5 BATCHING MATERIALS

A. Meet AASHTO M 157.

B. Meet the requirements of the UDOT Quality Management Plan for Ready-Mix Concrete.

C. Operate the batch mixer at the manufacturer's recommended drum speed.

D. Keep drums and blades free from excessive cement and mortar buildup.

E. Add the admixtures separately to the mix water.

F. Do not use any process, which will cause "flash set" of the mix.

G. At central mix plants, mix all materials for at least 80 seconds at recommended drum speed.
   1. When adding more water or cement, mix 30 additional seconds.
   2. Introduce the cement into the batcher before the fly ash.

H. Conduct mixing efficiency tests as specified.
   1. AASHTO M 157, Annex A-1.
   2. Engineer may order mixing efficiency tests at the beginning of concrete operations, or anytime deemed necessary.

I. Maintain the mixing period for truck mixers between 70 and 100 revolutions at mixing speed.
   1. Maintain a minimum of 90 revolutions for front-end discharge trucks.
   2. Complete concrete mixing before the truck leaves the batch plant yard.

J. Hand Mixing:
   1. Only Class B and C concrete may be hand mixed.
   2. Hand-mixed batches cannot exceed 0.5 cubic yard.
   3. Hand mix on a watertight platform.
   4. Spread the aggregate evenly on the platform, and thoroughly mix in the dry cement until the mixture becomes uniform in color.

3.6 TRANSPORTING

A. Transport ready-mixed concrete in transit mixers or agitator trucks.
   1. Do not load trucks in excess of their rated mixing capacity, or 63 percent of the drum gross volume, or less than 2 cubic yards.
   2. The truck rating plate must be readable.

B. Equip transit mixers or agitator trucks with a visible water meter and revolution counter (electronic or mechanical). Use the water meter to measure all water discharged from the tank of the truck.

C. Obtain approval to add water after the transit mixer or agitator truck leaves the batch plant.
   1. Add water within the specified time limits.
   2. Do not add more water than the batch ticket indicates.
   3. Do not add water after more than 0.5 cubic yard of concrete has been discharged from the drum and do not exceed the water/cement ratio.
   4. When adding water, rotate the drum at least 30 revolutions at the mixing speed recommended by the manufacturer.

3.7 LIMITATIONS - GENERAL

A. Timing. Reject concrete if:
   1. It is not placed within 90 minutes when the air temperature is below 80 degrees F.
   2. It is not placed within 75 minutes when the air temperature is between 80 and 85 degrees F.
   3. It is not placed within 60 minutes when the air temperature is between 86 and 90 degrees F.
   4. Initial set has developed.

B. Do not temper concrete by adding water or by any other means after initial set or false set has taken place.

C. Concrete Temperature:
   1. Place concrete in the forms when the concrete temperature is between 50 and 90 degrees F.
   2. Do not place concrete when the mix temperature exceed 90 degrees F.
   3. Refer to articles 3.8 and 3.9.

D. Pumping and Conveying Equipment
   1. Do not use equipment, or a combination of equipment and the configuration of that equipment, that causes a loss of entrained air content that exceeds one half of the range of air content allowed by specification.
   2. At the direction of the Engineer, Contractor is responsible for verification and/or monitoring of air loss.

3.8 LIMITATIONS - COLD WEATHER

A. Cold weather limitations apply when the temperature is likely to fall below 40 degrees F within 14 days of placement.

B. Comply with the following regulations for placing concrete in cold weather:
   1. Submit a written plan for approval 14 calendar days before concrete placement.
   2. Do not use chemical additives in the concrete to prevent freezing.
   3. Provide all necessary cold weather protection for in-place concrete (cover, insulation, heat, etc.).
   4. Do not place concrete in contact with frozen surfaces.
   5. Produce concrete with a temperature between 60 degrees F and 90 degrees F at the time of placing.
   6. Adequately vent combustion-type heaters that produce carbon monoxide.
   7. Maintain the concrete temperature above 50 degrees F for the first 14 days after placing.
   8. Protect the concrete from freezing until a compressive strength of at least 3,500 psi has been achieved.
   9. Maintain moist conditions for exposed concrete not in contact with forms; avoid loss of moisture from the concrete due to heat applied.
   10. Limit the drop in temperature next to the concrete surfaces when removing heat to 20 degrees F during any 12-hour period until the surface temperature of the concrete reaches that of the atmosphere.
   11. Determine the concrete temperature with a surface thermometer insulated from surrounding air.

C. Paving:
   1. Submit a written plan for approval 14 calendar days before concrete placement.
   2. Paving may begin when base surface temperature is 36 degrees F in the shade and ascending.
   3. Maintain the mix temperature at a minimum 60 degrees F.
   4. Cease operations when the ambient temperature is 45 degrees F in the shade and decreasing.
   5. Do not add chemical admixtures to prevent freezing.
   6. Remove and replace concrete damaged by frost action at no additional cost to the Department.

7. Do not use material containing frost or lumps.
8. Do not heat water or aggregate to more than 150 degrees F.
9. Protect the concrete from freezing until a compressive strength of at least 3500 psi has been achieved.

3.9 LIMITATIONS - HOT WEATHER

A. Cool all form surfaces that will come in contact with the concrete to below 95 degrees F.

B. Paving: Discontinue paving when mix temperature reaches 90 degrees F either at point of placement or batch plant platform, or when ambient air temperature exceeds 100 degrees F in the shade.

3.10 LIMITATIONS-SURFACE EVAPORATION

A. Surface evaporation limitations apply and may occur at any time of the year, when any combination of air temperature, relative humidity, and wind velocity, that have the potential to impair the quality of fresh or hardened concrete or otherwise result in abnormal properties. Submit a written plan for approval 14 calendar days before concrete placement that shows proper attention will be given to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures and water evaporation that could impair strength or serviceability of the concrete. Refer to ACI 305R.

B. The surface evaporation plan may include any of the following actions:
1. Construct windbreaks or enclosures to effectively reduce the wind velocity throughout the area of placement.
2. Use fog sprayers upwind of the placement operations to effectively increase the relative humidity.
3. Reduce the temperature of the concrete by shading the material storage area or production equipment, cool aggregate by sprinkling, cool aggregate and/or water by refrigeration or by replacing a portion or all of the mix water with flaked or crushed ice to the extent that the ice will completely melt during mixing of the concrete.
4. Adjustment of the placement schedule.
5. Use of an approved water-based mono-molecular polymer liquid evaporative reducer at application rates recommended by the manufacturer. Not to be used as a finishing aid.

3.11 FIELD QUALITY CONTROL - SAMPLING

A. Engineer conducts sampling and testing.
   1. When testing concrete from a concrete pump, Engineer takes the samples from the hose after all of the priming grout has been wasted.
   2. When testing concrete used on bridge decks, Contractor places a small pile of concrete in front of the deck screed and provides suitable access for the Engineer to obtain samples.

B. Provide and maintain cylinder storage devices to control the temperature within the specified range.
   1. Maintain cylinders at a temperature range of 60 degrees F to 80 degrees F for the initial 16-hour curing period.
   2. Do not move the cylinders during this period.
   3. Equip the storage device with an automatic 24-hour temperature recorder, that continuously records on a time-temperature chart, with an accuracy of ±1 degree F.
   4. Have the storage devices available at the point of placement at least 24 hours before placement.
   5. Engineer stops placement of concrete if the storage device cannot accommodate the required number of test cylinders.
   6. Use water containing hydrated lime if water is to be in contact with cylinders.
   7. A 24-hour test run may be required.

C. Do not place concrete without approval.

D. Cure cylinders representing steam-cured concrete as specified. Leave the cylinders with the product while steam is applied and then standard cured for the remaining 28 days. AASHTO T 23.

END OF SECTION

SECTION 03152

CONCRETE JOINT CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Joint Filler and Joint Sealer

B. Waterstops

1.2 REFERENCES

A. AASHTO M 148: Liquid Membrane-Forming Compounds for Curing Concrete

B. AASHTO M 153: Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

C. AASHTO M 213: Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

D. AASHTO T 132: Tensile Strength of Hydraulic Cement Mortars

E. AASHTO Standard Specifications for Highway Bridges

F. ASTM C 509: Elastomeric Cellular Preformed Gasket and Sealing Material

G. ASTM C 719: Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)

H. ASTM D 412: Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension

I. ASTM D 794: Determining Permanent Effect of Heat on Plastics

J. ASTM D 1084: Viscosity of Adhesives

K. ASTM D 1621: Compressive Properties of Rigid Cellular Plastics

L. ASTM D 1622: Apparent Density of Rigid Cellular Plastics

M. ASTM D 1623: Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics

N. ASTM D 2240: Rubber Property-Durometer Hardness

O. ASTM D 2628: Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

P. ASTM D 3569: Standard Specification for Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant-Type for Portland Cement Concrete Pavements

Q. ASTM D 5329: Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphalt and Portland Cement Concrete Pavements

R. ASTM D 6690: Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

S. Federal Specifications

T. Military Specifications

1.3 SUBMITTALS

A. For Silicone Joint Sealer: Furnish manufacturer's certified test results of each lot of the joint sealant material to Engineer, except for the bond to cement mortar test. Certificate must show use of primers, where applicable.

PART 2 PRODUCTS

2.1 PREFORMED ELASTOMERIC JOINT SEALANTS

A. Preformed elastomeric joint seal material made of vulcanized elastomeric compound using polymerized chloroprene as the only basic elastomer.

B. Engineer approves the shape of any joint sealer prior to submission of the individual production lot.

C. Department evaluation requirements for any joint seal geometry are:
   1. Overall width of sealer: 7/16 inch minimum.
   2. Overall depth of sealer: maximum of 1 inch when compressed to 7/32 inch.

3. Materials Physical Property: Conform to ASTM D 2628.
4. Maintain the force-deflection requirements in Table 1.

Table 1

Deflection Condition	Force Requirement
Seal compressed to 3/8 inch width	2 lb/inch minimum
Seal compressed to 7/32 inch width	12 lbs/inch maximum

5. Heat-age the specimens used for determining the original force-deflection relationship in an oven for 70 hours at 212 degrees F. under 50 percent deflection.
6. Subject the specimens to another force-deflection test after heat-aging and comply with the requirements in Table 2.

Table 2

Deflection Condition	Force Requirement
Seal compressed to 3/8 inch width	1 lb/inch minimum
Seal compressed to 7/32 inch width	12 lbs/inch maximum

D. Use a one-component, polycholorprene, lubricant adhesive containing only soluble phenolic resins blended with anti-oxidants and acid acceptors in an aromatic hydrocarbon solvent mixture with the following properties:
1. Average net weight 7.8 lbs/gallon ± 5 percent.
2. Solids content by weight of 25 lbs ± 3 percent. Meet ASTM D 1084.
3. Suitable viscosity for use with installation equipment.
4. Film strength of 2,300 psi minimum tensile strength and 750 percent minimum elongation before breaking. Meet ASTM D 412.
5. Manufactured within 9 months of use.
6. Deliver in containers plainly marked with the manufacturer's name or trade mark, lot number, date of manufacture. Send manufacturer's certification of specification compliance.

E. Department may sample and test materials after delivery to the project site.

2.2 HOT-POURED JOINT SEALANT

A. As specified for general requirements, physical properties, packing, marking, and sampling. Meet ASTM D 6690 Type II.

B. Test physical requirements as specified in ASTM D 5329.

2.3 PREMOLDED JOINT FILLERS

A. As specified.

B. Meet AASHTO M 153 and AASHTO M 213.

2.4 SILICONE JOINT SEALER

A. Select and use a prequalifed sealant from the Approved Products List, available from the Department.

B. Silicone joint sealer and special category for self-leveling: Both made of low-modulus silicone specifically formulated to seal Portland Cement Concrete Pavement joints.

C. Furnish in a one-part, non-acid curing formulation.

D. Meet the following physical requirements:
   1. Refer to the plan details.
   2. Backer rod compatible with the sealant and all components of the joint sealant system. Meet the requirements for Backer Rod.
   3. Prevent any bond or adverse reaction from occurring between the backup materials and the sealant.

E. Meet the test requirements in Tables 3 and 4.

Table 3

Test Requirements (Silicone Joint Sealer) and Test Methods		
Tensile Stress; 150 percent max elongation, 7-day cure at 77 ± 3 degrees F. And 45-55 percent relative humidity (rh).	45 psi	ASTM D 412 (DIE C)
Flow	0.3 inch maximum	MIL S 8802
Extrusion Rate 100 degrees to 0 degrees F.	0.2 - 0.6 lbs/min	MIL S 8802
Tack-Free Time		MIL S 8802
Specific Gravity	1.01 - 1.515	ASTM D 794 Method A
Durometer Hardness, shore A: cured 7 days at 77 ±3 degrees F and 45-55 percent relative humidity (rh).	10-25 (0 degrees F)	ASTM D 2240
Shelf life	6 month minimum from date of shipment from plant or point of manufacture.	
Ozone and Ultraviolet (UV) Resistance	No chalking, cracking, or bond loss after 5000 hours	
Bond to concrete mortar concrete briquette air cured 14 days 77 ±3 degrees F.	50 psi minimum	
Movement capability and adhesion. Magnitude of cycles movement shall be appropriate for sealant category, cure 7 days in air 77 ±3 degrees F then 7 days in water 77 ±3 degrees F.	+100 percent and -50 percent of joint width. No more than 0.5 square inches (adhesive or cohesive) failure in the 3 specimens combined after 10 cycles.	

Table 4

Test Requirements for Self-Leveling (Silicone Joint Sealer) and Test Methods		
Flow, sag, or slump	Self-leveling	
Extrusion Rate	6-12 lbs/min.	MIL S 8802
Elongation, percent minimum	800 at 21 days	ASTM D 412 DIE C, Mod.
Modulus at 150 percent elongation	30 psi maximum after 21 days	
Tensile Adhesion +0 Concrete (minimum percent elongation)	+600 after 21 days	ASTM D 3569
Accelerated Weathering	No chalking, cracking, or bond loss after 5000 hours	
Shelf Life	Six month min. from date of shipment from plant or point of manufacture.	
Durometer Hardness, Shore OO: cured 14 days at 77 ±3 degrees F and 45-55 percent, rh	20-80 (0 degrees F)	ASTM D 2240
Movement capability and adhesion. Magnitude of cycles movement shall be appropriate for sealant category, cure 14 days in air 77 ±3 degrees F, and then 7 days in water 77 ±3 degrees F	+100 percent and -50 percent of joint width. No more than 0.5 square inches (adhesive or cohesive) failure in the three specimens combined after 10 cycles.	

F. Department determines the bond to concrete mortar with the following test:
   1. Test as specified in AASHTO T 132.
   2. Briquettes molded as specified, sawed in half, and bonded with a thin section of sealant.
   3. Briquettes dried to a constant weight in oven at 100 ± 5 degrees F.

G. Department uses the following test following ASTM C 719 for movement capability and adhesion:
   1. Prepare 1 inch by 1 inch by 3 inch concrete blocks as specified.
   2. Use a sawed face for the bond surface.
   3. Seal 2 inches of block, leaving 1/2 inch on each end of specimen unsealed.
   4. Dimension the sealant to a 3/8 inch depth and a 1/2 inch width.
   5. Subject sealant to movement as specified.
   6. Magnitude of the movement must meet each specific category, and the rate of extension or compression must be 1/8 inch per hour.

H. Take one or more random samples (minimum of 2 quarts per sample) of each lot and seal in airtight containers.
   1. Notify Engineer when stockpiles located at either the job site or the vendor's place of business are ready to be sampled.
      a. Establish job site stockpiles at least 30 working days prior to use.
      b. Establish vendor's place of business stockpiles 40 working days prior to use.
   2. The Department may take samples at the sealant manufacturing plant at least 30 days before shipment to the job site.
   3. Laboratory testing may take 30 working days after submitting samples.

I. Do not place any materials until testing is completed and materials are approved by the Engineer.

J. Sealant must be delivered in the manufacturer's original sealed container, displaying the lot number, expiration date of the shelf-life warranty, and the sealer trade name.

K. Submit Certificate of Compliance to the Engineer when the sealant is delivered to the job site. Certificate must include:
   1. Verification of test results
   2. Manufacturer's name
   3. Lot number
   4. Expiration date of the shelf-life warranty
   5. Sealer trade name
   6. Project destination
   7. Representative sealant

2.5 BACKER ROD

A. Use closed-cell, polyethylene-foam rods conforming to the requirements in Table 5.

Table 5

Backer Rod Requirements and Test Methods		
Diameter	Joint width + 1/8 inch	
Density	2 lbs/ft^3	ASTM D 1622
Tensile Strength	25 psi	ASTM D 1623
Absorption	0.5 percent by volume	ASTM C 509
Compression Deflection	25 percent at 8 psi	ASTM D 1621

2.6 JOINT SEALER (STRUCTURES)

A. Cold-applied, gun-grade, single-component, polyurethane base material that cures under field condition to form a rubber-like, non-sag, elastomeric joint seal, as specified in Federal Specifications TT-S-00230 C. Type II, Class A.

B. Use material that bonds tightly to the sides of the concrete groove and exhibits the physical properties in Table 6 when cured and tested after 21 days at 73 degrees F.

Table 6

Physical Properties of Joint Sealer (Structures) and Test Methods		
Modulus of Elasticity at 100 percent Elongation	132 psi	ASTM D 412
Hardness (Shore A)	40 ± 5	
Elongation (at break)	700 percent	ASTM D 412
Recovery	Greater than 90 percent	
Tensile Strength	190 psi	ASTM D 412
Adhesive in Peel	20 lbs/inch	TT-S00230 C Type II, Class A
Service Range	-40 degree F to 150 degree F	TT-S-00230 C
Initial Cure, Tack Free (Depending on Temperature and Humidity)	6 to 8 hours	
Final Cure	5 to 8 days	
Staining Characteristics	Nonstaining	
Color	Gray	

2.7 WATERSTOPS

A. Provide waterstops as specified.

B. Meet AASHTO Standard Specifications for Highway Bridges, Division II, Subsection 8.9.2.6.

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 03211

REINFORCING STEEL AND WELDED WIRE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for placing reinforcing steel and steel welded wire fabric.

B. Coating for reinforcing steel and steel welded wire fabric.

1.2 REFERENCES

A. AASHTO M 31: Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

B. AASHTO M 55: Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

C. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

D. AASHTO M 284: Epoxy Coated Reinforcing Bars

E. ASTM A 36: Carbon Structural Steel

F. ASTM A 767: Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

G. CRSI Manual of Standard Practice

H. UDOT Minimum Sampling and Testing Guide

I. UDOT Quality Management Plans

1.3 SUBMITTALS

A. Furnish Certificates of Compliance from the manufacturer stating that the materials meet this specification.

B. Prequalify all coatings meeting AASHTO M 284 Annex A1: Prequalification of Organic Coatings for Steel Reinforcing Bars.
   1. Furnish a copy of the Prequalification Test Report to the Department's Construction and Materials Division.
   2. Provide an 8-ounce sample of the coating material from each batch in conformance AASHTO M 284 Annex A1.2.2, to the Department's Construction and Material Division.

C. A copy of the purchase order or a detailed letter to the Engineer verifying the warehouses or fabricators of the steel reinforcing bars or welded wire reinforcement with required samples.

D. Samples of the steel reinforcing bars or welded wire reinforcement from the fabricator's source, following UDOT's Minimum Sampling and Testing Guide.
   1. Provide 3 samples of each size cut to 2 ft length.
   2. Samples may be waived if the original contract amount is less than 4,000 lbs.
   3. Supply test bars at no additional cost to Department.

E. Splice Shop Drawings: Submit five sets for approval showing the proposed number and locations of each mechanical butt splice splicing.
   1. Submit before ordering the reinforcing steel whenever splicing requirements vary from the plans and specifications, including all lengths including splices.

F. Submit two sample mechanical butt splices and test to destruction in the presence of the Engineer.

G. Reinforcing Steel Shop drawings.
   1. Submit before ordering the reinforcing steel whenever splicing requirements vary from the plans and specifications, including all lengths including splices.

1.4 QUALITY ASSURANCE

A. The Department may witness coating processes for project work and obtains random samples by heat number and manufacturer to conduct verification testing.

B. Prequalification:
   1. Epoxy Coating Suppliers: through UDOT's Quality Management Plan - Reinforcing Steel Epoxy Coating.
   2. Galvanized Coating Suppliers: through UDOT's Quality Management Plan - Reinforcing Steel Galvanized Coating.
   3. Reinforcing steel suppliers through UDOT's Quality Management Plan (QMP) for steel.

1.5 DELIVERY, STORAGE AND HANDLING

A. Do not damage the bars or the coating during handling and storage.
   1. Use systems with padded contact areas when handling epoxy coated bars.
   2. Pad all bundling bands for epoxy coated bars.
   3. Lift all bundles with strong-back, multiple supports, or a platform bridge.
   4. Do not drop or drag bars.

B. Repair damaged bars or coating at no additional cost to the Department.

PART 2 PRODUCTS

2.1 REINFORCING STEEL

A. Deformed billet-steel bars as specified. Meet AASHTO M 31, Grade 60

2.2 EPOXY AND GALVANIZED COATINGS

A. As specified. Meet AASHTO M 284 OR AASHTO M 111.

B. Coat bars as shown on the plans.
   1. Maintain epoxy coating thickness between 8 and 12 mils.
   2. Maintain galvanized coating thickness as specified. ASTM A 767.
   3. Coat bars after bending, unless the fabricator can show that satisfactory results can be obtained by coating before bending.
   4. Reject any bent bars with visible cracks or damage in the coating.

2.3 WIRE AND WIRE REINFORCEMENT

A. Cold-Drawn Steel Wire: As specified. Meet AASHTO M 55.

B. Welded Steel Wire Reinforcement: As specified. Meet AASHTO M 55.

C. Tie Wire: 16 gauge before coating.
   1. Use coated wire.

2.4 BAR SUPPORTS

A. Epoxy-coated, galvanized, or plastic-coated, or plastic bar supports:
   1. Meet the requirements of the “Bar Support” chart following this Section.
   2. Remove contaminants that affect the adhesion of the coating to the wire.

3. Use an electrostatic-spray method, fluidized bed, or flocking to apply an epoxy coating.
4. Apply plastic coating by spraying, dipping, or using as a powder.
5. Maintain galvanized coating thickness as specified. AASHTO M 111.
6. Maintain the thickness of epoxy or plastic coatings at a minimum of 5 mils with no maximum.
7. Use patching material per the manufacturer's recommendation to repair damaged coating.
   a. Use patching material that is compatible with the coating, and that is inert in concrete.
   b. Hanger marks on the coated bar supports that result from the coating application process are acceptable and are not considered damaged coating.

B. Precast concrete block bar supports:
1. Minimum 28-day compressive strength of 2,500 psi
2. Three inch thick supports with sides ranging from 4 inches to 6 inches with a minimum soil contact area of 24 $inch^2$.

2.5 MECHANICAL ANCHORAGE DEVICE

A. Splice Coupler **(Same coating system as bar)**
1. Reinforcing steel splice coupler shown by tests to be capable of developing in tension 175 percent of the strength of the reinforcing bar without damage to the concrete.
2. Steel Plate: Meet ASTM A 36.

PART 3 EXECUTION

3.1 PLACEMENT

A. Maintain a clean surface keeping all reinforcement free from loose mill scale, loose or thick rust, dirt, paint, oil, or grease.

B. Bend all bars accurately.

C. Place all reinforcement in designated position and securely hold in position while placing and compacting concrete.

D. Wire bars together with ties at all intersections except when spacing is less than 9 inches in each direction, in which case, tie at alternate intersections.

E. Maintain the specified distance from the forms and between layers of reinforcement by means of prefabricated chairs, ties, hangers, or other approved devices.

F. Precast concrete block bar supports are only allowed when the concrete is placed in contact with the soil and then only as the support for the bottom mat of bars.

G. Do not tack weld reinforcing bars in place.

H. Overlap at least one panel of welded-wire fabric sheets to each other and fasten at the ends and edges.

I. Support reinforcing steel for concrete "T" beams, pier caps, approach slabs, and deck slabs on metal chairs or slab bolsters following this Section, article 2.4, Bar Supports.

J. Space chairs for supporting the top steel and bolsters for supporting the bottom steel not more than 4 ft on center of the bar in each direction.

K. Tie deck steel to beams or forms at regular intervals of not more than 5 ft on center along the beams to prevent steel movement during concrete placement.

L. Support reinforcing steel for slabs on grade on metal chairs attached to a sand plate, or use precast concrete block supports following this Section, article 2.4, Bar Supports.

M. Engineer verifies placing and fastening of reinforcement in each section of work before any concrete is deposited.

3.2 FIELD CUTTING

A. Saw or shear coated bars that are specified to be cut in the field. Do not flame cut.

B. Repair the sawed or sheared end using the specified patching or repair material.

3.3 SPLICING

A. Furnish all reinforcing steel in the lengths specified.

B. Do not splice bars, except where specified.

C. Stagger splices as far as possible.

D. Place and tie lapped splices in the bars. Maintain the minimum distance to the surface of the concrete shown.

E. Do not lap splice No. 14 and No. 18 bars.
   1. Use mechanical butt splices when using No. 14 or No. 18 bars.
      a. Decide the number and location of the splices with the following limitations:
         1) Extend bars a minimum of 10 ft above the top of footing.
         2) Stagger splices such that no particular bar designation is spliced more than 50 percent in 5 ft.
      b. Use a standard, approved, exothermic process for mechanical butt splicing where the molten filler metal, contained by a high-strength steel sleeve of larger inside diameter than the bars, is introduced into the annular space between bars and the sleeve and between the ends of the bars.
      c. After cooling and hardening of the filler metal, the splice must be capable of transferring the minimum ultimate tensile strength of the reinforcing bar from one bar to the other by the mechanical strength of the splice components.
      d. The splice must not depend on fusion of the filler metal with the bars.
         1) Do not heat the bars to their melting point during the splicing process.
         2) Do not allow the degree of heat required to affect the splice to decrease the structural properties of the bars or affect their original hardness.
      e. Splice according to the manufacturer's recommendations using the manufacturer's standard jigs, clamps, ignition devices, and other required accessories to make splices. Preheat bars where required by the manufacturer.

F. Use one of the following mechanical butt splices for bars sizes No. 3 through No. 11 when designated on the plans. Follow the manufacturer's published recommendations for equipment and splicing procedures.
   1. A full mechanical connection that develops in tension or compression at least 175 percent of the specified yield strength of the bar.
   2. As described in this Section, article 3.3, Splicing, paragraph E.

3.4 BENDING

A. Bend reinforcement to the shapes specified. Refer to CRSI Manual of Standard Practice.

B. Do not heat the bars during the bending operations.

C. Cut and bend as specified.

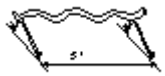
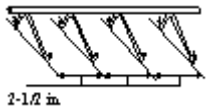
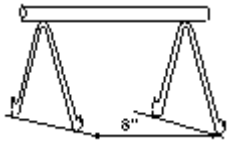
D. Complete all bending before coating except as specified for bent bars.

3.5 FIELD QUALITY CONTROL

A. Have the coated bars inspected for damage to the coating after the bars are in place and immediately before concrete placement.

B. Repair all visible defects using the specified method recommended by the coating manufacturer.

Bar Supports

Types and Sizes				Minimum Wire Sizes[2] and Geometry			
Symbol	**Bar Support Illustration**	**Type of Support**	**Standard Sizes**	**Nominal Height**	**Carbon Steel**		**Geometry**
					Top	**Legs**	
SB[1]		Slab Bolster	3/4, 1, 1-1/2, and 2 inch heights in 5 ft and 10 ft lengths	All	4 ga. Corrugated	6 ga.	Legs Spaced 5 inches on Center, Vertical Corrugations Spaced 1 inch on Center (See Note 3)
BB[1]		Beam Bolster	1, 1-1/2, and 2 inch; over 2 inch to 5 inch heights in increments of 1/4 inch lengths of 5 ft.	Up to 1-1/2 inch incl. Over 1-1/2 inch to 2 inches incl. Over 2 inches to 3-1/2 inches incl. Over 3-1/2 inch	7 ga. 7 ga. 4 ga. 4 ga.	7 ga. 7 ga. 4 ga. 4 ga.	Legs Spaced 2-1/2 inches on Center (See Note 3)
BC		Individual Bar Chair	3/4, 1, 1-1/2, and 1-3/4 inch heights	All	-----	7 ga.	(See Note 3)
JC		Joist Chair	4, 5, and 6 inch widths and 3/4, 1, and 1-1/2 inch heights	All	-----	6 ga.	(See Note 3)
HC or HPC*	 * SAND PLATE NEED NOT BE COATED	Individual High Chair	2 inch to 15 inch heights in increments of 1/4 inch.	2 inches to 3-1/2 inches incl. Over 3-1/2 inches to 5 inches incl. Over 5 inches to 9 inches incl. Over 9 inches to 15 inches incl.	----- ----- ----- -----	4 ga. 4 ga. 2 ga. 0 ga.	Legs at 20 degree or less with vertical. When height exceeds 12 inches, legs are reinforced with welded crosswires or encircling wires (See Note 4)
CHC		Continuous High Chair	Same as HC in 5 ft and 10 ft lengths	2 inches to 3-1/2 inches incl. Over 3-1/2 inches to 5 inches incl. Over 5 inches to 9 inches incl. Over 9 inches to 15 inches incl.	2 ga. 2 ga. 2 ga. 2 ga.	4 ga. 4 ga. 2 ga. 0 ga.	Legs at 20 degree or less with vertical. All legs 8-1/4 inches on center maximum, with leg within 4 inches of end of chair, and spread between legs not less than 50 percent of nominal height. (See Note 5)

Bar Supports Table, page 2

Notes:

1. Top wire on continuous supports, not otherwise designated as corrugated, may be straight or corrugated at the option of the manufacturer.

2. Minimum wire sizes are American steel and wire gauges.

3. To provide adequate stability against overturning, the leg spread measured between points of support on the minor axis of the support shall not be less than 70 percent of the\ nominal height.

4. To provide adequate stability against overturning, the leg spread measured between points of support on the minor axis of the support shall not be less than 55 percent of the nominal height.

5. To provide adequate stability against overturning and to provide adequate load capacity, the leg spread measured between points of support on the minor axis of the support shall not exceed the minimum and maximum percentages of the nominal height, as shown.

Nominal Height (inches)	**Distance Between Supports as a Percent of Nominal Height**	
	Minimum	**Maximum**
Under 4	70	No Limit
4	70	95
6	65	90
8	60	85
10	55	80
12	50	75
Over12	50	75

END OF SECTION

SECTION 03310

STRUCTURAL CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing structural concrete, including concrete slope protection, diversion boxes, catch basins, and cleanout boxes.

1.2 RELATED SECTIONS

A. Section 00555: Prosecution and Progress.

B. Section 02316: Roadway Excavation.

C. Section 02752: Portland Cement Concrete Pavement.

D. Section 02841: Traffic Barriers.

E. Section 03055: Portland Cement Concrete.

F. Section 03152: Concrete Joint Control.

G. Section 03211: Reinforcing Steel and Welded Wire.

H. Section 03390: Concrete Curing.

I. Section 05832: Expansion Joints.

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 148: Liquid Membrane-Forming Compounds for Curing Concrete

C. AASHTO M 153: Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

D. AASHTO M 183: Structural Steel

E. AASHTO M 213: Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

F. AASHTO M 235: Epoxy Resin Adhesives

G. AASHTO Division II Section 3

H. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation

1.4 ACCEPTANCE- Price Adjustments for Strength

A. Use a pay factor of 1.0 when concrete strength meets or exceeds the specified strength.

B. When concrete is below specified strength:

1. Department may accept item at a reduced price.

2. The pay factor applies to the portion of the item that is represented by the strength tests that fall below specified strength.

3. Department calculates the pay factor as follows:

Percent below specified strength:	**Pay Factor:**
0-2 percent	0.9
2-4 percent	0.8
4-6 percent	0.7
6-8 percent	0.6
8-10 percent	0.5

4. Remove and replace all concrete represented by the test if the concrete strength is less than 90 percent of the specified strength.

1.5 SUBMITTALS

A. Falsework Drawing: When required in the contract, submit three copies (prepared by a licensed engineer) for approval at least three weeks before construction starts.

B. Use AASHTO Division II Section 3 (Temporary Work) for minimum design criteria.

PART 2 PRODUCTS

2.1 CONCRETE

A. Class AA(AE) concrete, unless specified otherwise.

B. Concrete Slope Protection: Class A(AE).

C. Refer to Section 03055.

2.2 REINFORCING STEEL AND WELDED WIRE (COATED)

A. Refer to Section 03211.

2.3 JOINTS AND SEALERS

A. Pre-Molded Joint Filler meeting AASHTO M 153.
   1. Concrete Slope Protection: Refer to Section 03152.

B. Preformed Joint Filler: AASHTO M 213.

2.4 BACKER ROD

A. Use backer rod composed of closed-cell polyethylene foam of sufficient size to prevent the sealant from passing to the bottom of the groove.

B. Refer to Section 03152.

2.5 WATERSTOPS

A. Refer to Section 03152.

2.6 RIGID PLASTIC FOAM

A. Preformed, extruded, cellular polystyrene thermal insulation material that has a water absorption property of 0.3 or less.

B. ASTM C 578.

2.7 CURING COMPOUND

A. As specified. AASHTO M 148, Type I-D, Class A.

2.8 FORMS

A. Plywood, wood, metal, glass, or a combination of these materials.

2.9 BARRIER REFLECTORS

A. Refer to Section 02841.

B. Comply with GW series Standard Drawings.

2.10 PARAPET CONNECTION BARS

A. AASHTO M 183.

B. Galvanize as indicated on the drawings. AASHTO M 111.

2.11 PARAPET ANCHOR BOLTS

A. Meet AASHTO M 213.

PART 3 EXECUTION

3.1 PREPARATION

A. Falsework
   1. Construction:
      a. Use materials able to sustain the stresses required by the falsework design.
      b. Use suitable jacks or wedges to set the forms to the grade or camber required, and to prevent settling.
      c. Produce a finished structure of the specified camber, and built to the lines and grades indicated.

2. Footing Construction:
   a. Build falsework on a solid footing that is safe against undermining, protected from softening, and capable of supporting any imposed loads.
   b. Demonstrate that the soil bearing values do not exceed the supporting capacity of the soil. (Conduct test loads or have soils investigation conducted by a licensed engineer.)
   c. Use piling or caissons to support falsework that cannot be founded on a solid footing.
   d. Space, drive, and remove piles following approved falsework drawings.

B. Forms
1. Use mortar-tight concrete forms, true to the dimensions, lines, and grades of the structure, and of sufficient strength to prevent deflection during the placement of concrete.
2. Discontinue using any form or forming system that produces a concrete surface with excessive undulations until modifications have been made. Undulations are excessive if they exceed either 1/8 inches or 1/270 of the center-to-center distance between studs, joints, forms, fasteners, or wales.
3. Countersink all bolt and rivet holes when using metal forms for exposed surfaces so that a plane, smooth surface of the desired contour is obtained.
4. Use lumber that is free of knotholes, loose knots, cracks, splits, warps, or other defects that affect the strength or appearance of the structure. Rough lumber may be used for forming surfaces if visible rough surfaces do not show on the final structure.
5. Form all exposed surfaces of each element of a concrete structure with the same forming material or with such materials that produce a concrete surface that is uniform in texture, color, and appearance.
6. Clean the inside surface of forms of all dirt, mortar, and foreign material before concrete placement.
7. Use form oil that permits the ready release of the forms and does not discolor the concrete.
8. Do not place concrete in the forms until:
   a. All work connected with form construction has been completed.
   b. All embedded materials have been placed.
   c. All dirt, chips, sawdust, water, and other foreign materials have been removed.
   d. Inspection and approval have been obtained.
9. Do not use stay-in-place deck forms.

C. Footings
1. Earthwork: Refer to Section 02316.
2. The Engineer may direct written changes in dimensions or elevations necessary to secure a satisfactory foundation.

3. Do not dewater by pumping during concrete placement, or for 24 hours thereafter, unless pumping is outside the enclosure. Do not use well points to dewater footing.

3.2 GIRDERS SLABS, AND COLUMNS

A. Slab Span: Place concrete in one continuous operation.

B. Cast-In-Place T-Beams:
   1. Place concrete in one or two continuous operations: The first to the top of the girder stems and the second to completion.
   2. Obtain a bond between the stem and slab that is positive and mechanical, and secured by means of shear keys in the top of the girder stem.

C. Concrete in columns:
   1. Place concrete in one continuous operation.
   2. Allow concrete to set at least two days before placing caps.
   3. Do not place concrete in the superstructure until the columns have been stripped and approved.
   4. Do not place the superstructure load on the bents until it has been in place a minimum of 14 days.

D. Through-Girder Superstructures:
   1. Place concrete in one continuous operation unless otherwise specified.
   2. If otherwise specified, provide special shear anchorage to assure monolithic action between girder and deck.

3.3 BOX CULVERTS

A. Allow base slab and footing to cure for 24 hours before the remainder of the culvert is constructed.

B. Construct side walls and top slab monolithically unless the wall height exceeds 10 ft. Keep the construction joints vertical and at right angles to the axis of the culvert.

C. When side walls and top slab are not placed monolithically, construct shear keys in the top of the side walls for anchoring the top slab.

D. Construct wingwalls monolithically.

3.4 CONCRETE SLOPE PROTECTION

A. Preparing subgrade:
   1. Prepare the area to be paved by smoothing and shaping the berms and slopes and excavating for the cut-off walls.
   2. Fill and compact all depressions and humps.
   3. Furnish extra material to properly finish the slopes when required.
   4. Compact all soft and yielding material resulting in a firm and substantial subgrade of uniform density.
   5. Thoroughly sprinkle the area with water before placing the concrete.
   6. Have the Engineer approve all surfaces before placing concrete.

B. Placing concrete:
   1. Do not place concrete upon spongy, frozen, or unstable surfaces.
   2. Provide concrete of a consistency that it can be placed on the slopes without deformation.
   3. Complete all scoring as indicated on the plans.
   4. Complete the entire pavement in one placement if possible, or terminate the placement with a construction joint located in a scoring or at the junction of the slope and the abutment.
   5. Finish and cure concrete using a Floated Surface Finish. Refer to paragraph 3.11 and Section 03390.

C. Sealing joints and closures:
   1. Furnish 1-inch thick, rigid plastic foam (styrofoam) for all expansion joints located between structural members and the slope protection.
   2. Place the rigid plastic foam material against the surface of all structural members before placing the concrete slope protection.
   3. Anchor the rigid plastic foam in place with a compatible adhesive or other approved methods.
   4. Seal this area just before final inspection.
   5. Remove curing compounds, oil, grease, dirt, and any other foreign materials from concrete surfaces and grooves by sandblasting or other permitted methods.
   6. Place the backer rod and sealant after the concrete has properly cured.
   7. Apply the backer rod and sealant to clean and dry concrete surfaces.
   8. Place sealant with hand or power-operated caulking guns after placing the backing materials.
      a. Limit the depth of sealant in the groove to 3/8 inch.
      b. Start the placement at one side and proceed to the other side on horizontal grooves and from top to bottom on vertical grooves.
      c. Use a concave pointing tool with soap solution to tool the sealant.
   9. Do not place the sealant unless temperatures are at least 50 degrees F and rising.

3.5 PLACING CONCRETE

A. Remove struts, stays, and braces that hold the forms in correct shape and alignment when no longer necessary.

B. Mix and place concrete within the limitations specified in Section 03055.

C. Do not deviate from the placement schedule without written approval.

D. If the concrete cannot be protected during adverse weather, the Engineer may postpone placement operations.

E. Observe the following precautions when handling concrete:
   1. Avoid segregation of the ingredients.
   2. Arrange chutes, troughs, or pipes used as aids in placing concrete so the concrete does not separate.
   3. Use metal or metal-lined chutes and troughs. (Do not use aluminum.)
   4. Equip chutes with baffle boards or a reversed section at the end of the outlet when placing on steep slopes.
   5. Extend open troughs and chutes down inside the forms or through holes left in the forms; terminate the ends in vertical downspouts.
   6. Thoroughly flush all chutes, troughs, and pipes with water before and after each placement.
   7. Do not allow the free-fall of concrete to exceed 10 ft for thin walls (maximum 10 inch thickness) or 5 ft for other types of construction without the use of a tremie or a flexible metal spout.
   8. Use flexible metal spout sections composed of conical sections not more than 3 ft long, with the diameter of the outlet and the taper of the various sections such that the concrete does fill the outlet and retards concrete flow.

F. Observe the following precautions when placing concrete:
   1. Deposit concrete as close as possible to its final position, without allowing it to flow laterally in the form.
   2. Spread fresh concrete in horizontal layers with thickness not greater than what can be compacted with vibrators.
   3. Do not use vibrators to flow concrete laterally.
   4. Limit placement interruptions to 45 minutes.
   5. Place and compact each layer before the preceding layer has taken initial set.
   6. Do not place concrete in water flowing under head within the area of a footing.
   7. Pass the screed over the area with a screed face device to measure the cover before concrete placement.

8. Relocate and tie reinforcing steel that projects above the specified level before placing the concrete.
9. Raise and support reinforcing steel that is more than 1/4 inch below the specified level before placing the concrete.
10. Firmly support screed rails for bridge deck slabs to prevent movement during concrete placement. When using a finishing machine, support the machine rails on the bridge beams. (Do not place the machine rails on the forms unless the form supports have been strengthened and the Engineer gives written approval.)

G. Observe the following precautions when compacting concrete:
1. Use high frequency internal vibrators to compact all concrete for structures (except concrete placed under water).
2. Supply enough vibrators to compact the fresh concrete to the desired degree within 15 minutes after it is deposited in the forms.
3. Supply at least two vibrators for structures involving more than 25 cubic yards of concrete.
4. Do not attach vibrators to or against the forms or the reinforcing steel.
5. Do not allow vibrators to penetrate layers of concrete that have taken initial set.
6. Use spades or wedge-shaped tampers to secure a smooth and even texture of the exposed surface.

3.6 PLACING CONCRETE UNDER WATER

A. Place and deposit concrete under water when specified on the plans.

B. Seal the forms or cofferdams watertight.

C. Do not pump water while placing concrete or disturb the concrete until it has set at least 24 hours, or attained at least 50 percent of its design strength.

D. Regulate placing to keep surfaces approximately horizontal at all times.

E. Place the concrete by beginning at one end of the form and progressing in a zig-zag movement from side to side across the length of the form.

F. Place the concrete using a tremie or concrete pumping equipment.

G. Observe the following steps when placing concrete with a tremie:
1. Use an 8-inch to 12-inch diameter steel tube tremie constructed with watertight connections, a hopper to receive concrete, and a device at the bottom to exclude water from entering the tube.

2. Use support that permits the discharge end to move over the entire top work surface and permits the tremie to be rapidly lowered to stop or retard flow when necessary.
3. Minimize the number of tremie location shifts for continuous placement.
4. Keep the tremie tube full to the bottom of the hopper during placement.
5. Slightly raise the tremie when a batch is dumped into the hopper, but do not raise it out of the concrete at the bottom until the batch discharges to the bottom of the hopper. If the concrete seal around the tube is lost, re-plug the end and refill the tube with concrete.

3.7 PUMPING CONCRETE

A. Place concrete with a concrete pump in good operating condition. Replace pump that causes excessive or erratic loss of air entrainment.
   1. Use a pump that produces a continuous stream of concrete without air pockets.
   2. Do not add water to the concrete in the pump hopper.

B. Do not allow pump vibrations to damage freshly placed concrete.

C. Do not use concrete contaminated by the priming or cleaning of the pump.

3.8 LIMITATIONS

A. Place all concrete possible in daylight.

B. If either mixing, placing, or finishing occurs after daylight hours, light the work site so all operations are plainly visible. Refer to Section 00555.

C. Keep all traffic off concrete bridges and culverts for 21 days after final concrete placement.

D. Hot and Cold Weather Limitations: Refer to Section 03055.

3.9 EXPANSION JOINTS

A. Refer to Section 05832.

B. Adjust bearing positions and joint widths as directed when steel or concrete is installed at temperatures above 68 degrees F and below 50 degrees F.

3.10 CONSTRUCTION JOINTS

A. Make construction joints where shown on plans or in the placing schedule.

B. Obtain Engineer's written approval when additional construction joints are desired and meet the following requirements:
   1. Place and construct without impairing strength and appearance.
   2. Place in planes perpendicular to the principal lines of stress and at points of minimum shear.
   3. Make monolithic structures by extending the reinforcing across the joint.
   4. Avoid construction joints through paneled wing walls or large surfaces which are to be treated architecturally.
   5. Make a straight line joint across the face of the pour for the full width of the bridge deck.
   6. Leave a rough surface to increase the bond with the concrete placed later.
   7. Form tapered sections with an insert so that the succeeding layer of concrete ends in a section at least 6 inches thick.
   8. Place a bulkhead from the surface to the top mat of steel to ensure a straight vertical face. Shape the concrete below the top steel to a near vertical face in line with the bulkhead.
   9. When a bulkhead cannot be placed, establish a straight vertical face by saw cutting to a minimum depth of 1 inch. Shape the concrete below the saw cut to a near vertical face.

C. Before resuming concrete placement, meet the following:
   1. Re-tighten forms.
   2. Roughen the surface of hardened concrete without leaving loosened particles or damaged concrete.
   3. Clean off concrete surface of foreign matter and laitance by sandblasting.
   4. Saturate concrete surface with water.
   5. Apply epoxy adhesive as specified to face of construction joints.

3.11 CONCRETE SURFACE FINISHING CLASSIFICATIONS

A. Ordinary Surface Finish: A true and uniform finished surface.

B. Rubbed Finish: A surface smooth in texture and uniform in appearance, free of all form marks or irregularities.

C. Wire Brush or Scrubbed Finish:
   1. A finished surface with the cement surface film completely removed and the aggregate particles exposed leaving an even-pebbled texture.

2. An appearance ranging from fine granite to coarse conglomerate depends on the size and grading of the aggregate used.

D. Floated Surface Finish:
1. For flat work: strike off and use a floated surface finish.
2. For bridge decks and approach slabs: machine finish only.

3.12 CONCRETE SURFACE FINISHING

A. Give all formed concrete surfaces at least an Ordinary Surface Finish except as specified otherwise.

B. Use other types of finishes as required in addition to the Ordinary Surface Finish.

C. Provide a Rubbed Finish for all surfaces that cannot meet Ordinary Surface Finish requirements due to irregularities, honeycombing, excessive surface voids, discoloration, and other defects.

3.13 CONCRETE SURFACE FINISHING PROCEDURES

A. Ordinary Surface Finish:
1. After removing forms, remove all fins and projections.
   a. Clean, point, and true all honeycomb spots, broken corners or edges, cavities made by form ties, and other holes and defects.
   b. Keep all areas to receive mortar saturated with water for at least 30 minutes before mortar placement.
2. For pointing, use a mortar of cement and fine aggregate, not more than 1 hour old, mixed in the proportions used in the grade of concrete being finished.
3. Cure the mortar patches and rub to blend with surrounding concrete.
4. Tool and free all joints of mortar and concrete. Leave the full length of the joint filler exposed with clean and true edges.

B. Rubbed Finish:
1. Wet the surface of concrete while still green, paint with grout, and rub with a wooden float until the surface is covered with a lather of cement and water.
   a. A thin grout (1 part cement, 1 part fine sand) may be used in the rubbing.
   b. Let this lather set for at least 5 days, then rub lightly with a fine carborundum stone until smooth.

2. For hardened concrete, use a mechanically operated carborundum stone to finish the surface at least 4 days after placing.
    a. Finish in the same manner as above; however, let the lather set for at least 15 days before lightly rubbing with a fine carborundum stone until smooth.
3. Commercial grade rubbing mortar may be used if approved by Engineer.

C. Wire Brush or Scrubbed Finish:
1. After the forms are removed and the concrete is green, scrub the surface with stiff wire or fiber brushes using a solution of muriatic acid (one part acid, four parts water).
2. Once the scrubbing produces the desired texture, wash the entire surface.
3. Use water mixed with 5 percent by volume ammonium hydroxide to remove all traces of the acid.

D. Floated Surface Finish on flat work other than bridge decks and approach slabs:
1. Striking Off:
    a. After compaction, carefully rod and strike off the surface with a strike board following the cross sections and grades shown on the plans.
    b. Allow for camber as required.
    c. Operate the strike board longitudinally or transversely and move it forward with a combined longitudinal and transverse motion, ensuring that neither end is raised from the side forms during the process.
    d. Keep a slight excess of concrete in front of the cutting edge at all times.
2. Floating:
    a. Use longitudinal, or transverse floating, or both to create a uniform surface.
    b. Longitudinal floating is required except in places where it is not feasible.
3. Longitudinal Floating:
    a. Work the longitudinal float, operated from foot bridges, with a sawing motion while holding it parallel to the road centerline.
    b. Pass gradually from one side of the pavement to the other. Move the float forward one-half of its length and repeat operation.
    c. Substitute machine floating, if equivalent results are produced.
4. Transverse Floating:
    a. Operate the transverse float across the concrete surface by starting at the edge and slowly moving to the center and back again to the edge.
    b. Move the float forward one-half of its length and repeat the operation.
    c. Preserve the crown and cross section of the concrete surface.

5. Straightedging:
    a. Test the concrete surface for trueness with a straightedge after the longitudinal floating has been completed and the excess water has been removed, but while the concrete is still plastic.
    b. Furnish and use an accurate 10 ft straightedge held parallel to the road centerline in contact with the surface.
    c. Check the entire area, immediately filling depressions with freshly mixed concrete, then strike off, consolidate, and refinish.
    d. Cut down and refinish high areas.
    e. Continue the straightedge testing and re-floating until the concrete surface is at the required grade and contour.

E. Floated Surface Finish for bridge decks and approach slabs:
1. Machine-finish exposed surfaces unless otherwise permitted.
2. Finish concrete by striking off and floating the surface.
3. Allow the Engineer enough time to inspect finishing machines during daylight hours before concrete placement.
4. Stop finishing operations hampered by darkness unless lighting facilities are provided.
5. Extend finishing machine rails beyond both ends of the scheduled placement, and allow sufficient distance to permit the float to fully clear the concrete.
6. Use adjustable rails set to elevations established by the Engineer, installed to prevent springing or deflection under the weight of the finishing equipment, and placed to operate without interruption.
7. Place screed machine parallel to the abutments and bents within 10 degrees.
8. Support screed rails to prevent movement during placing of the concrete.
9. Either support finishing machine rails on the bridge beams or on form supports stiffened to prevent deflection.
    a. Obtain written approval before using form supports.
    b. This may require load tests.
10. Attach a measuring device to the screed face and pass it over the area.
11. Before placing concrete, relocate and tie reinforcing steel that projects above the specified level, and raise and support steel that is more than 1/4 inch below the specified level.
12. Place concrete in a uniform heading approximately parallel to the screed machine.
13. Limit the rate of placing to allow enough time to finish the surface before initial set.
14. Continuously place concrete the full length of the structure or superstructure unit unless otherwise shown or approved.
15. Provide sufficient material, equipment, and manpower to place deck concrete at a minimum rate of 25 cubic yards per hour.

16. Strike off the surface to the required elevations with the finishing machine immediately after placing and consolidating the concrete.
17. Do not add water to the concrete in front of or behind the screed.
18. Have the strike-off method and equipment approved. Maintain satisfactory performance. Use equipment capable of finishing concrete within the surface tolerances specified. Maintain satisfactory consolidation and surface tolerance to prevent shutdown and rejection of the equipment.
19. Furnish a 10 ft straightedge to check the surface tolerance, placed both longitudinally and transversely, immediately behind the screed machine and hand-finished areas.
20. Correct irregularities greater than 1/8 inch from the straightedge, before additional placement, and immediately fill depressions with concrete, and refinish.
21. Cut down and refinish high areas.
22. Continue straightedge testing and corrective measures until the entire surface is free of observable departures from the straightedge.

F. Final texturing for bridge decks and approach slabs: (a textured hardened finish):
1. After floating, do not texture finish concrete deck surfaces that are to be covered by a water-proofing membrane system.
2. Use a texture process that produces regular 1/8 inch wide transverse grooves spaced randomly from 1/2 inch to 3/4 inch on centers and 1/8 inch deep.
3. Keep the finished surface free from porous spots and surface irregularities.
4. Furnish a work bridge that follows the finishing machine to facilitate texturing and application of the membrane-curing compound.
5. Check the surface smoothness for acceptance after the concrete has hardened.
6. If the surface deviates more than 1/8 inch from a 10 ft straightedge, remove irregularities by grinding following Section 02752.

3.14 CURING STRUCTURES

A. Refer to Section 03390.

3.15 FORM REMOVAL

A. Obtain approval before removing forms.

B. Remove all forms from the concrete surfaces.

C. Do not use any method of form removal likely to cause overstressing of the concrete.

D. Remove supports to permit the concrete to uniformly and gradually take the stresses due to its own weight.

E. Do not remove forms used in ornamental work, railings, parapets, and exposed vertical surfaces for at least six hours after placement.

F. To determine the condition of columns, always remove forms before removing shoring from beneath beams and girders.

G. Removing falsework:
   1. Do not remove until the backfill at the abutments have been placed up to the bottom of the approach slab.
   2. Do not remove falsework supporting the deck of rigid frame structures until the fill has been placed in back of the vertical legs.
   3. Keep falsework and forms in place under slabs, beams, and girders for 14 days after the day of last concrete placement. Forms for slabs having clear space of less than 10 ft may be removed after seven days.
   4. In cold weather, keep forms and falsework in place as approved in the written plan for cold weather concrete.

H. Patch formed surfaces within 24 hours after form removal:
   1. Cut back and remove all projecting wire or metal devices used for holding the forms in place and that pass through the body of the concrete at least 1 inch beneath the surface of the concrete.
   2. Remove lips of mortar and all irregularities caused by form joints.
   3. Fill all small holes, depressions, and voids with cement mortar mixed in the same proportions as that used in the body of the work.
   4. To patch larger holes or honeycombs, obtain a solid uniform surface by chipping away coarse or broken material.
   5. Cut away feathered edges to form faces perpendicular to the surface.
   6. Cover with epoxy-adhesive coating as specified. AASHTO M 235, Type II
   7. Fill the cavity with stiff mortar composed of one part Portland Cement to two parts sand thoroughly tamped into place.
   8. Pre-shrink the mortar by mixing it approximately 20 minutes. Vary the time according to manufacturer's recommendations, temperature, humidity, and other local conditions.
   9. Float the surface of this mortar with a wooden float before initial set.
   10. Keep the patch wet for five days.
   11. After curing, rub patches on exposed surfaces to blend them with surrounding concrete.
   12. Add coarse aggregate to the patching material when patching large or deep areas.
   13. Make a dense, well-bonded, and properly cured patch.

I. Areas with honeycomb will be rejected. After receiving written notice of rejection, remove and rebuild the structure in part or wholly, as specified, at no additional cost to the Department.

3.16 MISCELLANEOUS CONSTRUCTION

A. Drainage and weep holes:
   1. Construct drainage and weep holes at locations indicated on the plans or as directed.
   2. Place ports or vents for equalizing hydrostatic pressure below low water.
   3. Use non-corrosive materials for weep hole forms.
   4. Remove wooden forms after the concrete is placed.
   5. Paint exposed surfaces of metal drains as indicated on the plans.

B. Anchor Bolts: Securely and accurately set all necessary anchor bolts in piers, abutments, or pedestals as the concrete is being placed.

C. Bearing plate areas:
   1. Finish bridge seat bearing areas high and rub or grind to grade within a tolerance of " 1/16 inch.
   2. Do not grout under bearing plates.

3.17 CLEANING

A. Clean up by removing all falsework and falsework piling, (down to 2 ft below the finished ground line) rubbish, and temporary building materials before final inspection.

END OF SECTION

SECTION 03311

JOINT CLOSURE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Remove asphalt surfacing, deck concrete, joint armor steel, and reinforcing steel at existing joint area; place new reinforcing steel; and recast joint area.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 03152: Concrete Joint Control

C. Section 03211: Reinforcing Steel and Welded Wire

D. Section 03310: Structural Concrete

1.3 REFERENCES

A. ASTM D 412: Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement Concrete: Class AA (AE). Refer to Section 03055.

B. Reinforcing Steel (Coated): Refer to Section 03211.

C. Galvanized Sheet Metal: 16 gage, 0.06 inch thick.

D. Rigid Plastic Foam: Type 9, density of 2 lbs/ft^3.

E. Backer Rod: Refer to Section 03152.

2.2 SEALANT MATERIAL

A. With the following characteristics:
   1. Applied cold and curable under field conditions
   2. Polyurethane based, gun grade
   3. Elastomeric, non-sag seal
   4. Bonds tightly to concrete sides and joints

B. Physical properties when cured 21 days at 73 degrees F. Refer to the following table.

Table 1

Property	Value	Method
Modulus of elasticity of 100 percent elongation	132 psi	ASTM D 412
Hardness	40 ± 5	Shore A
Elongation (at break)	450 percent	ASTM D 412
Recovery	Greater Than 90 percent	
Tensile strength	190 psi	ASTM D 412
Adhesive in Peel	20 lbs/inch	
Adhesive loss	0 percent	
Service range	-40 degree F to 150 degrees F	
Initial cure, tack free, (depending on temperature and humidity)	6 to 8 hours	
Final cure	5 to 8 hours	
Staining Characteristics	Non-staining	

PART 3 EXECUTION

3.1 PREPARATION

A. Asphalt Removal:
   1. Make saw cuts full depth, parallel to existing joints to define removal area.
   2. Do not damage concrete deck when removing asphalt surfacing.

B. Concrete Saw Cuts:
   1. Saw Cut in concrete deck 1 inch deep and parallel to existing joints to define the work area.
   2. Note that the length of the joint closure is the width of the bridge deck adjusted for the skew of the individual structure.

C. Prevent debris from falling into streams, pedestrian areas, traffic areas, and onto railroad tracks.

3.2 REMOVE CONCRETE

A. Use jackhammer method to remove existing concrete.
   1. Partial Depth Removal of Concrete Slab: Use 30-pound class jack hammers or smaller.
   2. Full Depth Removal of Concrete Slab: Use 90-pound class hand operated jack hammers or smaller.
   3. Operate jack hammers at an angle greater than 45 degrees as measured from the deck surface.

B. Remove parapet concrete in the closure area. Where an existing electrical conduit is encountered, protect the conduit from damage.

3.3 REINFORCING STEEL

A. Existing Reinforcing Steel
   1. Refer to the design plans for specific directions.
   2. Thoroughly clean steel that remains in place of all corrosion and adhering materials by sandblasting.

B. New Reinforcing Steel: Place coated reinforcing steel after sandblasting operations are complete.

3.4 PLACE CONCRETE

A. Refer to Section 03055 and Section 03310.

B. Clean existing concrete and steel surfaces. Dampen before placing concrete.

C. Restrict traffic on the joint closure areas until the concrete has reached a compressive strength of 3,000 psi. Engineer may take additional concrete samples.

END OF SECTION

SECTION 03390

CONCRETE CURING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete curing materials and methods.

1.2 REFERENCES

A. AASHTO M 148: Liquid Membrane-Forming Compounds for Curing Concrete

B. ASTM C 156: Water Retention by Concrete Curing Materials

C. ASTM C 309: Liquid Membrane-Forming Compounds for Curing Concrete

D. ASTM C 1315: Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

E. ASTM D 56: Test Method of Flash Point by Tag Closed Tester

F. ASTM D 2369: Test Method for Volatile Content of Coatings

G. ASTM D 2371: Test Method for Pigment Content of Solvent Reducible Paints

H. ASTM E 1347: Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry

1.3 SUBMITTALS

A. For Concrete Curing Compound:
   1. Provide a manufacturer's certificate of compliance as verification for all concrete work.
   2. Provide the Engineer with test results before placing concrete pavement.

PART 2 PRODUCTS

2.1 CURING COMPOUND FOR STRUCTURAL AND ARCHITECTURAL CONCRETE

A. Meet AASHTO M 148, Type I D, Class A.

B. Meet applicable VOC air-pollution control requirements.

2.2 CURING COMPOUND FOR PORTLAND CEMENT CONCRETE PAVEMENT

A. Select a curing compound from the Approved Products List (APL) maintained by the UDOT Research Division.
   1. Meet AASHTO M 148, Type 2, Class B.
   2. Conform to the criteria in Table 1.
   3. Resin type: Poly-alpha-methylstyrene (PAMS).
   4. Do not use compounds that show significant phase separation within 24 hours after thorough agitation.
   5. Meet applicable VOC air-pollution control requirements.

Table 1

Characteristics (Curing compound for PCC)	Min.	Max.	ASTM
Total Solids, percent by weight compound	35		D 2369 D 2371
$Ti0_2$ Pigment, percent reflectance	60		E 1347
Drying Time: Set to touch, min. Track Free, min		 60 120	C 309
Coverage rate, ft^2/gal		100	
Water Loss, lb/ft^2 in 72 hours		0.06	C 156
Flash point, degrees F	50		D 56

2.3 CURING COMPOUND FOR LEAN CONCRETE BASE COURSE

A. Select from the Qualified Products List maintained by UDOT Research Division.
   1. Use a curing compound with a wax base.
   2. Meet AASHTO M 148, Type 2
   3. Meet applicable VOC air-pollution control requirements.

2.4 CURING COMPOUND FOR CONCRETE BARRIER

A. Select from the Accepted Products Listing maintained by UDOT Research Division.
   1. Meet ASTM C 1315, Type 1, Class A.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify concrete surfaces are ready for curing. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

B. Follow product manufacturer's recommendations for preparing surfaces.

C. For newly placed concrete using membrane-curing compound method:
   1. Deliver the curing compound in a ready-mixed form with the pigment uniformly disbursed without diluting or altering the compound. If the compound is chilled and too viscous, warm it to a maximum of 100 degrees F.
   2. Keep surfaces moist until the curing compound is applied.
   3. Complete all patching or surface finishing before applying compound.

D. For lean concrete base course curing: Do not dilute or alter the compound.

3.2 CURING STRUCTURES

A. Bridge Decks, Approach Slabs, Curbs, and Parapets.
   1. Apply membrane-curing compound at the manufacturer's recommended rate so that no portion of the deck or approach slab is exposed to the atmosphere for more than 20 minutes after the tining or finishing operation.
   2. Apply membrane-curing compound at a uniform rate of 100 ft^2/gal.
   3. Work bridge to follow immediately after the finishing machine to allow application of the curing compound while the concrete is still plastic.

4. As soon as the concrete is sufficiently set to support the materials, cover bridge decks, approach slabs, curbs, and parapet walls with material that retains moisture and does not prevent evaporation, such as cotton or burlap mats.
   a. Restrain the cotton or burlap mats to prevent wind or other forces from removing them.
   b. Do not damage the finish.
5. Keep concrete moist continuously for seven days after placement. Keep the entire surface damp, but do not wash away or erode the surface.

B. Other newly placed concrete: Use membrane-curing compound method.
   1. Keep surfaces wet and moist until the curing compound is applied.
   2. Complete all patching or surface finishing before applying compound.
   3. Warm chilled compound that is too viscous to a maximum of 90 degrees F.
   4. Apply curing compound immediately after finishing operations are completed
   5. Spray the entire surface of the concrete with a membrane curing compound at a uniform rate of 100 ft^2/gal.
   6. Immediately re-spray any portion damaged before the seven-day curing expires.

3.3 CURING CURB, GUTTER, FLATWORK, SIDEWALK, DRIVEWAY, AND OTHER MISC CONCRETE ITEMS (CONCRETE SLOPE PROTECTION)

A. Refer to this Section, article 3.1, Preparation and article 3.2, Curing Structures, paragraph B, Other newly place concrete.

3.4 CURING PRE-STRESSED CONCRETE

A. Cure following this Section article 3.2, Curing Structures or article 3.10, Steam Curing, until concrete has reached a strength of 4,000 psi or as designated on the plans.

3.5 CURING PRE-CAST CONCRETE BARRIER

A. Cure exposed surfaces immediately after finishing operations are completed.
   1. Apply the curing compound at a rate of 100 ft^2/gal.

B. After removing form, broom clean the surface of the barrier and apply two coats of curing compound.
   1. Apply the first coat at a rate of 100 ft^2/gal.
   2. Allow the first coat to dry thoroughly before applying the second coat.
   3. Apply the second coat at a rate of 200 ft^2/gal.

3.6 CURING CAST-IN-PLACE CONCRETE BARRIER

A. Cure immediately after finishing operations are completed.

B. Apply two coats of curing compound as specified for Curing Pre-cast Concrete Barrier.

3.7 CURING PRE-CAST NOISE WALL

A. Cover surface of exposed aggregate noise wall panels with a moisture barrier or membrane immediately after initial finishing operations are completed.

B. Leave cover in place until final finishing operations (exposed aggregate) are performed.

C. Remove cover, complete final finishing operations, and immediately apply curing compound.
   1. Apply curing compound at a uniform rate of 100 ft^2/gal.
   2. After removing from forms, apply curing compound to all surfaces not previously covered.

D. Cure all other precast noise wall components.
   1. Apply curing compound to all exposed surfaces immediately after finishing or form removal operations are completed.
   2. Apply curing compound at a uniform rate of 100 ft^2/gal.

3.8 CURING LEAN CONCRETE BASE COURSE

A. After finishing operations are complete, apply curing compound.
   1. Spray entire exposed area (top and sides) at a rate of 200 ft^2/gal.
   2. Use fully atomizing mechanical sprayers that have a wind-protective hood.
   3. Hand spray on small areas and areas inaccessible to mechanical spraying equipment.
   4. Provide complete coverage with curing compound at edges, corners, sides, and rough spots.

B. Damage to the film of curing compound occurring within 72 hours of application must be repaired immediately at no additional cost to Department.

3.9 CURING PORTLAND CEMENT CONCRETE PAVEMENT

A. Pretest the liquid membrane curing compound using an infrared spectrometer to determine specification compliance.

B. Provide the Engineer with the test results before placing the concrete pavement.

C. Delay placing concrete pavement until an acceptable shipment of curing compound is received.

D. Warm viscous curing-sealing compound to a temperature not to exceed 100 degrees F if necessary.

E. Thoroughly mix the compound during use and uniformly disperse the pigment throughout the vehicle. Stir continuously mechanically during application and do not dilute or alter in any manner.

F. Apply compound to the entire pavement surface and exposed edges immediately after completing finishing operations:
   1. Apply the curing compound in two approximately equal applications.
   2. Apply the second application in the opposite longitudinal direction as the first at a combined application rate equal to 100 ft^2/gal.
   3. Allow at least 30 minutes between applications.
   4. Small and irregular areas and areas inaccessible to mechanical spraying equipment may be hand sprayed.

G. Stop paving operations if the application of the compound behind the paving machine is delayed until the problem is resolved.
   1. Keep the pavement moist with water until the compound application process is resumed.
   2. Apply the water in a fog-mist spray without damaging the pavement surface texture.

H. Immediately repair any damage to the compound film occurring until seven days after the initial application at no additional cost to Department.

3.10 STEAM CURING

A. Steam curing.
   1. Provide a complete steam curing system approved by the Engineer, including 24 hour temperature control and monitoring devices, and a suitable enclosure to contain live steam and minimize moisture and heat losses.

2. Do not apply steam until the concrete has set. Wait four to six hours if retarders are used. If no retarders are used, wait two to four hours.
3. Maintain 100 percent relative humidity in the steam curing enclosure.
4. Do not apply steam directly on the concrete.
5. When applying steam, increase the ambient air temperature at a rate not to exceed a 40 degrees F per hour until a temperature range of 140 degrees to 160 degrees F is reached.
6. Maintain the temperature range until the concrete has reached the specified strength.
7. When discontinuing the steam, decrease the ambient air temperature at a rate not to exceed a 40 degrees F per hour until reaching a temperature of not more than 20 degrees F above the air temperature to which the concrete will be exposed.

END OF SECTION

SECTION 03392

PENETRATING CONCRETE SEALER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for applying protective penetrating concrete sealer.

1.2 REFERENCES

A. AASHTO T 260: Sampling and Testing for Total Chloride Ion in Concrete and Concrete Raw Materials

B. ASTM C 267: Chemical Resistance of Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes

C. ASTM C 666: Resistance of Concrete to Rapid Freezing and Thawing

D. ASTM E 274: Skid Resistance of Paved Surfaces Using a Full-Scale Tire

1.3 SUBMITTALS

A. Certificate of Compliance to the Engineer or the Construction and Materials Division.

B. One quart of the product to the Engineer.

PART 2 PRODUCTS

2.1 PENETRATING CONCRETE SEALERS

A. Choose from the following list:
   1. Silane
   2. Siloxane
   3. Silicate
   4. Siliconate
   5. Organo Silane Ester
   6. Styrene Acrylic Copolymer

7. Organo Siloxane
8. Alkylalkoxy Siloxane
9. Alkylalkoxy Silane

B. Comply with requirements of Table 1:

Table 1

Penetrating Concrete Sealer Requirements				
*** Properties**	**Requirements**	**ASTM**	**AASHTO**	**** UDOT**
Accelerated Weathering	As Specified	C 666	T 260	
Freeze-thaw Test Medium	Less than or equal to 3 percent Road Salt			Sealer Studies
Minimum Depth Penetration	Greater than or equal to 3/16 inches			Sealer Studies
Freeze-thaw Weight Loss	Less than or equal to 6 percent 300 Cycles			Sealer Studies
Chemical Resistance	Subsections: 1.1.2 1/1/3	C 267		
Friction Number	Greater than or equal to 40	E 274		
Infrared Spectrogram	Materials Division Base Comparison			Materials Studies

* Certified test results from a private accredited testing laboratory will suffice for acceptance.

** Utah Department of Transportation, Materials and Research Division concrete sealer studies of 1986 and 1990.

PART 3 EXECUTION

3.1 PREPARATION

A. Keep surfaces dry and free of laitance, dirt, dust, paint, grease, oil, rust, and other contaminants.

B. Remove any curing compound from the surface of the concrete before applying penetrating sealer.

C. Use one of the following cleaning methods:
   1. Hydroblasting - 700 psi min.
   2. Shotblasting
   3. Sandblasting
   4. Etching

D. Keep concrete surface matrix intact without exposing any large aggregate.

E. Cure concrete for 28 days prior to sealer application.

F. Place the material after obtaining the approval from the Engineer.

3.2 APPLICATION

A. Application Rate:
   1. Based upon the residue content at a coverage rate of 0.11 lbs/yd^2.
   2. Apply according to manufacturers recommendation for each of the following surfaces:
      a. Horizontal
      b. Vertical
      c. Overhead

B. Application Drying Time: Select a sealer with maximum drying time of 1½ hours.

C. Upon application, meet the minimum Friction Number of 40 for at least 90 percent of friction numbers.

END OF SECTION

SECTION 03412

PRESTRESSED CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pretensioning, fabricating, curing, transporting, and storing prestressed concrete.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 03211: Reinforcing Steel and Welded Wire

C. Section 03390: Concrete Curing

D. Section 05120: Structural Steel

1.3 REFERENCES

A. AASHTO M 203: Steel Strand, Uncoated Seven-Wire for Prestressed Concrete

B. AASHTO M 270: Structural Steel for Bridges

C. AASHTO Standard Specifications for Highway Bridges, Division II

D. ASTM C 150: Portland Cement

E. Federal Standards

F. UDOT's Quality Management Plan

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prestressing Steel:
   1. Protect against physical damage and corrosion during shipping, handling, and storing.

2. Clearly mark the shipping package or form with handling instructions, and information about the corrosion inhibitor including date, place, safety orders, and instructions for use.

B. Transport precast girders in an upright position. Support the girders during transportation in approximately the same point(s) they will be supported when installed.

C. Prevent cracking or damaging precast units during storage, hoisting, and handling.

D. Installation of lifting devices is permitted provided that any portion of the devices that protrudes above the top of the girder is removed when no longer needed.

1.5 SUBMITTALS

A. Certification stating the manufacturer's minimum guaranteed ultimate tensile strength for each sample of prestressing steel.

B. Submit five sets of working shop drawings of the prestressing system before beginning the project or ordering materials.
   1. Show complete details and substantiating calculations of the method and material to be used in operations including any reinforcing steel alterations from those shown on the plans.
   2. Method and sequence of stressing including complete specification and details of the prestressing steel, working stresses, and all other data pertaining to the prestressing operation. Include the proposed arrangement of the prestressing steel in the members.

1.6 ACCPETANCE

A. Girders may be accepted at a reduced price when the average compressive strength is at least 94 percent of the specified strength.
   1. Price reduction factor is as follows:

$$\text{Price Reduction Factor} = 1.00\text{-}0.30 \left\{ \frac{f'c - AVG}{0.06 f'c} \right\}^2$$

   Where: $f'c$ = specified 28-day compressive strength in Psi.
   AVG = average compressive strength of 3 cylinder breaks in Psi.

   2. Department will calculate the amount paid by multiplying the contract unit price for the prestressed concrete member by the price reduction factor.

PART 2 PRODUCTS

2.1 CONCRETE

A. Portland Cement: Type I or Type II, or Type III, low alkali.

B. Type III cement: conform to ASTM C 150, Table 2, for moderate sulfate resistance.

C. Class AA(AE) concrete per Section 03055, except as modified below.
   1. Air entraining admixture to provide 5.0 to 7.5 percent entrained air.
   2. Minimum compressive strength 5,000 psi at 28 days.
   3. Minimum compressive strength for transfer of prestressing force is 4,000 psi.
   4. Maximum slump is 7 inches.
   5. Coarse aggregate gradation meeting the 3/4 inch No. 4 sieve per Section 03055, Table 2.
   6. Minimum cement content must be 611 lbs/yd^3.
   7. Water-Cement ratio must not exceed 0.44 by weight, including free-water in the aggregates.

D. Girders: Reject if the average 28-day compressive strength of representative cylinders is less than 94 percent of the specified strength. Core tests are not permitted for compressive strength tests.

2.2 PRESTRESSING STEEL

A. Meet AASHTO M 203. 1/2 inch diameter, Grade 270.

B. Replace prestressing steel that has damage, loose rust, pitting, or serious corrosion. Slight rusting that occurs after placement in the beds is acceptable if it does not cause visible pits.

C. Oiling or greasing the strand is not acceptable.

2.3 REINFORCING STEEL (COATED)

A. As specified. Refer to Section 03211.

2.4 ELASTOMERIC BEARING PADS

A. As specified. AASHTO Standard Specifications for Highway Bridges, Division II, Article 18.2.

2.5 ZINC-RICH PAINT

A. As specified. Federal Standard TT-P-641.

2.6 THREADED RODS

A. Stainless Steel per Section 05120. AASHTO M 270, Grade 250.

2.7 BEARING PLATE

A. As specified. AASHTO M 270, Grade 250.

2.8 SOURCE QUALITY CONTROL

A. Prestressing Steel:
   1. Furnish three 5 ft long strand samples from each reel or portion of reel that will be used on the project, at no additional cost to the Department.
   2. Testing may require 14 calendar days after the date of receipt without granting an increase in contract time.
   3. The contract time is increased by the number of days of delay if test results are not returned within 14 calendar days and construction operations are delayed. Make written notification for any additional claim resulting from delay within 5 working days after approval of the materials.

2.9 QUALITY ASSURANCE

A. Department pre-qualifies Contractor as a supplier of pre-cast concrete products in accordance with UDOT's Quality Management Plan: Precast/Prestressed Concrete Structures.

PART 3 EXECUTION

3.1 PREPARATION

A. All equipment (jacks, pressure gauges, load cells) used to stress tendons must be accurate.
   1. Calibrate each jack and its gauge as a unit with the cylinder extension in the final jacking force position.
   2. Furnish a certified calibration chart.

B. Calibrate the load cell and provide an indicator to determine the prestressing force in the tendon. The range of the load cell must be such that the lower 10 percent of the manufacturer's rated capacity is not used in determining the jacking stress.

C. The prestressing force may be tested by Engineer.

D. Provide sufficient labor, equipment, and material to install and support testing equipment at the prestressing tendons, and to remove the equipment when testing is completed.

3.2 PRETENSIONING

A. Install and support testing equipment at the prestressing tendons, and remove the testing equipment after the testing is completed.

B. Tension all prestressing steel with hydraulic jacks so that the force in the prestressing steel is not less than the value shown.

C. Do not allow the initial stress to exceed 70 percent of the specified minimum ultimate tensile strength.

D. Average working stress in the prestressing steel must not exceed 60 percent of the specified minimum ultimate tensile strength of the prestressing steel unless otherwise shown.

E. Maximum temporary tensile stress (jacking stress) in prestressing steel to exceed 75 percent of the specified minimum ultimate tensile strength.

F. Working force and working stress are the force and stress remaining in the prestressing steel after all losses peculiar to prestressing have either taken place or been provided for. These losses include creep and shrinkage of concrete, elastic compression of concrete, creep of steel, and take up of anchorages.

G. Anchor the prestressing steel at stresses (initial stress) that result in the ultimate retention of working forces not less than those shown.

H. The loss in stress in pretensioned, prestressing steel due to creep and shrinkage of concrete, creep of steel, and elastic compression of concrete is assumed to be 35,000 psi. If lightweight concrete is used, the loss is assumed to be 40,000 psi.

I. Do not cut or release prestressing steel in pretensioned members until the concrete in the member has attained a compressive strength of not less than the value shown on the plans or 4,000 psi, whichever is the greater.

J. Check prestressing steel strands in pretensioned members, if tensioned individually, for loss of prestress not more than 12 hours before placing concrete for the members. Use methods and equipment acceptable to Engineer.

K. Re-tension all strands that show a loss of prestress in excess of three percent.

L. Increase the calculated elongation of the prestressing steel in pretensioned members to compensate for the loss in stress when it is tensioned at a temperature appreciably lower than the estimated temperature of the concrete and the prestressing steel at the time of initial set of the concrete. Do not allow the jacking stress to exceed 75 percent of the specified minimum ultimate tensile strength.

M. Maintain a minimum lateral eccentricity of prestress when cutting and releasing prestressing steel in pretensioned members. Submit a cutting or release pattern to the Engineer for prior approval.

N. Cut off all pretensioned, prestressing steel flush with the end of the member and the exposed ends of the prestressing steel, and then clean and paint a 1 inch strip of adjoining concrete; or cut the strands a minimum of 1 inch back from the girder end, fill the recess with grout, and finish flush with the girder ends.

O. Remove all dirt and residue not firmly bonded to the metal or concrete surfaces.

P. Cover the surfaces with a thick application of zinc-rich paint. Apply two applications to surfaces that are not covered by concrete or mortar. Thoroughly mix the paint at the time of application and work it into voids in the prestressing tendons.

3.3 PLACING CONCRETE

A. Do not place concrete into forms until the placement of the reinforcement and prestressing steel has been Department inspected.

B. Vibrate the concrete internally, externally, or both.

C. Avoid displacing reinforcing steel or strands.

3.4 LIMITATIONS

A. Refer to Section 03055 for hot and cold weather limitations.

B. Remove side forms of the prestressing members within one to two days provided satisfactory arrangement has been made for curing the concrete.

C. Adequately support the members at all times to prevent deadload bending until after the anchorages for pretensioned members have been released.

3.5 CURING

A. Cure as specified in Section 03390.

3.6 INSPECTION

A. Provide free entry to inspectors while the work on the contract is being performed.

B. Reject materials showing defects during or previous to installation.

END OF SECTION

SECTION 03575

FLOWABLE FILL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for placing flowable fill.

1.2 REFERENCES

A. AASHTO M 154: Air-Entraining Admixtures for Concrete

B. AASHTO M 194: Chemical Admixture for Concrete

C. ASTM C 150: Portland Cement

D. ASTM C 618: Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete

E. ASTM D 4832: Preparation and Testing of Controlled Low Strength Material (CLSM) Test

1.3 SUBMITTALS

A. Batch Proportions: Submit to Engineer seven days before placement.

B. Trial Batch:
   1. Submit certified test results or conduct laboratory trial batch to verify strength prior to placement.
   2. The Department or its representative witnesses the trial batch.

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement: ASTM C 150.

B. Pozzolan: ASTM C 618.

C. Sand.

D. Coarse aggregate: Determine a suitable aggregate size and gradation for the intended application.

E. Admixtures:
   1. Water reducers and set accelerators: AASHTO M 194.
   2. Air entrainment: AASHTO M 154.

PART 3 EXECUTION

3.1 INSTALLATION

A. Combine materials to meet the requirements for strength and constructability as required. Determine strength from trial batches at 28 days.
   1. Minimum strength: 50 psi. ASTM D 4832.
   2. Maximum strength: 150 psi. ASTM D 4832.
   3. Slump: 5 inches to 10 inches.

B. Determine a suitable aggregate size and gradation for the intended application.

END OF SECTION

SECTION 03605

APPROACH SLAB JACKING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Raising the approach slab(s) by pumping cement grout underneath.

1.2 CERTIFICATION

A. Provide compliance certifications for the mix design materials conforming to the requirements of the specified specifications.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Furnish all equipment necessary to perform this work.

B. Grout device:
   1. Consisting of a cement injection pump and a high-speed colloidal mixing machine.
   2. The colloidal mixing machine must operate at a minimum speed of 1,200 rpm and consist of a rotor operating in close proximity to a strator, creating a high shearing action and subsequent pressure release to make a homogeneous mixture.

C. Provide water storage tank and a pump to deliver water to the grout mixer.

D. Furnish an air compressor and rock drills or other device capable of drilling the grout injection holes through the approach slab and any base material, if necessary. Equipment must be in good condition.

2.2 DRY MIX DESIGN

A. Use the standard mix design for jacking and grouting as follows:
   1. One part (by volume) Portland Cement Type I or II.
   2. Three parts (by volume) Pozzolan (natural or artificial).

B. Do not deviate from the dry mix proportions of Portland Cement and Pozzolan unless approved by the Engineer. The water content may be varied, as required for the local conditions.

C. May add an approved liquefier and/or water reducing agent. The Engineer approves the proportions.

PART 3 EXECUTION

3.1 PREPARATION

A. Measure the dry cement and Pozzolan accurately in cubic yards whether available in bulk or packaged.

B. Batch water through a meter or scale.

3.2 DRILLING

A. Drill a minimum of four evenly spaced holes into each half of every approach slab where required to obtain uniform placement underneath the approach slab. Drill holes that are vertical and not out-of-round.

3.3 PUMPING

A. Pump in a pattern and in the amount required to completely fill the voids underneath the slab. Raise the approach slabs to within plus or minus 3/16 inch from a string line grade.

B. Remove Pozzolan mix material from the drill holes at the completion of the pumping operation. Clean the circumference of the hole and seal the hole with a stiff sand and cement grout or an approved fast setting cement mortar.

END OF SECTION

SECTION 03921

PARAPET SURFACE REPAIR AND SEALING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Repair and seal existing concrete front face and top of parapets.

1.2 RELATED SECTIONS

A. Section 03310: Structural Concrete.

PART 2 PRODUCTS

2.1 MATERIALS

A. Patching Concrete:
   1. Select from the Performance Data Products Listing (PDPL) maintained by the UDOT Research Division.
   2. Only use products recommended for vertical application by the manufacturer.

B. Substrate Coating: Bonding agent or primer recommended by the patching concrete manufacturer.

C. Surface Sealing Material (Penetrating Type): Select from the Accepted Products Listing (APL) maintained by the UDOT Research Division.

PART 3 EXECUTION

3.1 PREPARATION

A. For Surface Repair:
   1. Remove loose and spalled concrete before sandblasting.

2. Sandblast the top and traffic face of the concrete surfaces to remove all dirt, grease, laitance, rust and corrosion prior to placing concrete.

B. For Sealing:
1. Sandblast the top and traffic face of the parapet surfaces to remove all dirt, grease, and laitance.
2. Patch spalled or damaged spots on parapets before applying sealer.

3.2 SURFACE REPAIR

A. Prevent sandblasting material and debris from falling into streams, pedestrian areas, traffic areas, or onto railroad tracks.

B. After sandblasting, coat concrete substrate with the manufacturer's recommended primer of the particular patching concrete.

C. Place concrete within the manufacturer's prescribed time period after sandblasting and prime coating has been completed.

D. Patching Concrete:
1. Apply the one component, non-shrinking patching concrete uniformly to build back the original surfaces of the face and top areas of the parapets to within ± 1/8 inch of the original surface. Allow concrete to cure in accordance with the requirements of the manufacturer's recommendation.
2. If the patch fails to bond to the existing concrete, remove the patch completely and repair again.

E. Finishing Surfaces:
1. Provide a uniform color matching existing parapet.
2. Finish according to Section 03310. Follow manufacturer's recommendations for procedure.

F. Coating Parapet Surfaces:
1. Allow concrete to properly cure.
2. Sandblast all curing compound from the top and traffic face of the parapet.
3. Coat all sandblasted surfaces with the penetrating concrete sealer following the manufacturer's recommended procedure.

G. If wingwalls, overhanging portions of the deck, and/or exterior beam surfaces become stained or discolored due to water or concrete leaking from the forms, provide a satisfactory treatment to restore these surfaces to a uniform color.

H. Remove sandblasting materials and debris from the deck after the work is complete.

3.3 SEALING

A. Coat the top and traffic face (front face) with the penetrating concrete sealer, following the manufacturer's application procedures and recommendations.

END OF SECTION

SECTION 03922

DELAMINATION REPAIR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Repair delaminated concrete areas.

1.2 PAYMENT PROCEDURES

A. This item is included in other items of work.

1.3 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete.

B. Section 03310: Structural Concrete.

1.4 REFERENCES

A. AASHTO M 235: Epoxy Resin Adhesives.

1.5 ACCEPTANCE

A. Rebuild the areas to original shape, ± 1/8 inch.

B. Remove and repair if the patching fails to bond. Department does not allow additional compensation for continual repair.

PART 2 PRODUCTS

2.1 MATERIALS

A. Repair Concrete:
   1. Portland Cement Concrete: Class AA (AE). Refer to Section 03055.
   2. Cement: Type II. Refer to Section 03055.
   3. Aggregate: 3/4 inch maximum.

B. Patching Concrete:
   1. Select from the Performance Data Products Listing (PDPL) maintained by the UDOT Research Division.
   2. Only use products for which the manufacturer recommends vertical application.

C. Substrate Coating: Use a bonding agent or primer recommended by the particular patching concrete manufacturer.

D. Epoxy Resin Adhesive: Type II. AASHTO M 235.
   1. Use a class rating consistent with the application temperature.
   2. Select from the Performance Data Products Listing (PDPL) maintained by the UDOT Research Division.

E. Surface Sealing Material (Penetrating Type): Select from the Accepted Products Listing (APL) maintained by the UDOT Research Division.

2.2 MIXER

A. Use an approved type of small mixer to batch out the repair concrete when specifically approved by the Engineer.

PART 3 EXECUTION

3.1 PREPARATION

A. Locate the repair areas: Sound the items requiring this work and mark the limits of delaminated areas for repair work in the presence of the Engineer.

B. Remove concrete:
   1. Remove all loose materials by dry sweeping.
   2. Clean by blowing with compressed air at 90 psi.

3. Make ½ inch deep saw cuts in the sound concrete surrounding the damaged areas.
4. Remove all damaged and shattered concrete.

C. Cleaning:
1. Remove all loose materials by dry sweeping.
2. Clean by blowing with compressed air at 90 psi.
3. Sandblast clean all exposed reinforcing steel and concrete surfaces before placing new concrete.

3.2 INSTALLATION

A. Form Work
1. Use forms and braces to place new concrete to the original dimensions.
2. Vibration is required in the forms when the area between forms and existing concrete surface will allow use of vibrators.

B. Use one type of repair concrete.

C. Placing concrete when thickness to be placed is less than or equal to 3 inches:
1. Use patching concrete.
2. Coat the cleaned concrete using the manufacturer's recommended primer.
3. Place patching concrete in layers not exceeding the manufacturer's recommended application thickness per layer.
4. Apply the surface sealer recommended by the manufacturer.
5. Consult the manufacturer's recommendations for finishing.

D. Placing concrete when thickness to be placed is greater than 3 inches:
1. Apply an epoxy-resin adhesive to the cleaned concrete surface of the repair area before placing the new concrete.
2. Place the concrete and allow it to cure following the requirements of Section 03310.
3. After the concrete has properly cured, sandblast the finished concrete surfaces and coat with a non-penetrating type epoxy sealer. Follow the manufacturer's procedure.

E. Finished surfaces: Provide the look of one color.

END OF SECTION

SECTION 03923

COLUMN SEALING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Clean Concrete and apply sealer to entire column.

PART 2 PRODUCTS

2.1 CONCRETE SEALER

A. Penetrating type.

B. Select from the Accepted Products Listing (APL) maintained by the UDOT Research Division.

PART 3 EXECUTION

3.1 APPLICATION

A. Sandblast the entire exposed column surfaces clean of all dirt, grease, and laitance.

B. Coat the entire column with the penetrating concrete sealer following the manufacturer's application procedures and recommendations.

END OF SECTION

SECTION 03924

STRUCTURAL CONCRETE REPAIR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Restore to sound condition:
   1. Column
   2. Pedestal
   3. Bent Cap
   4. Pier Cap
   5. Diaphragm
   6. Wingwall
   7. Abutment Backwall
   8. Beam End

1.2 RELATED SECTIONS

A. Section 03922: Delamination Repair

B. Section 03935: Epoxy Injection and Sealing

PART 2 PRODUCTS

2.1 MATERIALS

A. Refer to Section 03922 and Section 03935.

2.2 BEAM END REPAIR SURFACE SEALING MATERIAL

A. Penetrating type.

B. Select from the Accepted Products Listing (APL) maintained by the UDOT Research Division.

PART 3 EXECUTION

3.1 CRACK REPAIR

A. Repair cracks from 1/64 inch to 1/4 inch wide by epoxy injection and sealing. See Section 03935.

B. Repair cracks greater than 1/4 inch wide as "delaminated concrete."

3.2 DELAMINATION REPAIR

A. Repair delaminated concrete by delamination repair. Refer to Section 03922.

B. Beam End Delamination Repair: Use a patching concrete.

C. After concrete removal:
   1. Repair any crack found in a delaminated area according to Section 03935.
   2. After the injection operation, apply surface sealing after repairing the delaminated area.

D. When surface sealing after crack injection and delamination repair operations:
   1. Use epoxy sealer for surface sealing exclusively.
   2. Apply sealer to a minimum beam length of 4 ft covering all surfaces in that beam segment.

END OF SECTION

SECTION 03932

CONCRETE SLOPE PROTECTION REPAIR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Prepare and place concrete slope protection and cutoff wall where required.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 03211: Reinforcing Steel and Welded Wire

C. Section 03310: Structural Concrete

D. Section 03390: Concrete Curing

1.3 REFERENCES

A. ASTM D 412: Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.

B. Federal Specifications

1.4 SUBMITTALS

A. For each lot of materials supplied, submit certificates of compliance and sealant material test results.

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement Concrete: Concrete Class A(AE). Refer to Section 03055.

B. Cement: Refer to Section 03055.

C. Reinforcing Steel: Refer to Section 03211.

D. Backer Rod: Refer to Section 03211.

E. Rigid Plastic Foam: Type 9, Density of 2 lbs/ft^3.

F. Sealant Material
1. Applied cold and curable under field conditions.
2. Polyurethane based, gun grade.
3. Elastomeric, non-sag seal.
4. Bonds tightly to concrete sides and joints.
5. Physical properties when cured 21 days at 73 degrees F as follows.

Table 1

Property	Value	Method
Modulus of elasticity at 100 percent elongation	132 psi	ASTM D 412
Hardness	40 ± 5	Shore A
Elongation (at break)	450 percent	ASTM D 412
Recovery	Greater than 90 percent	
Tensile strength	190 psi	ASTM D 412
Adhesive in peel	20 lbs/inch	TT-S-00230C
Adhesive in loss	0 percent	TT-S-00230C
Service range	-40 degrees F to 150 degrees F	
Initial cure, tack free (depending on temperature and humidity)	6 to 8 hours	
Final cure	5 to 8 days	
Staining characteristics	Non-staining	
Federal Specification	Type II Class A	TT-S-00120C

PART 3 EXECUTION

3.1 PREPARATION

A. Prepare the subgrade of the area to be paved:
1. Smooth and shape the berms and slopes. Excavate cutoff walls where required.

2. Fill depressions with untreated base course material, grade and compact.
3. Firmly compact the subgrade.
4. Thoroughly sprinkle the surface with water prior to placing the concrete. The Engineer will approve all surfaces before concrete is placed.

3.2 PLACING CONCRETE

A. Place concrete slope protection within 7 days after removing concrete slope protection. Refer to Section 03055 and Section 03310.

B. Make concrete consistency such that concrete may be placed on the slopes without deformation.

C. Complete all scoring as indicated on the plans.

D. Stop placing concrete if it is not feasible to complete the entire slope protection during one placement. Use a construction joint located in a scoring, or at the junction of the slope and the abutment.

3.3 FINISHING AND CURING CONCRETE

A. Use a floated surface finish. Refer to Section 03310.

B. Cure following Section 03390.

3.4 SEALING JOINTS AND CLOSURES

A. Place the backing rod and sealant when the concrete has properly cured.
1. Concrete surfaces in the grooves must be clean and dry when backing and sealant are placed.
2. Completely remove curing compounds, oil, grease, dirt, and any other foreign materials from concrete surfaces in the grooves by sandblasting.

B. Place the sealant with hand or power operated caulking guns after placing the backing rod.
1. Start the placement at one side and proceed to the other side on horizontal grooves and from top to bottom on vertical grooves.
2. Tool the sealant using a concave pointing tool with soap solution.

C. Place rigid plastic foam material (styrofoam), 1 inch thick against the surface of all structural members prior to placing the concrete slope protection.
1. Anchor the rigid plastic foam in place with a compatible adhesive.
2. Recess the rigid plastic foam in the joints so a groove is formed above the styrofoam filler.

3. Fill the groove with sealant above the styrofoam so the joint is sealed over completely.
4. Place sealant when the ambient air temperature is at least 50 degrees F and rising.

END OF SECTION

SECTION 03933

PARAPET/PARAPET END MODIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Methods and materials for modifying existing concrete parapet systems to:
   1. Meet current standards.
   2. Prepare the parapet system for attachment of guardrail system or precast concrete barrier.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 03211: Reinforcing Steel and Welded Wire

C. Section 03310: Structural Concrete

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 213: Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

C. AASHTO M 235: Epoxy Resin Adhesives

D. AASHTO M 270: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched and Tempered Alloy Structural Steel Plates for Bridges

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement Concrete, Class AA(AE). Refer to Section 03055.

B. Cement: Refer to Section 03055.

C. Reinforcing Steel (Coated): Refer to Section 03211.

D. Connection Bar:
   1. AASHTO M 270, Grade 36.
   2. Galvanized. AASHTO M 111.

E. Guardrail Preset Anchors: Follow plans.

F. Surface Sealing Material:
   1. (Non-penetrating type)
   2. Approved concrete epoxy sealer product from the Accepted Products Listing available at Research Web site. Refer to http://www.udot.utah.gov/index.php/m=c/tid=719.

G. Preformed Joint Filler: As specified. AASHTO M 213.

H. Anchoring Epoxy:
   1. Type I.
   2. Class rating consistent with the application temperature.
   3. Refer to the Accepted Products Listing. Listing available at Research Web site. Refer to http://www.udot.utah.gov/index.php/m=c/tid=719.
   4. AASHTO M 235.

PART 3 EXECUTION

3.1 PREPARATION

A. Locate existing electric conduit, protect from damage.

B. Carefully remove existing parapet railing and brackets, and deliver to the UDOT maintenance shed designated by the Engineer.

3.2 CONCRETE REMOVAL

A. Prevent debris from falling into streams, pedestrian areas, traffic areas or railroad tracks.

B. For parapet modification to meet standards:
   1. Remove the existing parapet concrete. Prevent damage to wingwalls and deck surface.
   2. Remove loose and spalled concrete. Sandblast the removal areas.

C. For preparing parapet end modifications:
   1. Make saw cuts 1 inch deep to define the work area.
   2. Remove concrete using 90 pound class hand-held jackhammers or smaller. Prevent damage to wingwall.
   3. Remove approach slab curb between the parapet end and the approach slab end.
   4. Remove loose and spalled concrete and sandblast the removal areas.

3.3 REINFORCING STEEL

A. Existing Reinforcing Steel:
   1. Refer to the design plans for specific directions.
   2. Thoroughly clean by sandblasting remaining steel of all corrosion and adhering materials.

B. New Reinforcing Steel:
   1. For parapet end modifications: Use epoxy resin adhesive to attach rebar as indicated on the plans. AASHTO M 235.
   2. Place new coated reinforcing steel after sandblasting operations are complete.

3.4 PLACE CONCRETE

A. Refer to Section 03055 and Section 03310.

B. Clean concrete and steel surfaces. Dampen existing concrete before placing new concrete.

3.5 CONNECTION BARS

A. For modifying to meet standards: Provide two bars for each parapet end.

B. For preparing parapet end modifications: Provide two bars for each parapet end modification except where noted otherwise.

3.6 FORMS

A. Clean forms thoroughly.

B. Coat forms with an approved release agent from the Accepted Products Listing available at Research Web site. Refer to http://www.udot.utah.gov/index.php/m=c/tid=719.

C. Use a release agent guaranteed in writing by the manufacturer not to stain concrete or impair bonding properties of any concrete protective surface coating.

3.7 FINISHING

A. Refer to Section 03310.

3.8 COATING CONCRETE SURFACES

A. Allow concrete to properly cure.

B. Sandblast the top and traffic face of the parapet of all curing compound.

C. Coat all sandblasted surfaces with the non-penetrating type epoxy sealer. Follow the manufacturer's recommended procedure.

3.9 STAINING

A. When any concrete surface of the structural members become stained, provide a treatment to restore to a uniform color.

END OF SECTION

SECTION 03934

STRUCTURAL POTHOLE PATCHING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Repair potholes and delaminated areas on bridge decks and approach slabs.

1.2 RELATED SECTIONS

A. Section 01571: Temporary Environmental Controls

B. Section 03055: Portland Cement Concrete

C. Section 03390: Concrete Curing

1.3 REFERENCES

A. AASHTO M 235: Epoxy Resin Adhesives

1.4 SUBMITTALS

A. Submit a plan for handling water approved by the Engineer before the water blasting operation begins.

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement Concrete: Class AA(AE), 3/4 inch maximum aggregate. Refer to Section 03055.

B. Cement: Refer to Section 03055.

C. Epoxy Resin Adhesive:
   1. Type II.
   2. Choose class rating consistent with the application temperature.
   3. AASHTO M 235.

D. Water: Use water containing no hazardous or toxic materials.

2.2 EQUIPMENT

A. Jackhammer: 30 pound class.

B. Water Blast Equipment:
   1. Provide a complete concrete removal system capable of removing concrete to the specified depth.
   2. Equipped with a full rotation water jet. Use a water jet having an angle of impingement of 60 degrees or less as measured from the deck surface.

2.3 TESTING AND CALIBRATING HYDRODEMOLITION EQUIPMENT

A. The Engineer designates a trial area to demonstrate that the equipment, personnel, and method of operations are capable of producing results satisfactory to the Engineer.

B. Do not change parameters once the operation parameters of the hydrodemolisher are defined and satisfactorily demonstrated.

C. Maintain an inventory of common wear parts and replacement accessories for the equipment on the job site.

PART 3 EXECUTION

3.1 PREPARATION

A. Locate all unsound concrete in the deck and approach slabs and mark a rectangular area surrounding each pothole in the presence of the Engineer.
   1. Refer to pothole patching plan.
   2. Remove any asphalt surfacing prior to sounding survey.

3.2 CONCRETE REMOVAL

A. Use either the jackhammer or hydrodemolition method described below.

B. Jackhammer Method:
   1. Saw Cuts: Make saw cuts 1 inch deep at the rectangular limits of the repair areas.
   2. Remove concrete using 30 pound class jackhammer.
   3. Operate jackhammer at an angle greater than 45 degrees as measured from the deck surface. Protect any reinforcing steel encountered.
   4. Pneumatic hammers heavier than 15 pound class will not be permitted for removals in areas directly below the top reinforcing steel.

C. Hydrodemolition Method:
   1. Remove delaminated concrete to the required depth using hydrodemolition methods. Required depth depends on the delamination depth.
   2. Provide the water necessary for the hydrodemolition operation. Use water containing no hazardous or toxic materials.
   3. Collect water and debris from the removal operations retention basins or sediment traps. Refer to Section 01571 and EN series Standard Drawings.
      a. Use pond liners to limit the amount of water leached into the soil from retention basins at the ends of the bridge. Contain waste water, along with concrete debris from the removal operation, in holding ponds for 12 hours before discharging of the water.
      b. The ponds must be equipped with a turn-down elbow to eliminate oil or floatables from being discharged. Dispose of remaining material in the holding ponds in the proper manner.
      c. Clean all water that is returned to the stream bed of sediments and debris. Use temporary slope drains to return water to the stream. Do not allow water to run across traveled lane.
   4. Light Jackhammer Removal Method:
      a. Use a jackhammer to remove concrete that cannot be removed with the water blast equipment.
      b. Operate jackhammer at an angle greater than 45 degrees as measured from the deck surface. Protect any reinforcing steel encountered.
      c. Pneumatic hammers heavier than 15 pound class will not be permitted for removals in areas directly below the top reinforcing steel.

D. Blow Through:
   1. If removal blows completely through the bridge deck, immediately stop the equipment and make the necessary adjustments to limit the area of complete concrete removal. Use sandbags to limit the flow of water through the hole, if necessary.
   2. Lower a rope through the hole and lift a 3/4 inch thick piece of plywood large enough to cover the hole with a 2 inch overlap on all sides.
   3. Secure the plywood tightly against the bottom of the slab using 1/4 inch to 1/2 inch threaded tie rods fastened to 2 x 4 studs at the top of the deck. Remove the forms as soon as the concrete is set and patch the hole.
   4. Use treated plywood to facilitate stripping.

3.3 BONDING CONCRETE

A. Apply an epoxy resin adhesive to the repair area to assist in bonding the fresh concrete to the hardened concrete.
   1. Apply the material according to the manufacturer's specifications.
   2. Keep the repair area clean until new concrete has been placed.

3.4 PATCHING CONCRETE

A. Sandblast clean all exposed concrete surfaces and reinforcing steel prior to placing new concrete. Place concrete within four hours after sandblasting has been completed.

B. Provide new rebar splices to existing rebars, equivalent size, wherever a section loss greater than 50 percent occurs.

C. Place concrete and strike off level with deck surface. Cure a minimum of four days using the water method. Refer to Section 03390.

D. Patch failure: if the patch fails to bond to the existing concrete, remove the patch completely and repair the pothole again.

3.5 PROTECTION

A. Prevent debris from falling into streams, pedestrian areas, traffic areas, or railroad tracks.

END OF SECTION

SECTION 03935

EPOXY INJECTION AND SEALING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Repair concrete cracks by injecting epoxy and sealing the concrete surfaces.

1.2 PAYMENT PROCEDURES

A. These items are included in other items of work.

1.3 ACCEPTANCE

A. Penetration of 95 percent of all cracks from 1/64 inch to 1/4 inch wide is required.

1.4 DELIVERY

A. Deliver the packages materials in unopened packages with labels clearly indicating the following:
   1. Name of Manufacturer
   2. Manufacturer's product name or product number
   3. Manufacturer's lot number
   4. Mix ratio
   5. SPI Hazardous Material Rating and appropriate warnings for handling

PART 2 PRODUCTS

2.1 MATERIALS

A. Select from the Performance Data Products Listing (PDPL) maintained by the UDOT Research Division.
   1. Epoxy Injection Material:
      a. Use only products for which vertical crack injection is recommended by the manufacturer.
      b. Use appropriate cap seal material recommended by the particular epoxy manufacturer.
   2. Surface Sealing Material: Penetrating sealer.

2.2 EQUIPMENT

A. Minimum of two pumps with the following required characteristics:
   1. Electric-powered and portable.
   2. Positive displacement.
   3. Positive-ratio control of exact proportions of the two components at the nozzle.
   4. In-line metering and mixing.

B. Injection equipment required characteristics:
   1. Automatic pressure control capable of discharging the mixed adhesive at any pre-set pressure up to 200 psi " 0.5 psi.
   2. Equipped with a manual pressure control override.

C. Capable of maintaining the volume ratio of the injection material prescribed by the manufacturer within a tolerance of " 5 percent by volume at any discharge pressure up to 200 psi.

D. With sensors on both the component A and B reservoirs that automatically stop the machine when only one component is being pumped to the mixing head.

PART 3 EXECUTION

3.1 INSTALLERS

A. Injection equipment operators must have a minimum of two years experience in the methods and materials of the selected system for application of epoxy injection.

B. Injection equipment operators must know the technical aspects of:
   1. Correct material selection and use.
   2. Equipment operation, maintenance, and troubleshooting.

3.2 PREPARATION

A. Sandblast clean the concrete surfaces.

B. Seal cracks.

C. Provide entry ports for the epoxy injection. Space ports a maximum of 6 inches.

3.3 EPOXY INJECTION

A. Proceed from lower to higher ports.

B. When epoxy appears at a higher port, plug the port being injected and move to a higher port.

3.4 EPOXY SEALING

A. Grind flush all ports extending above the concrete surfaces.

B. Apply the sealant at the minimum application rate of 0.09 gal/yd^2.

C. Cover the entire length of the crack with epoxy sealant for a minimum of 2 ft on either side of the crack.

D. Mask the member so a straight vertical line is produced at the cutoff point.

E. Apply a second coat at the same application rate as soon as the first coat is dry to the touch. Do not exceed the following times between coats:

Hours	**Temperature (Degrees F)**
72	66
36	77
24	90

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for erecting structural metals.

1.2 RELATED SECTIONS

A. Section 09972: Painting for Structural Steel

1.3 REFERENCES

A. AASHTO M 164: High-Strength Bolts for Structural Steel Joints

B. AASHTO M 270 M: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges

C. AASHTO M 291: Carbon and Alloy Steel Nuts

D. AASHTO M 293: Hardened Steel Washers

E. AASHTO Standard Specifications for Highway Bridges

F. ASTM A 123: Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products

G. ASTM F 606: Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets

H. ASTM F 959: Compressible-Washer-Type Direct Tension Indicators for Use With Structural Fasteners

I. ANSI/AASHTO/AWS D1.5

J. UDOT Steel and Concrete Construction Manual

1.4 SUBMITTALS

A. Manufacturer's certificate of compliance for nut proof load tests as specified. AASHTO M 291.
   1. Certificate must show corresponding lot numbers appearing on the shipping package, certification, test location, time and date, and results of all testing.
   2. Include rotational capacity and proof load test results.

B. Three copies of certified mill test reports for all fabricated structure materials before fabrication, including materials manufactured outside the United States.

C. Shop Drawings: Submit five copies of shop detail drawings for all fabricated materials.
   1. Submit one set on 33 inch x 23 inch sheets with a 2 inch blank margin on the left edge and four sets on 11 inch x 17 inch sheets with the department project designation data, drawing number, and sheet number in the lower right corner.
   2. All details are subject to modification or approval.
   3. Do not order materials or begin work until receiving final approval of the shop detail drawings.
   4. Do not deviate from the approved shop drawings unless authorized in writing. Contractor is responsible for costs incurred doe to faulty detailing or fabrication.
   5. Engineer reserves the right to retain these drawings up to 14 calendar days without granting an increase in the number of working days for the project. This right applies each time the drawings are submitted.
      a. If the drawings are held in excess of 14 calendar days and cause a delay in the Contractor's operations, the contract time may be increased by the number of days delayed.
      b. Written notification and justification must be submitted within five working days after approval if claiming an increase in contract time.

1.5 QUALITY ASSURANCE

A. Bolts and Nuts (Black and Galvanized): Subject to the Rotational Capacity Test, Section 8.5, and the following requirements. AASHTO M 164:
   1. Go through twice the required number of turns (from snug tight condition) in a Skidmore-Wilhelm Calibrator or equivalent tension measuring device without stripping or failure as specified.

2. Modify Table 8 in AASHTO M 164 as follows:

Bolt Length **Bolt Diameters**	**Nominal Nut Rotation, Degree (Turn)**
≤ 4	240 degrees (2/3)
> 4 and ≤ 8	360 degrees (1)
> 8	480 degrees (1-1/3)

3. Maximum recorded tensile strength must be equal to or greater than 1.15 times the required fastener tension as specified.
4. Measured torque necessary to produce the required fastener tension must not exceed the value obtained by the following equation:

	Torque	≤	0.25 PD
Where:	Torque	=	Measured Torque (foot-lbs)
	P	=	Measured Bolt Tension (lbs)
	D	=	nominal diameter (feet)

5. Bolts and nuts require proof load tests as specified in ASTM F 606, Method 1 (Proof Load).
6. Bolts and nuts require wedge tests as specified in AASHTO M 164, Section 8.3.

B. Foreign Materials:
1. Have inspected, sampled, and tested at a distribution point in the United States, all materials that have been manufactured outside the United States.
2. Furnish facilities and arrange for all testing beyond the Department's capability.
   a. Engineer or Engineer's representative must witness all tests.
   b. Reimburse Department for travel expenses if testing of foreign materials is conducted outside Utah.
   c. Reimburse Department for all excess costs connected with out-of-state shop inspection for foreign materials including travel expenses or the services of an approved inspection agency
   d. Pay for in-plant inspections deemed necessary.
3. Use foreign manufacturers who have previously established the ability to furnish material uniformly and consistently within the specifications.

C. Welding operators must be prequalified. Comply with UDOT Steel and Concrete Construction Manual.

PART 2 PRODUCTS

2.1 STRUCTURAL METALS

A. As specified unless otherwise indicated. Follow AASHTO Standard Specifications for Highway Bridges, Division II, Section 11.3.

2.2 HIGH TENSILE STRENGTH NUTS, BOLTS, AND WASHERS

A. Use bolts, nuts and washers displaying the manufacturer's markings.

B. Bolts: As specified in AASHTO M 164 with the following modifications:
   1. Maximum hardness: Rockwell C33
   2. Minimum hardness: Rockwell C24
   3. Maximum tensile strength:
      a. 150 ksi for bolts 1 inch or less in diameter
      b. 120 ksi for bolts larger than 1 inch in diameter
   4. Lubricate bolts before installing

C. Nuts:
   1. As specified in AASHTO M 291 or AASHTO M 293.
   2. Use heat-treated Grades DH and 2H, except use Type DH3 nuts when Type 3 bolts are called for.

D. Washers: As specified in AASHTO M 293.

E. Load Indicator Washers: As specified in ASTM F 959.

2.3 ELASTOMERIC BEARING PADS

A. As specified in AASHTO Standard Specifications for Highway Bridges, Division II, Article 18.2.

2.4 FABRICATION

A. As specified in AASHTO Standard Specifications for Highway Bridges, and UDOT Steel and Concrete Construction Manual. ANSI/AASHTO/AWS D 1.5.

B. If steel structure is to be part of a bridge structure, the fabricator must have American Institute of Steel Construction (AISC), Category III, Quality Certification.
   1. Category III, Quality Certification not required for railings, grates, grate frames, and drain pipes.

2.5 APPROACH SLAB DRAIN ANGLES AND GRATE

A. AASHTO M 270, Grade 36.

B. Hot-dip galvanize after fabrication. ASTM A 123.

PART 3 EXECUTION

3.1 INSPECTION

A. Notify Engineer immediately upon placing the fabrication order to allow time for shop inspection.
   1. Do not begin fabrication until arrangements for shop inspection have been made.
   2. Facilitate inspection procedures on site and supply personnel as needed to properly inspect the work.

B. Allow authorized inspectors free and immediate access to all parts of the plant.

C. Furnish facilities for inspection of material and workmanship in the mill and shop.

D. The Inspector has the authority to reject any materials or work not meeting the specifications.
   1. Material accepted by the Inspector may be rejected if found defective at a later time.
   2. Replace or correct rejected material at no additional cost to the Department.
   3. Contractor may appeal disputes with the Inspector to the Engineer for a final decision.

3.2 INSTALLING HIGH STRENGTH BOLTS

A. Testing:
   1. Provide a Skidmore-Wilhelm calibrator or other acceptable bolt tension-indicating device for bolt testing at the job site.
   2. Use direct-tension indicators with solid plates when the fastener-grip length is too short to be tested in a Skidmore-Wilhelm calibrator.

3. Check the direct-tension indicators in a Skidmore-Wilhelm calibrator using bolts of sufficient length before using.

B. Test the installed bolt/nut/washer assembly periodically to verify compliance.

C. Use direct-tension indicator washers as specified to tighten high strength bolts.
   1. ASTM F 959.
   2. Tighten bolts according to the manufacturer's methods and procedures or as modified by Engineer.
   3. Tighten the fastener to reduce the gap to 0.005 inch or less regardless of which element is turned for tightening.

D. Install bolts as specified in AASHTO Standard Specifications for Highway Bridges, Division II, Section 11.5.6.4 and in the following procedure.
   1. Complete the *Bolted Field Splice Certification* form at the end of this section as bolt tightening progresses.
   2. Place direct-tension indicator washer where the washers will not be embedded in concrete.
   3. Use drift pins to align bolt holes and maintain dimensions and camber of the member.
   4. Insert bolts in open holes with washers as specified by the manufacturer, and hand tighten.
   5. Tighten at least 50 percent of the bolts (more as required) to approximately 1/2 final tension to draw all plies of the connection into firm contact. Do not tighten any bolts to indicated full tension at this time.
   6. Remove drift pins and replace with bolts.
   7. Tighten all bolts to full tension. Tighten bolts progressively from fixed or rigid points to the free edges.

E. Store the bolts and nuts in the original containers until used.
   1. Protect from dirt and moisture.
   2. Remove only as many fasteners from protected storage as can be tightened during a work shift, and return unused fasteners to protected storage at the end of each work shift.
   3. Clean and re-lubricate fasteners that accumulate rust or dirt resulting from site conditions.

3.3 WELDING

A. As specified in ANSI/AASHTO/AWS D1.5, except as modified by the contract.

B. Field welds must meet the same requirements as shop welds, including inspection by the Department.

C. When AISC Category III is required for the fabrication of the element, do all field welding under the fabrication certification.

D. Comply with welding procedures and inspection requirements. UDOT Steel and Concrete Construction Manual.

E. For surface preparation and painting, refer to Section 09972.

3.4 BEARINGS AND ANCHORAGES

A. Do not place masonry bearing plates upon bridge seat bearing areas that are improperly finished, deformed, or irregular. Set bearing plates level in exact position with full even bearing.

B. Locate the anchor bolts in relation to the slotted holes in expansion shoes to correspond with the temperatures at the time of erection. Adjust nut-gap on anchor bolts as shown at the expansion ends to permit free movement of the span.

C. Form bridge seat bearing areas and place anchor bolts according to details shown.

END OF SECTION

Bolted Field Splice Certification follows.

Bolted Field Splice Certification

Consecutively number splices looking stations ahead and increasing from left to right. Copy this page as required. Initial the appropriate box to certify that the bolt tightening has been done in accordance with the specifications.

Do not perform final tightening until the inspector certifies that plates are drawn into full contact. Do not place concrete deck until the inspector has certified that all bolts are properly tightened. Prior to the final inspection, send a completed copy of this form to the State Bridge Engineer, 4501 South 2700 West, Salt Lake City, UT 84119.

Project Number Structure Number

Splice No.	**Top Flange**		**Web**		**Bottom Flange**	
Plates were drawn into contact with each other before final tightening of any bolts.	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials
Bolts are tightened to spec. (Gap under direct tension indicator is less than or equal to 0.005 inch.)	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials

Splice No.	**Top Flange**		**Web**		**Bottom Flange**	
Plates were drawn into contact with each other before final tightening of any bolts.	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials
Bolts are tightened to spec. (Gap under direct tension indicator is less than or equal to 0.005 inch.)	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials

Splice No.	**Top Flange**		**Web**		**Bottom Flange**	
Plates were drawn into contact with each other before final tightening of any bolts.	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials
Bolts are tightened to spec. (Gap under direct tension indicator is less than or equal to 0.005 inch.)	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials

SECTION 05822

EXPANSION BEARINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install expansion bearings, and mating surface.

1.2 RELATED SECTIONS

A. Section 05120: Structural Steel

1.3 REFERENCES

A. AASHTO M 270: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges

B. AASHTO Standard Specifications for Highway Bridges, Division II, Section 18

C. ASTM A 240, Type 304: Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

D. Federal Specifications

1.4 DEFINITIONS

A. **Mating surface:** stainless steel sheet welded to the girder sole plate.

B. **Prefabricated expansion bearing:** Polytetraflouroethylene (PTFE) sliding surface bonded to the preformed fabric pad.

1.5 PAYMENT PROCEDURES

A. Expansion bearing is included in the contract lump sum price for structural steel.

PART 2 PRODUCTS

2.1 POLYTETRAFLUOROETHYLENE (PTFE)

A. Meet AASHTO Standard Specifications for Highway Bridges Division II, Section 18.

B. Material composed of either filled or unfilled virgin PTFE sheets as specified.

C. Unfilled sheets must have minimum thickness of 0.03 inch, and filled sheets must be 0.1 inch " 0.01 inch thick.

2.2 STAINLESS STEEL PLATE

A. Meet ASTM A 240, Type 304.

B. Minimum thickness of 1/4 inch and minimum 8 Finch (root mean square) mirror-like finish on the side that contacts the PTFE.

2.3 ADHESIVE MATERIAL

A. Meet Federal Specifications MMM-A-134.

B. Epoxy resin, FEP film or approved equal.

2.4 PREFORMED FABRIC PAD

A. Meet AASHTO Standard Specifications for Highway Bridges, Division II, Section 18.

B. As specified with dimensions in compliance with the plans.

2.5 STRUCTURAL STEEL

A. Painted Structural Steel: As specified. Meet AASHTO M 270, Grade 36 Type steel.

B. Unpainted Weathering Steel for girders: As specified. Meet AASHTO M 270, grade 50W.

C. These standards do not apply to the stainless steel plate.

2.6 MANUFACTURE - EXPANSION BEARINGS

A. The preformed fabric pad must be bonded to the PTFE at the bearing manufacturer's factory under controlled conditions and in strict conformance to the adhesive system manufacturer's written instructions.

B. Bond the filled or unfilled PTFE to a rigid, confining substrate that limits the flow (elongation) of the confined PTFE to not more than 0.009 inch under a load of 2,000 psi for 15 minutes at 78 degrees F for a 2 inch x 3 inch test sample. Do not bond the PTFE to the preformed fabric pad.
   1. Make the bonded PTFE surface smooth and free from bubbles.
   2. Polish the filled PTFE surfaces.

C. Weld the stainless steel with 1/8 inch continuous fillet welds to the sole plate.
   1. Do not allow the weld metal to project beyond the plane of the sliding surface.
   2. Use Type 309 electrodes or filler rods.
   3. Use welding procedures compatible with the stainless steel specified.

D. Prevent damage to the sliding surface.

E. Protect stainless steel and PTFE sliding surfaces during manufacture, shipment, and erection.
   1. Wipe the sliding surfaces clean immediately before setting the girder in place.
   2. Reject portion of the sliding surfaces damaged by scratches, weld splatter, gouges, or overspray from painting, or other defects.
   3. Replace the damaged units with new units in good condition at no additional cost to the Department.

F. Coefficient of friction between the PTFE and the stainless steel not more than 0.10 at 2,000 psi bearing pressure.

PART 3 EXECUTION Not used

END OF SECTION

SECTION 05831

EXPANSION JOINT MODIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Remove existing expansion joint system from bridge deck and install new expansion joint system.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 03211: Reinforcing Steel and Welded Wire

C. Section 03310: Structural Concrete

D. Section 05120: Structural Steel

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 235: Epoxy Resin Adhesives

C. AASHTO M 270: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges

D. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation

E. ASTM D 395: Rubber Property-Compression Set

F. ASTM D 412: Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension

G. ASTM D 471: Rubber Property-Effect of Liquids

H. ASTM D 573: Rubber-Deterioration in an Air Oven

I. ASTM D 1149: Rubber Deterioration-Surface Ozone Cracking in a Chamber

J. ASTM D 2240: Rubber Property-Durometer Hardness

K. American Institute of Steel Construction (AISC)

L. Federal Specifications

1.4 FABRICATION

A. Shop drawing requirements: Comply with Section 05120.

B. Certification: Comply with Section 05120, except that AISC, Category I Certification or the Department's Quality Certification program is acceptable.

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement Concrete: Class AA(AE). Refer to Section 03055.

B. Cement: Refer to Section 03055.

C. Structural Steel: Galvanized all structural steel as specified. AASHTO M 111.
   1. Steel Extrusions: AASHTO M 270, Grade 36.
   2. Plates: AASHTO M 270, Grade 36.
   3. Round Bars: AASHTO M 270, Grade 36.

D. Lubricating Material: Follow Federal Specification TTS-00230.

E. Epoxy Resin Adhesive: Follow AASHTO M 235.
   1. Type II.
   2. Choose class rating consistent with the application temperature.

F. Reinforcing Steel (Coated): Refer to Section 03211.

G. Rigid Plastic Foam: Type 9, density of 2 lbs/ft^3. ASTM C 578.

H. Neoprene Gland: Single convolution type with the following physical properties:

Table 1

Property Method	Requirements	ASTM
Tensile Strength, min. psi	2,000	D 412
Elongation at break, min. percent	250	D 412
Hardness, Type A Durometer (modified)	55 ± 5	D 2240
Compression Set, 70 hr. at 212 degrees F. Method B (modified)	40 percent	D 395
Oven Aging, 70 hr. at 212 degrees F. Tensile Strength. Loss, max. Elongation, loss, max.	 20 percent 20 percent	D 573
Hardness, Type A Durometer (points change)	0 to + 10	
Oil Swell, ASTM Oil 3, 70 hr at 212 degrees F. Weight Change, max	45 percent	D 471
Ozone Resistance, 20 percent Strain, 300 pphm in air 70 hr. at 104 degrees F. (modified)	No cracks	D 1149

2.2 JOINT SYSTEMS

A. Use only one brand of strip seal system on any single project.

B. The following systems are acceptable for this project and are detailed in the plans.
   1. Wabo Strip Seal System
   2. Structural Accessories Strip Seal System
   3. D. S. Brown Strip Seal System

2.3 TOLERANCES

A. After fabrication of the expansion joint and anchorage system, check the gland face and top of the extruded steel shape of each section for straightness. Use a string line stretched taut from curb angle point to curb angle point.

B. Shop Tolerances:
   1. Steel surfaces are not to deviate from the string line by more than 1/8 inch.

2. No surface is to deviate more than 3/32 inch when the string line is stretched between either end or crown point and the point of maximum departure from true.

C. Field Tolerances: Recheck steel surfaces for straightness under shop tolerance requirements after installing joint system in its final position and before placing concrete.

D. Final In-Place Tolerances:
1. Re-check the extrusion gland face after concrete placement. It is not to deviate from the string line by more than 1/4 inch. The parallel extrusion faces are not to deviate from each other by more than 1/8 inch at any location.
2. Place the top of the extrusion to meet the grade requirements shown on the plans.

PART 3 EXECUTION

3.1 PREPARATION

A. Asphalt Removal
1. Make saw cuts parallel to existing joints to define the removal area.
2. Remove asphalt surfacing in such a manner that the concrete deck is not damaged.

B. Concrete Saw Cuts
1. Place the saw cuts at the offset shown on the plans and saw 1 inch deep in the concrete deck parallel to existing joints to define work area.

C. Prevent debris from falling into streams, pedestrian areas, and traffic areas and on railroad tracks.

3.2 CONCRETE REMOVAL

A. Use jackhammer method to remove existing concrete.
1. Partial Depth Removal: Use 30-pound class hand operated jackhammers or smaller.
2. Full Depth Removal: Use 90-pound class hand operated jackhammers or smaller.
3. Operate jackhammers at an angle greater than 45 degrees as measured from the deck surface.

B. Parapet:

1. Remove parapet concrete in the prescribed limits shown on the plans.
2. Where existing electrical conduit is encountered, protect the conduit from damage.

3.3 REINFORCING STEEL

A. Existing Reinforcing Steel: Clean steel that remains in place thoroughly of all corrosion and adhering materials by sandblasting.

B. New Reinforcing Steel: Place coated reinforcing steel after sandblasting operations are complete.

3.4 SYSTEM INSTALLATION

A. Install expansion joint system according to the manufacturer's recommendations.

B. A factory-trained representative must be present during setting of the system, placement of concrete, installation of neoprene seal element, and during the watertight integrity test.

3.5 JOINT WIDTH

A. Form the joint width, as shown on the plans, using rigid plastic foam. Anchor securely.

B. Place rigid plastic foam between sections of concrete parapet to maintain separation of sections.

3.6 PLACE CONCRETE

A. Clean concrete and steel surfaces before coating with an epoxy adhesive. Follow adhesive manufacturer’s application instructions.

B. Place Concrete according to Section 03055 and Section 03310.

3.7 INSTALL JOINT GLAND

A. Install the gland after the complete steel extrusion installation to ensure that the length of the joint has a continuous seal.

B. Lubricate the steel extrusion cavity before installing the neoprene gland.

C. Remove the foam used to form the joint opening and any other objects prior to watertight integrity test. Gland convolution should hang freely after installation.

3.8 WATERTIGHT INTEGRITY TEST

A. Joint areas must be capable of holding water for 15 minutes without leaking.

B. If joint areas fail the test, remove any leaking seals, clean steel extrusion grooves, and reinstall the seals.

C. Install new seals when leakage persists.

END OF SECTION

SECTION 05832

EXPANSION JOINT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing expansion joint systems.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 05120: Structural Steel

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 270: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges

C. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation

D. ASTM D 240: Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter

E. ASTM D 395: Rubber Property-Compression Set

F. ASTM D 412: Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomer-Tension

G. ASTM D 1149: Rubber Deterioration-Surface Ozone Cracking in a Chamber

H. American Institute of Steel Construction (AISC)

I. Federal Specifications

1.4 DEFINITIONS

A. Expansion Joint System: Extruded neoprene seal element inserted into and bonded to a steel extrusion.

1.5 SUBMITTALS

A. Five copies of shop drawings for all fabricated structural steel materials. For details, refer to Section 05120.

PART 2 PRODUCTS

2.1 JOINT SYSTEMS LIST

A. Select an expansion joint system from the Department's approved list of joint systems, available from the Structures Division, 4501 South 2700 West, Salt Lake City, UT 84119.

2.2 STRUCTURAL STEEL

A. As specified.

B. Steel Extrusion: Meet AASHTO M 270, Grade 36.
   1. Galvanized per AASHTO M 111.

C. Plates and Round Bars: Meet AASHTO M 270, Grade 36

D. Lubricating Material: Meet Federal Specification TT-S-00230.

E. Neoprene Gland: Single convolution type with physical properties that comply with the following requirements:

Table 1

Property	Requirements	ASTM
Tensile Strength, min. psi	2,000	D 412
Elongation at Break, min. percent	250	D 412
Hardness, Type A Durometer (Modified)	(55 ± 5)	D 240
Compression Set, 70 hours at 212 degrees F Method B (Modified)	40 percent	D 395
Oven Aging, 70 hours at 212 degrees F Tensile strength, loss, max. Elongation, loss, max.	 20 percent 20 percent	
Hardness, Type A Durometer (Points change)	0 to + 10	
Oil Swell, ASTM Oil 3, 70 hours at 212 degrees F Weight Change, max.	45 percent	
Ozone Resistance 20% Strain, 300 pphm, in air at 104 degrees F (wiped with toluene to remove contamination)	No cracks	D 1149

2.3 RIGID PLASTIC FOAM

A. Any preformed, extruded, cellular polystyrene thermal insulation material that has a water absorption property of 0.3 or less.

B. Meet ASTM C 578.

2.4 FABRICATION - EXPANSION JOINT

A. Comply with Section 05120, except that AISC, Category I certification or the Department's Quality Certification program is acceptable.

2.5 SOURCE QUALITY CONTROL - EXPANSION JOINT

A. After fabrication of the expansion joint and anchorage system, examine the gland face and top of the extruded steel shape of each section for straightness. Use a string line stretched taut from curb point to curb angle point or necessary construction joint end.

B. Shop Tolerances: Steel surfaces must not deviate in straightness by more than 1/8 inch. When string line is stretched between either end and the point of maximum departure from true, the surface must not deviate more than 3/32 inch.

PART 3 EXECUTION

3.1 INSTALLATION OF EXPANSION JOINT SYSTEM

A. Install expansion joint system using manufacturer's recommendations. A factory-trained representative must be present during setting of the system, placement of concrete, and installation of the neoprene seal element.

B. Joint Width:
   1. Form the joint width using rigid plastic foam as shown on the plans. Anchor securely.
   2. Maintain separation of sections by placing rigid plastic foam between sections of the concrete parapet.

C. Joint Gland:
   1. After the complete steel extrusion installation, install the gland so that the length of the joint has a continuous seal.
   2. Lubricate the steel extrusion cavity before installing the neoprene gland.
   3. Remove the foam used to form the joint opening and any other objects that may interfere with the installation and operation of the gland so the gland convolution hangs freely after installation.

3.2 FIELD QUALITY CONTROL

A. Test expansion system to verify that joint areas can hold water for two hours without leakage.

B. If leaking occurs during testing, remove any leaking seals, clean steel extrusion grooves, and install new seals.

C. Field Tolerances for Expansion Joint: Re-examine steel surfaces again for straightness and shop tolerance requirements after installing joint system in its final position and before placing concrete.

D. Final In-place Tolerances for Expansion Joint:
   1. Re-examine the extrusion gland face again after concrete placement. Deviations from the string line of more than 1/4 inch are not allowed. The parallel extrusion faces must not deviate from each other by more than 1/8 inch at any location.
   2. Finish the top of the extrusion to the grade requirements of the concrete or bituminous material being placed on the bridge deck.

END OF SECTION

SECTION 06055

TIMBER AND TIMBER TREATMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Timber for signs, guardrails, and posts, and the preservative treatment for timber.

1.2 REFERENCES

A. AASHTO M 133: Preservatives and Pressure Treatment Processes for Timber

B. AASHTO M 168: Wood Products

C. AASHTO Standard Specifications for Highways and Bridges

D. American Wood Preservers' Association (AWPA) Standard Grading Rules

PART 2 PRODUCTS

2.1 STRUCTURAL TIMBER, LUMBER

A. As specified in AASHTO M 168.

B. Treat if required following AASHTO M 133.

2.2 POSTS

A. Wood posts that comply with the current AWPA Standard Grading Rules.

B. Pressure treated.

C. Sign posts:
   1. Use only one type of wood species on any one project.
   2. S4S, 80 percent FOHC, Douglas Fir-Larch, Grade No. 2 or better.
   3. Hem-fir, Lodgepole Pine, or Ponderosa Pine, Grade No. 1 or better.

D. Guardrail Post:

1. Surfaced or rough-sawn posts and offset blocks.
2. Use only one species of wood on any one project.
3. Douglas Fir-Larch, Hem-Fir, Lodgepole Pine, or Ponderosa Pine.
4. Grade No. 1 or better.

E. Steel Post with Wood Block:
1. Routed wood offset block of Southern Yellow Pine.
2. Surfaced or rough sawn blocks.
3. Grade No. 1.

F. Mailbox Post: Provide new material for post, shelf, and brace.
1. Sound fir, hemlock, or pine.
2. Free from all decay, splits, or other defects that would weaken the material.
3. Dimensions as shown on the plans.

2.3 TREATMENT

A. Meet AASHTO Standard Specifications for Highway Bridges and AASHTO M 133.

B. As specified. Use pentachlorophenol, ammoniacal copper arsenite, or chromated copper arsenate, Type A or B, whichever is compatible with the timber.

C. Use rodent-repellent treatment for any timber in contact with the ground.

D. Apply salt treatment to mailbox post and lumber requiring painting.

PART 3 EXECUTION Not used

END OF SECTION

SECTION 07105

WATERPROOFING MEMBRANE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Prepare an entire concrete deck and the approach slabs, or specified structure joint areas for waterproofing membrane.

B. Place waterproofing membrane.

1.2 REFERENCES

A. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation

B. ASTM D 5: Penetration of Bituminous Materials

C. ASTM D 36: Softening Point of Bitumen (Ring-and-Ball Apparatus)

D. ASTM D 146: Sampling and Testing Bitumen - Saturated Felts and Woven Fabrics for Roofing and Waterproofing

E. ASTM D 882: Tensile Properties of Thin Plastic Sheeting

F. ASTM D 3236: Apparent Viscosity of Hot Melt Adhesives and Coating Materials

G. ASTM E 96: Water Vapor Transmission of Materials

H. ASTM E 154: Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

I. Vermont DOT: Low Temperature Flexibility Test

1.3 WEATHER LIMITATIONS

A. Do not work during wet conditions or when the deck or ambient air temperatures are below 50 degrees F.

B. Do not apply the membrane unless the deck is surface dry.

1.4 SCHEDULING

A. Notify the Engineer at least one week before installing the membrane.

PART 2 PRODUCTS

2.1 HOT POURED POLYMER MEMBRANE

A. Characteristics:
   1. Single Component Elastomeric Material
   2. Applied hot
   3. Spreadable to uniform thickness after cooling
   4. ASTM C 578

B. Mechanical Properties:
   1. Penetration, Max: 100
   2. Pliability, at 10 degrees F: No cracks when bent 180 degrees over a 1-inch mandrel.

2.2 RUBBERIZED ASPHALT MEMBRANE

A. Characteristics:
   1. Laminate Form
   2. Heat Resistant
   3. Self-adhesive surface protected by special release paper

B. Mechanical Properties:

Property	Method	Value
Thickness, inch min.		0.065
Permeance-Perms, grains/sq ft·hr·inhg	ASTM E 96, Method B	0.10
Tensile Strength, psi	ASTM D 882, (modified for 1 inch opening)	50
Elongation, percent	ASTM D 882, (modified for 1 inch opening)	75
Puncture Resistance (Mesh), lb	ASTM E 154	200
Pliability, at -15 degrees F	ASTM D 146	No cracks in mesh or rubberized asphalt when bent 180 degrees over a 1/4 inch mandrel

2.3 PATCHING CONCRETE

A. Select from the Performance Data Products Listing (PDPL) maintained by the UDOT Research Division.

2.4 FIBERGLASS MATTING

A. Weight = 1.5 lbs/yd^2

2.5 BINDER

A. Compatible with the matting material and conforming to the following requirements:

Property	Method	Value
Penetration, 0.1 mm	ASTM D 5	40-82
Softening point, min.	ASTM D 36	155 degrees F
380 degrees F. viscosity, cps	ASTM D 3236	1000 - 1800
Low temperature flexibility, max.	Vermont DOT (modified)	0 degrees F

PART 3 EXECUTION

3.1 PREPARATION

A. Concrete deck:
   1. Sandblast to remove asphalt and all other foreign material from the entire deck, approach slabs and sides of the parapet for a height of 4 inches above the concrete deck.
   2. Vacuum or use compressed air to remove all dust and loose material from the deck.
   3. Remove all sharp ridges and projections that could puncture the membrane.
   4. Patch holes or spalled areas in the concrete deck with patching concrete to provide a flat deck surface.

B. Asphalt Surface: When membrane will be placed on an asphalt surface, apply a 1/2 inch layer of Hot Mix Asphalt as shown on the plans to provide a flat deck surface.

C. Joints and Cracks: Bond a 12 inch wide strip of woven fiberglass reinforcing to the deck over cracks and joints greater than 3/16 inch wide using a compatible binder.

3.2 APPLY MEMBRANE

A. Use either hot poured polymer membrane or rubberized asphalt membrane.

B. Hot pour polymer membrane: Follow manufacturer's recommendations for application temperatures, equipment, and procedures.
   1. Primer: Apply primer according to the instructions of the membrane manufacturer, if required.
   2. Application Rate: Apply at a uniform rate to yield a minimum membrane thickness of 3/32 inch.
   3. Vertical Surfaces: Apply the membrane on existing vertical surfaces and curb faces to a height 1 inch above that required for the asphalt surfacing overlay without splattering.
   4. Defects: Repair membrane that exhibits pin holes surface blisters, crazing or cracking after cooling.

5. Protection: Protect the membrane from damage by using asphalt roofing felt (30 lbs/200 sq ft) when asphalt surfacing is not placed within four hours of placing waterproofing membrane. Observe the following characteristics and procedures when using the asphalt roofing felt:
   a. Cover entire surface and lay dust side up.
   b. Lay parallel to the centerline of the roadway with a minimum overlap of 4 inches between adjoining sections.
   c. Bond overlap with suitable mastic or cement.
   d. Place free of wrinkles, bubbles or other defects. Repair any placement defects.
6. Traffic: Allow only necessary rubber tire vehicles on the membrane system.
   a. Do not allow public traffic.
   b. Maintain the roofing material in good condition until covered with pavement.
7. Preparation for overlaying: Do not use a tack or prime coat on the top surface of the asphalt rolled roofing.

C. Rubberized Asphalt Membrane: Follow membrane manufacturer's recommendations for application temperatures, equipment, and procedures.
1. Primer: Use primer furnished by the manufacturer of membrane material. Apply primer to all surfaces to be covered by the membrane according to the manufacturer's recommended procedure and application rate.
2. Placement: Overlap prefabricated membrane strips a minimum of 4 inches. Place joints such that a shingling effect will be achieved in which water will drain effectively.
3. Bonding: Use hand rollers or other satisfactory pressure apparatus on the membrane to assure firm and uniform contact with the primed surfaces. If necessary to assure a good seal at joints, an adhesive may be required or use a wide tipped torch to cause tackiness.
4. Placement: Place the membrane on the vertical face of the concrete curb to the height of the finished overlay surfacing.
5. Defects: Protect the entire membrane from developing wrinkles, air bubbles, or other placement defects. Patch any torn or cut areas and narrow overlaps using a satisfactory adhesive and a piece of membrane. Extend the patch at least 4 inches beyond any defect. Bond the patch firmly to the surface.
6. Traffic: Allow only necessary rubber tire vehicles on the membrane. Do not allow public traffic. Maintain the membrane in good condition until covered with pavement.
7. Preparation for Overlaying: If required by the membrane manufacturer, apply a bond coat of an acceptable adhesive to the surface of the membrane.

3.3 ASPHALT SURFACING OVERLAY

A. Place required surfacing after the membrane has cured according to manufacturer's recommendations. Deposit, spread, and roll asphalt material so the membrane will not be damaged.

END OF SECTION

SECTION 07921

SEALING EXISTING CONCRETE SLOPE PROTECTION JOINTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Seal existing concrete slope protection joints.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 03152: Concrete Joint Control

1.3 REFERENCES

A. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation

B. ASTM D 412: Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension

1.4 CERTIFICATES

A. Furnish the certificates of compliance and sealant material test results for each lot of material supplied.

PART 2 PRODUCTS

2.1 MATERIALS

A. Rigid Plastic Foam
   1. Type 9, density of 2 lbs/ft^3
   2. ASTM C 578

B. Backer Rod: Refer to Section 03152.

C. Portland Cement Concrete
   1. Refer to Section 03055.
   2. Maximum aggregate size of 3/4 inch.

D. Cement: Refer to Section 03055.

E. Sealant Material with the following characteristics:
   1. Applied cold and curable under field conditions.
   2. Polyurethane based, gun grade.
   3. Elastomer, non-sag seal.
   4. Bonds tightly to concrete sides and joints.
   5. Physical properties when cured 21 days at 75 degrees F as in Table 1.

Table 1

Property	Value	Method
Modulus of elasticity at 100 percent elongation	132 psi	ASTM D 412
Hardness	40 ± 5	Shore A
Elongation (at break)	450 percent	ASTM D 412
Recovery	Greater than 90 percent	
Tensile strength	190 psi	ASTM D 412
Adhesive in peel	20 lbs/inch	
Adhesive Loss	0 percent	
Service Range	- 40 degrees F to 150 degrees F	
Initial Cure, Tack Free (depending on temperature and humidity)	6 to 8 hours	
Final Cure	5 to 8 days	
Staining Characteristics	Non-staining	

PART 3 EXECUTION

3.1 JOINT LOCATIONS

A. The Engineer must mark the existing joints and the joint limits that require sealing according to the Typical Vertical Joint Sealing Detail, and Typical Contraction Joint Sealing Detail in the plans.

3.2 PREPARING JOINT AND CRACKS

A. Clean the existing joint material from the designated joints. Keep concrete surfaces in the joints clean and dry at the time the backing rod and sealant are placed.

B. Remove curing compounds, oil, grease, dirt, and any other foreign materials from the joint concrete surfaces by sandblasting.

3.3 SEALING HORIZONTAL JOINTS AND CRACKS

A. Seal the horizontal joints and cracks field marked by the Engineer.

B. Use a backer rod when the joint or crack width is greater than 1/2 inch.

C. Start at one side and proceed to the other side on horizontal grooves (cracks or joints).

3.4 SEALING VERTICAL JOINTS AND CRACKS

A. Seal the vertical joints and cracks field marked by the Engineer.

B. Start from top to bottom on vertical grooves (cracks or joints.)

3.5 SEALING ALONG WINGWALLS AND BACKWALL JOINTS

A. Place the rigid plastic foam material (styrofoam) against the surface of all structural members before placing the joint sealant.

B. Anchor the rigid plastic foam in place with a compatible adhesive.

C. Recess the styrofoam 3/8 inch in the joints so a groove is formed above the styrofoam filler.

D. Fill the groove above the styrofoam with sealant so the joint is sealed over completely.

3.6 PLACING SEALANT

A. Place with a hand- or power-operated caulking gun.

B. Tool the sealant using a concave pointing tool with soap solution.

C. Do not place sealant unless temperature is at least 50 degrees F and rising.

3.7 LARGE JOINT AND CRACK SEPARATION

A. Reestablish the original joint design by filling vertical or horizontal joints with concrete when joint widths are greater than 2 inches.

B. Fill vertical or horizontal cracks with concrete when crack widths are greater than 2 inches.

END OF SECTION

SECTION 07922

RELIEF JOINT CRACK SEALING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Clean and seal designated relief joints.

1.2 RELATED SECTIONS

A. Section 03152: Concrete Joint Control

1.3 REFERENCES

A. ASTM D 3405: Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements

B. ASTM D 3406: Joint Sealant, Hot-Applied, Elastomeric-Type, for Portland Cement Concrete Pavements

1.4 CERTIFICATION

A. Submit the manufacturer's certification of compliance for all shipments.

1.5 DELIVERY

A. Deliver packaged material in unopened packages with labels clearly indicating the following:
   1. Name of manufacturer
   2. Manufacturer's product name or product number
   3. Manufacturer's batch or lot number
   4. The application temperature range
   5. The recommended application temperature and the safe heating temperature range

PART 2 PRODUCTS

2.1 MATERIALS

A. Backer Rod: Refer to Section 03152.

B. Crack Sealing Compound: Sealant with the following characteristics:

Table 1

Property	Test Method	Requirement
Tensile Strength Adhesion, 4 h Cure	ASTM D 3406	Section 4.7
Ductility		min. 12 inches at 0 .4 inch/min. at 40 degrees F
Force-Ductility		4 lbs max.
Flow	ASTM D 3405	Section 4.3
Asphalt Compatibility		at 140 degrees F
Workability		1/4 inch penetration
Curing		45 minutes
Flexibility, 1/8 inch x 1 inch x 6 inches		no cracks

2.2 EQUIPMENT

A. Sealant placement equipment:
1. Capable of circulating hot oil for heat transfer to heat the product (sealant machines).
2. Do not use direct heat transfer units (tar pots).
3. Do not exceed the 525 gallon maximum product tank capacity of the sealant placement equipment.

B. Temperature control
1. Sealant unit required to have an approved ASTM Thermometer Number 50 degrees F, or a temperature measurement device capable of reading within " 4 degrees F from 194 degrees F to 700 degrees F.
2. Observe the sealant manufacturer's instruction on application temperature.

PART 3 EXECUTION

3.1 PREPARATION

A. Sampling:
   1. Stockpile all sealant to be used on the project at least 20 working days prior to use. Keep the stockpile dry.
   2. Notify the Engineer when stockpile is established and ready to be sampled.
   3. Take at least one random sample of each batch or lot number (minimum of 11 lb/sample).
   4. Do not place any material until the batch or lot material has been approved.
   5. No claim or extension of contract applies when the material fails to meet specification.

3.2 APPLICATION

A. Apply designated joints as shown on the plans.

B. Immediately before sealing the joints, clean 6 inches on both sides of the joint of foreign matter and loosened particles with an HCA (hot compressed air) heat lance. Adequate cleaning is determined by a darkening of the surface at least 6 inches in width, centered on the joint.

C. Fill the joints following the Relief Joint Crack Sealing detail on the plans.

D. Use an appropriate backer rod in the joint opening where the depth and width of the joint opening are greater than 2 inches and 1/2 inch respectively.

E. Replace the sealant material picked up or pulled out at the Contractor's expense. The Contractor will remain liable for any damage to the traveling public resulting from sealant application or sealant pull-out.

END OF SECTION

SECTION 09972

PAINTING FOR STRUCTURAL STEEL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Prepare and paint all surfaces except where indicated otherwise.

1.2 REFERENCES

A. ASTM E 11: Wire Cloth and Sieves for Testing Purposes

B. Federal Standard No. 595: Color

C. The Society for Protective Coatings (SSPC) Guidelines

1.3 SUBMITTALS

A. Detailed plan for approval for protection methods that includes Environmental Protection.

B. Source and gradation of the sandblast abrasive.

C. Type and source of solvent, if required.

D. Manufacturer's information regarding the specified coating materials, including:
   1. Required wet- and dry-film thickness
   2. Project safety data
   3. Thinning recommendations
   4. Temperature requirements
   5. Profile recommendations
   6. Mixing and application procedures
   7. Required equipment

E. Test samples as required.

1.4 SAMPLES

A. Department tests samples from each batch or lot of paint using infrared and gas chromatography techniques prior to use.
   1. Submit samples to UDOT's Central Chemistry Lab.
   2. Paints must match the spectrum samples on file in the UDOT Central Laboratory.

B. Reject paint that does not match the standard.

1.5 PAINTER AND SANDBLASTER QUALIFICATIONS

A. Responsable Parties:
   1. Contractors and subcontractors performing surface preparation or coatings applications in the field:
      a. Certification required prior to contract award by The Society for Protective Coatings to the requirements of SSPC QP 1.
      b. Remain certified for the duration of the project.
   2. Contractors, subcontractors and/or fabricators performing shop surface preparation or coatings applications:
      a. Certification required prior to contract award by The Society for Protective Coatings to the requirements of SSPC QP 3 enclosed shop or an AISC category III painting endorsement.
      b. Remain certified for the duration of the project.
   3. Fabricators, painting contractors, and painting subcontractors:
      a. Do not perform work if certification has expired.
      b. Requests for time extension for any delay to the completion of the project due to an inactive certification will not be considered and liquidated damages applies.
      c. Notify the Department of any change in certification status.

B. Disqualification:
   1. Engineer may withdraw qualification for questionable performance of the painter, blasting operator, or the equipment.
   2. Disqualifications results from inadequate surface preparation, improper profile, runs, sags, overspray, thin film thickness, excessive film build-up, uneven coating, nonuniform color, improper curing, or any other defect in the coating system.

1.6 PAYMENT PROCEDURES

A. Surface Preparation, or Painting, or both, are included in the contract lump sum price for structural steel.

PART 2 PRODUCTS

2.1 MATERIALS

A. Select a complete 3-part coating system consisting of a Zinc primer, Epoxy or Urethane intermediate coat and aliphatic Urethane top coat as approved by the New England Protective Coating Specification Criteria (NEPCOAT). Refer to http://www.udot.utah.gov/index.php/m=c/tid=719 for a link to this list.

B. Use paint color No. 26293 for the first field coat and No. 26306 for the top coat following Federal Standard 595.

PART 3 EXECUTION

3.1 INSPECTION

A. Engineer examines surfaces prior to surface preparation and prior to application of each succeeding coating. Correct any condition that is determined, by the Engineer, to negatively affect a proper coating application.

B. Provide safe access to permit inspection of the steel before and after painting. Use rubber rollers or other approved protective devices for scaffold fastenings. Do not mar or damage freshly coated surfaces.

3.2 PREPARING SURFACES

A. Painted steel: Clean surfaces with clean petroleum solvents and then blast clean to a near-white condition following SSPC-SP 10. Use clean oil-free air.
   1. Grind off all fins, tears, slivers, and burred or sharp edges present on any steel member, or those that result from the blasting operation.
      a. Reblast where needed.
      b. Remove all mill scale.
      c. Do not scar metal.
      d. Produce a 0.5 - 2 mils uniform profile.
   2. Remove all abrasive and paint residue using either a commercial vacuum cleaner or by double blowing.
      a. Equip commercial vacuum cleaner with a brush-type cleaning tool.
      b. Double blowing: vacuum the top surfaces of all structural steel, including top and bottom flanges, longitudinal stiffeners, splice plates, hangers, etc., after the double-blowing operations are completed.

3. Keep the steel dust-free and prime within 24 hours after cleaning. Reblast to a near-white condition if any rust is visible before priming.
4. Protect freshly coated surfaces from subsequent blast-cleaning operations.
   a. Repair surface if damaged.
   b. Mask all areas requiring field welding before shop painting.
5. Have the surfaces inspected and approved by Engineer or Construction and Materials Division representative of Department before applying shop coat.
6. Apply the shop coat at the fabrication site.
7. Apply Mist Coat to the top flange after shear studs have been attached.

B. Field painting:
1. Repair all damage to shop coat that occurs during shipping, handling, and erection.
2. Power wash steel without the field coat to remove contaminants or other foreign matter from the primed surface.
3. Blast clean any rusted areas to a near-white finish. Thoroughly clean the coating surrounding the blasted area and re-prime using an organic zinc from the same paint manufacturer and the same dry-film thickness specified for the shop coat. (SSPC-SP 10)
4. Remove all concrete drippings, abrasive, and paint residue. If using double blowing, vacuum the top and bottom flanges, splice plates, longitudinal stiffeners, hangers, etc., after completing double-blowing operations.
5. Allow the touch-up coat to dry according to manufactures recommendation as listed on the paint data sheet.

C. Weathering steel:
1. Construct so that erection marks on the steel are not visible after the structure is completed.
2. Commercially sandblast all faying surfaces according to the specification standards. Meet SSPC-SP 6.
3. Blast clean the following surfaces after the deck concrete is placed to specified surface finish:
   a. Underside of the exterior portion of the top flange, and underside of all bottom flanges.
   b. The exterior portion of web.
   c. Top side and outside edge of the exterior portion of the bottom flange.

3.3 PREPARING PAINT MATERIALS

A. Mix and thin paint materials per manufacturer's product data sheets for both shop and field painting. If weather conditions require paint thinning, follow manufacturer's recommendations.

B. Mix the paint to a lump-free consistency with a high shear mixer (such as a Jiffy mixer), according to the producer's directions.
   1. Do not use paddle mixers or paint shakers.
   2. Keep paint in the original containers
   3. Mix until all the metallic powder or pigment is suspended, and until all paint solids that may have settled to the bottom of the container are thoroughly dispersed.

C. Strain the paint through a screen having openings no larger than those specified for a No. 50 sieve per the material standard. ASTM E 11.

D. After straining, continuously agitate the mixed material up to and during the time of application.

3.4 APPLYING PAINT

A. Apply each coat at proper consistency and thickness, and in accordance with the manufacturer's recommendations, including field coating. When using spray nozzles, use pressures recommended by the producer of the coating system.

B. Produce a uniform, even coating that bonds to the underlying surface. Follow SSPC-PA1.

C. Apply field coats at the construction site after steel erection work is completed.
   1. Do not apply field coats until Engineer approves the surface.
   2. Dry-film thickness of the first field coat should be greater than 4 mils.
   3. Keep the dry-film thickness of the top coat greater than 2 mils.

D. Weather:
   1. If weather conditions require paint thinning, follow the manufacturer's recommendations.
   2. Temperature of the air and the steel must be above 40 degrees F, but not so hot as to cause the paint to blister.
   3. Relative humidity must be less than 85 percent or the combination of temperature, and humidity conditions must inhibit surface condensation.
   4. Test humidity by applying a thin film of water to a small area. If the film evaporates with 15 minutes, the surface may be painted.

E. Remove any shop coat that shows any indication of "mud-cracking" or adds more than 7 mils to a soundly bonded coating or bare steel.

F. Thoroughly clean areas having deficient primer thickness to remove all dirt.

G. Apply an immediate top coat to any surface at the fabrication site that will be inaccessible for painting after field erection.

H. Do not load material for shipment until shop paint is dry to the touch and until the UDOT inspection sticker is placed on the member by the inspector. Remove the sticker before painting field coats.

3.5 PROTECTION

A. Suspend work if protection is unsatisfactory.

B. Protect pedestrian and vehicular traffic.

C. Protect from splatter, splashes and overspray all portions of the structures that are not to be painted including superstructure, substructure, slope, and highway appurtenances. Protect where other damage during painting and blast cleaning operations could occur.

D. Use barriers during any blast-cleaning operations to protect pedestrians and vehicles, and to prevent spreading or falling of abrasive materials and debris on the traveled portions of the pavement. Remove any abrasive materials and debris on pavement, shoulders, or slope paving before reopening work areas to traffic.

E. Provide employees performing the blast-cleaning operations air-supplied sandblasting hoods approved by the US Bureau of Mines.

F. Minimum requirements for the air supply system:
   1. Airline filter, pressure-reducing valve with gauge, and pressure release valve.
   2. Do not allow the air supply to be contaminated with harmful materials or elements.

3.6 FIELD QUALITY ASSURANCE

A. Minimum Coating Thickness: Apply two or more coats if the required film thickness cannot be obtained by one coat without producing runs, bubbles, or sags.

END OF SECTION

SECTION 09991

CLEANING AND REPAINTING STRUCTURAL STEEL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Clean and repaint existing structural steel surfaces including all bearing units for existing paint systems that have red lead primer.

B. Remove existing paint from existing structural steel surfaces.

C. Prepare existing steel surface for repainting, and paint the cleaned structural steel surfaces.

1.2 REFERENCES

A. ASTM E 11: Wire Cloth and Sieves For Testing Purposes

B. Federal Standard No. 595: Color

C. The Society for Protective Coatings (SSPC) Guidelines

1.3 SUBMITTALS

A. The Contractor or the subcontractor must submit a written compliance program indicating that they have the equipment, training, containment, and monitoring system to comply with OSHA's standard on lead exposure in construction, as published in Federal Register, Section 29 CFR 1962.62, May 4, 1993.

1.4 PAINTER AND SANDBLASTER QUILIFICATIONS

A. Responsible Parties:
   1. Contractors and subcontractors performing surface preparation or coatings applications in the field:
      a. Certification required prior to contract award by The Society for Protective Coatings to the requirements of SSPC QP 2 Category A.
      b. Remains certified for the duration for the project.
   2. Fabricators, painting contractors, and painting subcontractors:
      a. Do not perform work if certification has expired.
      b. Requests for time extension for any delay to the completion of the project due to an inactive certification will not be considered and liquidated damages applies.

B. Disqualification:
   1. Engineer may withdraw qualification for questionable performance of the painter, blasting operator, or the equipment.
   2. Disqualification results from inadequate surface preparation, improper profile, runs, sags, overspray, thin film thickness, excessive film build-up, uneven coating, nonuniform color, improper curing, or any other defect in the coating system.

1.5 REQUIREMENTS FOR COATING APPLICATION

A. Have the painter, the blasting operator, or both consult with the manufacturer's technical representative for answers to technical questions relating to the application of the specified coating materials.

B. Obtain surface preparation approval from the Engineer before applying paint.

C. Use equipment capable of taking dry-film thickness readings on all portions including nuts and bolts.

1.6 PROJECT CONDITIONS/WEATHER LIMITATIONS

A. If weather conditions require paint thinning, follow the manufacturer’s recommendations.

B. Apply paint only when the following weather conditions exist:
   1. The temperature of the air and the steel: above 40 degrees F.

2. The relative humidity:
   a. Less than 85 percent, or such that the combination of temperature and humidity conditions inhibits surface condensation.
   b. To test humidity, apply a thin film of water to a small area. If the film evaporates within 15 minutes, the surface may be painted.
   c. Steel temperature a minimum of 5 degrees F above due point.

PART 2 PRODUCTS

2.1 MATERIALS

A. Blasting abrasive: type and size as specified.

B. Solvent: type and source as required.

C. Coating materials:
   1. Mix properly following manufacturer's recommendations and project specifications.
   2. Use necessary equipment for the proper application of the specified coating.

2.2 COATING SYSTEM

A. Select a complete 3-part coating system consisting of a Zinc primer, Epoxy or Urethane intermediate coat, and aliphatic urethane top coat as approved by the New England Protective coating Specification Criteria (NEPCOAT). Refer to http://www.udot.utah.gov/index.php/m=c/tid=719 for a link to this list.

B. Use manufacturer's information regarding the specified coating materials, including required wet- and dry-film thickness, project safety data, thinning recommendations, temperature requirements, profile recommendations, mixing and application procedures, and required equipment.

C. Use coating materials properly mixed meeting the manufacturer's recommendations and project specifications.

D. Paint Color: Federal Standard No. 595.
   1. Field coat: Color # 26293.
   2. Top coat: Color # 26306.

2.3 MIXING

A. Mix the paint to a lump-free consistency with a high shear mixer (such as a Jiffy mixer), according to the producer's directions.
   1. Do not use paddle mixers or paint shakers.
   2. Keep paint in the original containers and mix until all the metallic powder or pigment is suspended.
   3. Continue mixing until all solids that may have settled to the bottom of the container are thoroughly dispersed.

B. Strain the paint through a screen having openings no larger than those specified for a No. 50 sieve. ASTM E 11.

C. Continuously agitate the strained, mixed material up to and during the time of application.

2.4 QUALITY CONTROL

A Sampling:
   1. Take samples from each batch or lot of paint to be tested.
   2. Test the samples using infrared and gas chromatography techniques prior to use.
   3. Reject paint that does not match the standard. The prints must match the spectrum samples on file in the Central Laboratory.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean surfaces, including bearing units, of all oil, grease, and dirt with clean petroleum solvents or steam cleaning prior to blasting operation. SSPC-SP10.

B. Blast surfaces clean to near white with 0.5 to 2 mil profile.

C. Discoloration, light shadows, or slight streaks caused by stains of rust is not allowed on more than 5 percent of surface area.

D. Define acceptable surface preparation using SSPC-Vis 1.

E. Use SSPC-SP-11 to clean areas such as backside of base plates, corners, etc., that cannot otherwise be cleaned.

F. Prime the surface within 24 hours from blasting.

G. Do not prime the surface if rust has started to form. Clean the surface again before applying the prime coat.

H. Protection:
   1. Fully contain all material resulting from paint overspray.
   2. Enclosure system must withstand extreme high winds.
   3. Protect all portions of the structure that will not be painted.

I. Recover a minimum of 95 percent of debris from cleaning operation.
   1. Sample debris from cleaning operation. Submit samples to UDOT Materials and an independent accredited Materials Testing Lab for composition and disposal evaluation.
   2. Place reclaimed waste paint in EPA-USDOT approved containment. Store at the project site.
   3. The Engineer tests the waste paint who then contacts the UDOT chemist at 965-4298. Submit paint composition and disposal evaluation results from the independent materials testing lab. Disposition will be given to the contractor within 30 days. Dispose of waste paint as directed by the Engineer, submit disposal certificates for all waste paint.

3.2 APPLICATION

A. Conform to Field Inspection Provisions:
   1. Do not apply paint until the Engineer approves the prepared surface.
   2. Use rubber rollers or other approved protective devices on scaffold fastenings.
   3. Do not use metal rollers, clamps, and other types of fastenings that mar or damage freshly coated surfaces.

B. Apply paint with spray nozzles at pressures recommended by the producer of the coating system.

C. Prime Coat:
   1. Maintain the dry-film thickness of the prime coat between 2.5 and 6.0 mils.
   2. Apply two or more coats without producing runs, bubbles, or sags if the required film thickness cannot be obtained by one coat.
   3. Scrape any coat that produces “mud-cracking” or adds more than 7.0 mils to a soundly bonded coating or bare steel. Re-coat the surface.
   4. Thoroughly clean areas having deficient primer thickness with power washing equipment to remove all dirt. Wire-brush, vacuum, and re-coat the area.

D. Intermediate Coat: Paint as described in the standard specifications to produce a uniform, even coating which bonds to the underlying surface. SSPC-PA 1.
   1. Use the coating type and minimum dry-film thickness specified.
   2. Produce a dry-film thickness of the intermediate coat greater than 4 mils.

E. Finish coat: Keep the dry-film thickness greater than 2 mils.

F. Use wet and dry-film thickness gauges for testing the coating thickness during and after application.

G. Painting Safety: Follow SSPC Paint Application Guide No. 3, "A Guide to Safety in Paint Application."

END OF SECTION

SECTION 09992

CLEANING AND OVERCOATING STRUCTURAL STEEL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Clean and overcoat existing structural steel surfaces including all bearing units for existing paint systems that have red lead primer.

1.2 REFERENCES

A. ASTM E 11: Wire Cloth and Sieves For Testing Purposes

B. Federal Standard No. 595: Color

C. The Society for Protective Coatings (SSPC) Guidelines

1.3 DEFINITIONS

A. Overcoating: spot prime, an intermediate coat, and a top coat of paint over the entire surface on each girder.

1.4 SUBMITTALS

A. The Contractor or the subcontractor must submit a written compliance program indicating that they have the equipment, training, containment and monitoring system to comply with OSHA's standard on lead exposure in construction, as published in Federal Register, Section 29 CFR 1962.62, May 4, 1993.

1.5 QUALIFICATIONS AND EVALUATION

B. Responsible Parties:
   1. Contractors and subcontractors performing surface preparation or coatings applications in the field:
      a. Certification required prior to contract award by The Society for Protective Coatings to the requirements of SSPC QP 2 Category A.
      b. Remains certified for the duration for the project.
   2. Fabricators, painting contractors, and painting subcontractors:

c. Do not perform work if certification has expired.
d. Requests for time extension for any delay to the completion of the project due to an inactive certification will not be considered and liquidated damages applies.

B. Disqualification:
1. Engineer may withdraw qualification for questionable performance of the painter, blasting operator, or the equipment.
2. Disqualification results from inadequate surface preparation, improper profile, runs, sags, overspray, thin film thickness, excessive film build-up, uneven coating, non-uniform color, improper curing, or any other defect in the coating system.

1.6 REQUIREMENTS FOR COATING APPLICATIONS

A. Have the painter, the blasting operator, or both consult with the manufacturer's technical representative for answers to technical questions relating to the application of the specified coating materials.

B. Obtain surface preparation approval from the Engineer before applying paint.

C. Use equipment capable of taking dry-film thickness readings on all portions including nuts and bolts.

1.7 PROJECT CONDITIONS/WEATHER LIMITATIONS

A. If weather conditions require paint thinning, follow the manufacturer's recommendations.

B. Apply paint only when the following weather conditions exist:
1. The temperature of the air and the steel: above 40 degrees F.
2. The relative humidity:
a. Less than 85 percent, or such that the combination of temperature and humidity conditions inhibits surface condensation.
b. To test humidity, apply a thin film of water to a small area. If the film evaporates within 15 minutes, the surface may be painted.
c. Steel temperature a minimum of 5 degrees F above dew point.

PART 2 PRODUCTS

2.1 MATERIALS

A. Solvent: As recommended by the manufacturer.

2.2 COATING SYSTEM

A. Select a coating system as approved by the New England Protective Coating Specification Criteria (NEPCOAT). Refer to http://www.udot.utah.gov/index.php/m=c/tid=719 for a link to this list.

B. Paint Color: Federal Standard No. 595
   1. Field Coat: Use color No. 26293
   2. Top Coat: Use color No. 26306

C. Use manufacturer's information regarding the specified coating materials, including project safety data, thinning recommendations, temperature requirements, profile recommendations, mixing and application procedures, and required equipment.

D. Properly mix coating system. Meet the manufacturer's recommendations and project specifications.

E. Use necessary equipment for the proper application of the specified coating, observing safety practices found in SSPC Paint Application Guide No. 3, "A Guide to Safety in Paint Application."

F. Use wet and dry-film thickness gauges for testing the coating thickness during and after application.

2.3 TESTING

A. Provide samples from each batch or lot of paint prior to use.

B. UDOT Central Lab tests for acceptance.

2.4 MIXING PAINT

A. Mix the paint to a lump-free consistency according to the producer's directions.
   1. Keep paint in the original containers and mix until all the pigment is suspended.
   2. Continue mixing until all solids that may have settled to the bottom of the container are thoroughly dispersed.

B. Strain the paint through a screen having openings no larger than those specified for a No. 50 sieve. ASTM E 11.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean surfaces of all oil, grease, and dirt with clean petroleum solvents and low-pressure water-jetting wash.

B. Remove all corrosion, and all paint that shows peeling, brittleness, checking, scaling, or general disintegration, including bearing units.
   1. Use vacuum shrouded power tool cleaning.
   2. Remove paint from the area and beyond the edges of the area so that remaining paint system shows no rusting or blistering underneath, and adheres tightly to the surface. Remaining paint system should have sufficient adhesion that cannot be lifted as a layer by inserting a blade or putty knife under it.
   3. Feather the edges of the remaining paint system around the cleaned areas so the repainted surface appears smooth.

C. Protection:
   1. Fully contain all material resulting from surface preparation and paint overspray.
   2. Enclosure system must withstand extreme high winds.
   3. Protect all portions of the structure that will not be painted.

D. Recover a minimum of 95 percent of debris from cleaning operation.
   1. Sample debris from cleaning operation. Submit samples to UDOT Materials and an independent accredited Materials Testing Lab for composition and disposal evaluation.
   2. Place reclaimed waste paint in EPA-USDOT approved containment. Store at the project site.

3. The Engineer tests the waste paint who then contacts the UDOT chemist at 965-4298. Submit paint composition and disposal evaluation results from the independent materials testing lab. Disposition will be given to the contractor within 30 days. Dispose of waste paint as directed by the Engineer; submit disposal certificates for all waste paint.

3.2 APPLICATION

A. Do not apply paint until the Engineer approves the prepared surface.
   1. Use rubber rollers or other approved protective devices on scaffold fastenings.
   2. Do not use metal rollers, clamps, and other types of fastenings that mar or damage freshly coated surfaces.

B. Apply paint with spray nozzles at pressures recommended by the producer of the coating system.

C. Apply a minimum dry-film thickness of 2 mils spot prime, 2 mils intermediate coat, and a minimum of 1.5 mils for the top coat. Use a magnetic film thickness gauge for verification.

D. Apply two or more coats if the required film thickness couldn't be obtained by one coat without producing runs, bubbles, or sags.

E. Paint as described in the standard specifications to produce a uniform, even coating which bonds to the underlying surface. SSPC-PA 1.

END OF SECTION

SECTION 13551

GENERAL ATMS REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Follow the ATMS requirements defined herein.

1.2 RELATED SECTIONS

A. Section 00725: Scope of Work

B. Section 01554: Traffic Control

1.3 REFERENCES

A. ASTM A 153: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. ASTM A 307: Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

C. National Electric Code (NEC)

1.4 DEFINITIONS

A. ATMS - Advanced Traffic Management System

B. CCTV - Closed Circuit Television

C. RMS - Ramp Meter System

D. RWIS - Road Weather Information System

E. TOC - Traffic Operations Center

F. TMS - Traffic Monitoring Station

G. VMS - Variable message sign

H. WIMS - Weight In Motion System

PART 2 PRODUCTS

2.1 FACTORY ISSUED MANUALS

A. Furnish two copies of original, factory-issued manuals containing all technical information for each piece of equipment furnished.

B. Acceptable factory manuals must contain technical, diagnostic, and maintenance (preventative and troubleshooting) information. Advertising brochures and catalog cuts will not be accepted.

2.2 AS-BUILT DRAWINGS

A. Department:
   1. Provide project design files in MicroStation format.

B. Contractor:
   1. Carefully documents all changes and updates all files to accurately represent the system asbuilt conditions.
   2. Plots three sets of the updated files on 11 inch x 17 inch bond paper and submits the plots to the Engineer for review and approval.

C. As-built drawings will not be considered complete until the Engineer has given formal approval of the plots and design files.

PART 3 EXECUTION

3.1 EXISTING MATERIALS: LOCATION AND PROTECTION

A. Locate and mark all underground traffic signal circuits, lighting circuits, power sources, detection loops, and fiber optic cable.

B. Until final acceptance, repair all damage to traffic signal equipment, lighting equipment, and other ATMS devices including but not limited to, conduit, junction boxes, underground traffic signal circuits, VMS, power sources, detection loops, power conductors, or fiber optic cable, caused by the Contractor's activities or failure to maintain adequate traffic control or protection of the work. Existing improvements include but not limited to pavement, sidewalks, ramps, decorative pavement, driveways, parkways, landscaping, irrigation systems, snow ditches, and drainage improvements.

C. Following any repairs to underground facilities, contact the Engineer for inspection, prior to restoring cover.

D. Locate all utilities prior to construction:
   1. Contact Blue Stakes and all other utilities not participating in Blue Stakes.
   2. Determine the exact location of all existing utilities before commencing work.
   3. Repair any utility that is damaged resulting from the Contractor's failure to exactly locate and preserve all underground and overhead utilities, at no additional compensation.

E. Resolve any utility conflicts with the Engineer.

F. Minimize disruption to existing vegetation at all sites. Restore all grading to pre-existing condition.

3.2 LOCATION OF INSTALLED EQUIPMENT

A. Proposed equipment locations may be modified to avoid conflict with underground utilities or other obstructions. Consult Engineer for approval.

B. Install all above ground equipment the maximum practical distance from traffic or behind barrier or other approved protection.

C. No portion of the equipment can infringe within the following distances unless behind a barrier or other approved protection.
   1. 35 ft from the edge of traveled way for a freeway
   2. 35 ft from the edge of traveled way for an off ramp
   3. 50 ft from the edge of traveled way for an on ramp

D. Minimum distance behind guardrail for all above ground equipment: 4 ft.

E. Minimum distance behind concrete barrier for all above ground equipment: 2 ft.

3.3. EXCAVATION

A. When excavation is required do not damage streets, sidewalks, landscaping, or other surrounding conditions.

B. Do not excavate wider than necessary for the proper construction of the foundations and other equipment.

C. Do not perform excavation until immediately before construction of foundations.

D. Place the material from the excavation in a position that will minimize obstructions to pedestrian or vehicular traffic and interference with surface drainage.

E. Remove all surplus excavated material and properly dispose of it within 48 hours as directed by the Engineer.

F. After each excavation is completed, notify the Engineer for inspection.

G. Do not cover any underground materials or equipment fill under any circumstances, without the approval of the Engineer.

H. At the end of each working period, barricade and cover all excavations to provide safe passage for pedestrian and vehicular traffic.

I. Keep sidewalk and pavement excavations well covered and protected to provide safe passage for pedestrian and vehicular traffic until permanent repairs are made.

3.4 ANCHOR BOLTS

A. Place and hold anchor bolts in proper alignment, position, and height during the placing and vibrating of concrete.

B. Assemble bolts, nuts, washers and torque bolts as required by the manufacturer.

C. Anchor bolts will conform to minimum requirements of ASTM A 307. Do not weld anchor bolts to reinforcing steel. Galvanize all nuts, washers and anchor bolts in accordance with ASTM A 153.

3.5 TRAFFIC CONTROL

A. Refer to Section 00725, dealing with Maintaining Traffic.

B. Submit all lane closure and traffic control plans to the Department for approval. Refer to Section 01554.

C. Contact each business manager 48 hours prior to construction affecting any business access. Place BUSINESS ACCESS signs where access to business is not readily apparent. Keep at least one driveway open during periods when business is open for businesses with multiple driveways. Coordinate with the business owner for businesses with only one driveway to minimize the amount of time that the driveway is closed.

3.6 TEMPORARY TRAFFIC SIGNAL TIMING

A. Design and implement any temporary traffic signal timing or phasing required for traffic management during construction. Submit any proposed timing or phasing changes, including any temporary signal head placement, to the Engineer for review and approval seven days in advance.

B. Implement the approved temporary changes including for example, programming the controller, relocating traffic signal heads and, recabling. Contact the Engineer for inspection (giving 24 hours notice) prior to implementing temporary phasing.

3.7 REUSE EXISTING CONDUIT AND JUNCTION BOXES

A. Reuse existing conduit as follows:
   1. When no new adjacent conduit is being installed, or
   2. When new adjacent conduit is being installed within 1 ft of existing conduit the Contractor is proposing to reuse.

B. Reuse only existing conduit that meets National Electric Code requirements and UDOT standards for conduit material and depth of cover.

C. Replace existing plastic lid on all reused junction boxes with polymer concrete lid.

3.8 ABANDON EXISTING EQUIPMENT IN PLACE

A. Install #14 pull wire in all conduit that is abandoned in place.

B. Obliterate all existing foundations left in place to a depth of at least 6 inches below the existing surface. Properly dispose of removed concrete.

C. Properly label in each junction box all cables and conductors that are left in place.

3.9 REMOVE EXISTING EQUIPMENT

A. Remove existing equipment as specified.
   1. Either properly dispose of equipment or return equipment to the appropriate UDOT facility, as indicated.
   2. Contact Engineer at least 48 hours prior.

B. All removed poles, cabinets, and polymer concrete junction boxes:
   1. Contact the Engineer at least 48 hours prior.
   2. Return to respective UDOT maintenance shed.

C. Return all removed electronics and control equipment to:
   Utah Department of Transportation
   Traffic Operations Center
   2060 South 2760 West
   Salt Lake City, UT 84104-4592

3.10 ELECTRICAL

A. Perform all work in accordance with the National Electric Code.

3.11 WIRING

A. Tape the ends of unused conductors and label them as spares.

B. Crimp and solder all terminal connections.

C. Use powdered soapstone, talc, or other approved lubricants when pulling wiring in conduit.

D. Use color coded conductors as specified.

E. Neatly arrange wiring within cabinets, junction boxes, and enclosures. Do not install cables or conductors behind the cabinet heater.

F. Ground step-down transformer at cabinet to the ground rod in the nearest junction box that has power service conductors running directly to the transformer.

3.12 WIRE SPLICING

A. Do not splice wires except in detection circuits when changing the wire type in the junction boxes.

B. Mechanically secure, solder, individually insulate, and water seal all splices.

END OF SECTION

SECTION 13552

RAMP METER SIGNALS AND SIGNING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install ramp meter signals and signing.

B. Test the Ramp Meter System after installation.

1.2 RELATED SECTIONS

A. Section 02891: Traffic Signs

B. Section 02892: Traffic Signal

C. Section 03055: Portland Cement Concrete

D. Section 03211: Reinforcing Steel and Welded Wire

E. Section 13551: General ATMS Requirements

F. Section 16525: Highway Lighting

1.3 REFERENCES

A. AASHTO M 31: Deformed and Plaint Billet-Steel Bars for Concrete Reinforcement

B. AASHTO M 111: Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products

C. AASHTO M 284: Epoxy Coated Reinforcing Bars

D. AASHTO Division II Section 5

E. AASHTO Standard Specifications for Highway Bridges

F. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals

G. ASTM A 153: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

H. ASTM A 307: Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

I. American Iron and Steel Institute (AISI)

J. American National Standards Institute (ANSI)

K. National Electric Code (NEC)

L. Underwriters Laboratories (UL)

1.4 SUBMITTALS

A. Two copies of the following to the Engineer 15 days after receiving a Notice to Proceed:
   1. List of equipment and materials (name of manufacturer, size, and identification number).
   2. Detailed shop drawing, wiring diagrams, and certifications.
   3. All manufacturers' warranties, guarantees, instruction sheets, and parts lists.
   4. Submit a testing plan to the Department for approval. Local Field Operations testing is performed prior to opening of all lanes to live traffic.

B. Samples of materials to the Engineer for approval when requested.

C. Results of all tests conducted.

1.5 ACCEPTANCE TESTING

A. Conduct a Detector Loop Circuit Test per Section 02892, and submit Detector Loop Circuit Test to the Engineer for acceptance.

B. Perform the following Local Field Operations Test. After all ramp meter elements, equipment and hardware, power supply, and connecting cabling have been installed, demonstrate the following:
   1. Conduct and document a local field operation test demonstrating that all hardware, cables, and connections operates correctly and in conformance with the manufacturer's requirements.

2. Verify the power supply voltages and the functionality of the cabinet fans and heaters.
3. Verify the ability of the controller to properly process lane volume, occupancy, and speed for each detection zone indicated in the plans.
    a. Required accuracy for vehicle speed as recorded by the controller: +/- 3 mph.
    b. Speed data is not required for ramp meter detection zones, and for entrance and exit ramp detection zones located on ramps originating or terminating at a crossroad intersection.
4. Use test vehicles physically passing through the detection zones of any non-live lanes to simulate live traffic conditions.
    a. Do not perform test until the Department has approved the testing plan.
    b. Supply any necessary test vehicles if the testing is performed prior to opening of lanes to live traffic.
5. Verify visually that each ramp meter detection zone properly registers a call to the controller when a vehicle passes through the detection zone.
    a. Supply test vehicle if the testing is performed prior to opening of ramp meter to live traffic.
    b. Verify that all entrance and exit ramp detection zones have been properly located in relation to the stop bar and crossroad, as indicated in the plans.
6. Verify that:
    a. All ramp meter signal heads and all advanced flashing beacon and meter-on signs properly respond to activation and deactivation control from the controller.
    b. Verify that all ramp meter signals and signs properly respond to metering plan changes from the controller.
7. Perform testing after all construction for the site has been completed and final road surface has been constructed.
    a. It is not necessary for the communications installation to be completed at the time of the test.
    b. It is not necessary that all stations be locally tested concurrently.
    c. Notify the Engineer 48 hours prior to testing. Submit written verification of testing results.

C. Satisfy all additional testing requirements specific to the project.

PART 2 PRODUCTS

2.1 GENERAL

A. Use electrical components as listed and defined by the NEC.

2.2 FOUNDATION

A. Concrete: Class AA(AE) Concrete. Refer to Section 03055.

B. Reinforcing Steel: Coated steel. Refer to Section 03211.

2.3 RAMP METER SIGNAL ASSEMBLY

A. Signal Pole: Refer to Section 02892 and SL Series Standard Drawings.

B. For 12 inch signal heads: Section 02892. Louvered backplate required. Signal head housing: yellow.

C. Eight inch, one section signal head with red lens for enforcement. Signal head housing yellow. No backplate required.

D. Regulatory Sign: R10-6; 24 inch x 36 inch.

E. For 8 inch signal heads: Section 02892. Louvered backplate required. Signal head housing yellow.

F. For 24 inch x 18 inch "1 VEHICLE PER GREEN" Sign: Refer to AT series Standard Drawings.

G. Foundation Concrete: Class A(AE) Concrete. Refer to Section 03055.

2.4 MAST ARM SIGNAL ASSEMBLY

A. Signal Pole: Refer to SL Series Standard Drawings.

B. For 12 inch signal heads: Section 02892. Louvered backplate required. Signal head housing yellow.

C. 60 inch x 36 inch "1 VEHICLE PER GREEN EACH LANE" Sign: Refer to AT series Standard Drawings.

D. Concrete: Class AA(AE) Concrete. Refer to Section 03055.

E. Reinforcing Steel: Coated steel. Refer to Section 03211.

2.5 ADVANCE FLASHING BEACON SIGN

A. Signal Pole: Refer to Section 02892 and SL Series Standard Drawings.

B. Two-8 inch signal heads with yellow lens: Section 02892. Signal head housing: yellow. No backplate required.

C. Warning Sign: W3-3, 30 inch x 30 inch

D. 30 inch x 24 inch black on yellow "METERING WHEN FLASHING" Sign: Refer to AT series Standard Drawings.

E. Foundation Concrete: Class A(AE) Concrete. Refer to Section 03055.

2.6 BOLTS AND NUTS

A. Follow Section 02892.

2.7 WIRE

A. Follow Section 02892.

2.8 DETECTOR CIRCUIT

A. Follow Section 02892.

B. Consult the Engineer: Saw cut loops or pre-formed loops.

2.9 LUMINAIRE

A. For luminaires installed on ramp meter signal pole, follow Section 02892.

B. For luminaires not installed on ramp meter signal pole, refer to Section 16525.

2.10 GROUND ROD

A. Copper-coated steel as specified.

B. ANSI/UL 467.

2.11 MOUNTING BANDS AND BUCKLES

A. As Specified.

B. American Iron and Steel Institute, (AISI) Type 201.

C. Universal Mounting Brackets for Signals mounted on mast arm.

2.12 STATE FURNISHED MATERIALS PICK UP

A. Pick up all Department-furnished poles, anchor bolts, and signs at:
UDOT Complex
4501 South 2700 West
Salt Lake City, Utah 84114

B. Contact Engineer at least 10 days prior to pick up.

PART 3 EXECUTION

3.1 PREPARATION

A. Conform to the requirements of the NEC, current edition.

B. Load, transport, and install all state-furnished materials per the manufacturer's instructions and as shown in the plans.

C. Provide foundation, junction boxes, ground rod, grounding lug, conduit, signal heads, assemblies, and mounting devices, signs, and all additional equipment required for a complete and operational ramp meter system.

D. Install all wiring, conduit, and junction boxes as shown on site plans and details.
   1. Field locate all conduits and junction boxes to avoid drainage areas and steep slopes whenever possible.
   2. Protect existing conductors while installing new conductors.

E. Connect the controller and all wires as specified by the manufacturer.

F. Furnish and install all incidental items, such as wire nuts, grommets, tape connectors, and electrical nuts, necessary to make the ramp meter system complete.

G. After installation, the exterior of all equipment is free of all loose rust and mill scale, dirt, oil, grease and other foreign substances.

3.2 FOUNDATION

A. All material and workmanship conforms to AASHTO's Standard Specifications for Highway Bridges.

B. Prior to work, verify that the installation of the signal heads, mast arm, pole, and foundation in the location marked in the field has no conflict with existing utilities, underground and overhead. Comply with all utility and Blue Stakes requirements.

C. Place Ramp Meter Signal Assemblies 2 ft downstream of the stop bar and 4 ft outside the edge of shoulder. For Ramp Signal Assembly Details, see AT series Standard Drawings.

D. Place Mast Arm Signal Assemblies 40 ft to 120 ft downstream of stop bar. For Mast Arm Details, see AT series Standard Drawings.

E. Place Advance Flashing Beacon Assembly 350 ft to 375 ft downstream of stop bar. For Flashing Beacon Details, see AT series Standard Drawings.

F. Excavation: Refer to Section 13551.

G. Caissons conform to AASHTO Division II Section 5, Drilled Piles and Shafts. Caissons are drilled into either native soil or compacted fill.
   1. If formwork is required during drilling, the forms may be withdrawn during concrete placement.
   2. Cast the top of the caisson against the formwork for appearance.

H. Place concrete directly into the excavation. Use minimum forming.

I. Do not weld reinforcing steel, conduit, or anchor bolts; tie reinforcing steel and conduit securely in place.

J. Coat all reinforcing steel to conform to AASHTO M 284 or M 111 and AASHTO M 31 Grade 420, respectively. Coat the ends of cut reinforcing with approved epoxy coating.

K. Use class AA (AE) for all cast-in-place concrete. Cap all conduits before placing concrete.

L. Install weep hole in foundation per UDOT SL series Standard Drawings.

3.3 ANCHOR BOLTS

A. Refer to Section 13551.

3.4 SIGNAL POLES

A. Install the poles on new concrete bases. Apply rust, corrosion, and anti-seize protection at all threaded assemblies by coating the mating surfaces with an approved compound.

B. Install pole with the hand hole facing away from traffic.

C. Install ground rod per plans. NEC 250.

D. All fasteners and attachment hardware for bands and other equipment: stainless steel.

E. Furnish and install all incidental items, such as wire nuts, grommets, tape connectors, and electrical nuts, necessary to make the ramp meter system complete.

F. Adjusting the anchor bolt nuts, plumb all steel poles to the vertical with all signal heads and signs installed.

3.5 INSTALL WIRING

A. Follow Section 02892.

B. Mark cabinet cables with vinyl electrical color coding tape as specified in Table 1. Meet UL 510.

TABLE 1			
Cables Marked with Colored Tape			
	Lane One	Lane Two	Lane Three
Ramp Meter Circuit	Blue	Red	Yellow
Detector Circuit	Blue	Red	Yellow
Advance Flashing Beacon Signal	Blue and White	Red and White	Yellow and White

C. Use Table 2 when connecting the conductors for ramp meter signal heads.

TABLE 2	
Color-Coded Conductors	
	All Lanes
Ramp Meter Signal Circuit	White- Neutral Red- Red indicative Green- Green indicative Blue- Enforcement (if present) or spare

3.6 ADVANCE FLASHING BEACON SIGN

A. Follow Section 02891.

3.7 RAMP METER SIGNAL ASSEMBLY SIGN

A. Follow Section 02891.

3.8 INSTALL SIGNAL HEADS

A. Do not install signal heads at the intersection until ready for operation.

B. If turn on is not immediate, completely cover the signal heads with non-transparent, non-paper material tied securely around head.

C. Install directed and veiled optically-programmed signals following the manufacturer's instructions. Mask each section of the signal with recommended manufacturer's materials.

D. Use louvered back plates on those signal heads indicated. Use a minimum of four 0.12 inch stainless steel screws per section to mount the back plates, or according to manufacturer's instructions.

E. Orient meter-on ramp signal toward vehicles approaching the intersection stop-bar. Side Signal Head: axis or indication parallel to roadway surface.

3.9 INSTALL DETECTOR LOOPS

A. Follow Section 02892.

B. For location of Presence and Discharge Loop, see AT series Standard Drawings.

C. For saw cut loops, consult the Engineer: circular or octagon shaped.

3.10 INSTALL LUMINAIRE

A. Refer to Section 16525.

END OF SECTION

SECTION 13553

ATMS CONDUIT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install conduit for ATMS field elements and communication.

1.2 RELATED SECTIONS

A. Section 00725, Scope of Work

B. Section 02061: Select Aggregate

C. Section 03575: Flowable Fill

1.3 REFERENCES

A. ASTM D 2241: Standard Specification for Poly-Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)

B. American National Standards Institutes (ANSI)

C. National Electric Code (NEC)

D. National Electrical Manufacturers Association (NEMA) Articles

E. Railroad Standard Specifications

F. Underwriters Laboratories (UL)

PART 2 PRODUCTS

2.1 MATERIALS

A. Conduit and Fittings:
   1. Schedule 40 PVC rated at 194 degrees F, as specified. NEMA TC-2, NEMA TC-3, UL Listed.
   2. HDPE (high density polyethylene) SDR11 rated, as specified. ASTM D 2241.
   3. Rigid steel as specified. UL-6.
   4. Galvanized as specified. ANSI C80.1.

B. Multi-Conduit
   1. New, prefabricated.
   2. Minimum of four each 1 ¼ inch conduit.
   3. Label: FIBER OPTIC COMMUNICATIONS, permanent 1/2 inch black letters, every 6 ft, on outside of each conduit.
   4. Color code each conduit or cell.

C. Provide all materials used in the installation of conduits, such as bends, adapters, couplings, glue, plugs and fittings, to meet or exceed all of the recommendations of the conduit manufacturer for suitable installation.

D. Provide special termination kits from the conduit manufacturer for terminating the conduit in vaults and junction boxes. Provide kits that form a watertight seal of conduit to structure wall.

E. Use complete conduit sections in nominal 20 ft sections; couplings and fittings to provide for watertight integrity.

F. Use complete conduit rigid bend sections (11 ¼, 22 ½, 45, 90 degree angles) complete with bell and spigot. Do not field bend conduit.

G. Provide #14 solid copper conductor pull wire, Type THHN, for each empty conduit or cell.

H. Provide fiber optic and electrical buried cable marker warning tape that meets the following requirements:
   1. Material: Composite reinforced thermoplastic.
   2. Tape Color: Orange (communication) or Red (electric).
   3. Length: 5 ft minimum.
   4. Text: “Caution Buried Communication Cable” or “Caution Buried Electric” (front and back).

5. Text Color: Black.
6. Width: 3 inch minimum (face or diameter).

I. Provide jacketed #14 THHN solid green locator wire.

J. Provide locator wire connection device that meets the following requirements:
1. Screw clamp connection type.
2. Suitable for 22 to 8 AWG.
3. Rated 50 amps.
4. Rated 600 V.
5. Provide zinc bichromate plated steel mounting rail for locator wire connection device.

K. Backfill
1. Flowable Fill: Section 03575.
2. Free Draining Granular Backfill Borrow: Section 02061.
3. Native material: 96 percent compaction.

PART 3 EXECUTION

3.1 INSTALLATION

A. Plans depict conduit routing in schematic form only. Base final routing on actual field conditions at the time of construction, including Blue Stake markings, to prevent conflicts with existing utilities.

B. When installing conduit that houses communication cable, do not allow conduit to deflect vertically or horizontally along its length by a ratio greater than 10:1, (e.g. no more than 4 inch deflection per 40 inch in length).

C. When installing conduit, do not allow the sum total of the vertical and horizontal deflection of conduit between any two junction boxes to exceed 360 degrees.

D. Do not place conduit directly above parallel utilities.

E. If the planned location of conduit is parallel to the existing traffic signal or ATMS conduit, locate conduit within 1 ft of existing parallel conduit run.

F. Install all conduit bends to have a radius that is:
   1. Not less than 12 times the inside diameter of the conduit.
   2. Not less than the minimum bend radius of the cable installed within, per cable manufacturer's specifications.

G. Install conduits that cross finished curbs and gutters, sidewalks, concrete flatwork, textured or decorative surfaces by boring, jacking, or drilling. Entirely replace any damaged section at no additional cost to the Department.

H. Obtain appropriate permits before work commences.

3.2 TRENCH FOR CONDUIT

A. Paved Surface (asphalt concrete):
   1. Prior to any backhoe use, sawcut roadway to roadway base on both sides of trench to provide clean, straight wall for T-patch.
   2. Use flowable fill to within 3 ½ inch-6 inch of the existing roadway surface, depending on the existing pavement thickness.
   3. Minimum soil compaction under pavement: 96 percent.
   4. Evenly apply tack coat before final backfill.
   5. Restoration patch: match the composition, density, and elevation ("1/4 inch), of the existing surface.

B. Sidewalk or Decorative Pavement.
   1. Use flowable fill to within 3½ inch-6 inch of the existing roadway surface, depending on the existing pavement thickness.
   2. Minimum soil compaction under pavement: 96 percent.
   3. Restore sidewalk or decorative pavement to original condition or better after work is completed.

C. Unpaved Surface:
   1. Use backfill that matches the composition, density, and elevation ("0.2 inch), of the existing surface.
   2. Dispose of surplus material daily.

D. Conduit under Railroad Right-of-Way: Refer to Section 00725.
   1. Coordinate all work with appropriate Railroad personnel.
   2. Complete Railroad Safety Training.

E. Minimum cover of conduit:
   1. Minimum cover in sidewalks, paved ditches, unlined ditches, gutters: 2 ft.
   2. Minimum cover in highway right of way under pavement surface: 3 ft.
   3. Minimum cover within 20 ft of edge of pavement where signs or delineators are located: 5 ft.

4. Where final landscape above conduit is not finished and has elevation greater than adjacent curb, use top back of curb as base elevation for determining minimum cover.

F. Warning Tape:
1. Install orange warning tape with black legend CAUTION - BURIED COMMUNICATION CABLE in all trenches containing multi-duct conduit or conduit containing communication cables.
2. Install red warning tape with black legend CAUTION - BURIED ELECTRIC in all other trenches.
3. Not required when flowable fill is directly overlayed with asphalt pavement or PCCP.
4. Not required when boring conduit.

G. Locator Wire:
1. Install #14 THHN solid green locator wire continuously in 1 inch conduit and bond to grounding rods within each junction box.
2. Mount locator wire connection device to the sidewall of each junction box using a mounting rail.
3. Connect the locator wire to the terminal block and connect the terminal block to the ground rod.
4. Weld or clamp locator wire at transition if a sweep is used in place of a junction box at a transition between GRS and PVC. Provide corrosion protection as per NEC Article 346 at location of weld or clamp.

3.3 INSTALL CONDUIT

A. Place all conduits in the same trench before surfacing.

B. Above ground use galvanized rigid steel; underground use PVC or HDPE. Apply corrosion protection per NEC Article 346 to any portion of galvanized rigid steel conduit buried in the ground or encased in concrete.

C. Seal uncapped conduit ends inside junction box with duct seal. Insert seals a minimum of 2 inches inside the conduit.

D. Install #14 stranded THHN pull wire in all empty conduit including all cells of multi-duct conduit.
1. On each end of conduit install plug with ¼ inch hole for pull wire.
2. Leave 2 ft of pull wire outside of the plug and fasten securely to plug.

E. Place all conduit that passes through a structural member in a metallic sleeve.

F. Secure conduit on structures with standard galvanized iron conduit clamps using at least 5/16 inch diameter concrete expansion anchors at maximum 5 ft spacing.

G. Use conduit expansion fittings at structure expansion joint crossings.

H. Install all conduits so the backfill completely surrounds all exterior surfaces of the conduit. Separate multi-duct conduits using a commercially available conduit spacer or approved equivalent.

I. Install a bushing or adapter at ends of all nonmetallic conduit that contains a conductor per NEC Article 346, to protect the conductor from abrasion. Install rounded bushings on the ends of metal conduits per NEC Article 347.

J. Fill all new and existing conduit to less than 40 percent as per NEC.

K. Install bends in the multiconduit to be manufactured sweeps (11 ¼, 22 ½, 45, 90 degree angle) with conduit compatible bell and spigot ends.

L. Prior to pouring flowable fill, anchor the conduit in trench, at 16 ft intervals, to maintain the required conduit depth during pour.

M. Minimum separation between all conduit is 1.5 inch. The separation between individual conduit within a single cluster of multi-duct conduit is permitted to be closer.

N. Minimum separation between all conduit and the wall of the trench is 1.5 inch.

O. Place the locator wire conduit on the plane of the uppermost conduit in the trench. The separation between the locator wire conduit and other conduit may be less than 1.5 inch.

P. In native earth, do not place flowable fill closer than 6 inch to finished grade.

Q. If flowable fill is used, encapsulate conduit a minimum of 3 inch above the top conduit with flowable fill.

3.4 USE OF OCCUPIED CONDUIT

A. Maintain the physical condition and functional integrity of all cabling and wiring in existing occupied conduit.

B. Prior to installing fiber optic cable in an occupied conduit:
   1. Remove any existing fiber optic cable/copper wire.
   2. Re-pull new and existing fiber optic cable/copper wire together.
   3. Perform all necessary fiber splices, replace any impacted fiber cable spider fan-out kits.
   4. Perform all additional necessary work needed to restore existing fiber optic system.

3.5 REPAIR/RESTORATION

A. Restore all areas, including landscaping, concrete pavement, asphalt, finished curbs and gutters, box culverts, sewers, underground water mains, sprinkler systems, sidewalks, concrete flatwork, textured or decorative surfaces, that were damaged during conduit and junction box installation.

B. Coordinate with local utilities for utility repair. Advise the Engineer of all repairs.

END OF SECTION

SECTION 13554

POLYMER CONCRETE JUNCTION BOX

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install pre-cast polymer concrete junction box, ground rod, and maintenance marker.

1.2 RELATED SECTIONS

A. Section 02056: Common Fill

B. Section 02061: Select Aggregate

C. Section 02842: Delineators

D. Section 02892: Traffic Signal

E. Section 03055: Portland Cement Concrete

1.3 REFERENCES

A. ASTM C 109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm cubes)

B. ASTM C 496: Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens

C. ASTM C 1028: Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull Meter Method

D. ASTM D 543: Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents

E. ASTM D 570: Standard Test Method for Water Absorption of Plastics

F. ASTM D 635: Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastic in a Horizontal Position

G. ASTM D 790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Insulating Materials

H. ASTM G 154: Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

I. ANSI/UL 467: Grounding and Bonding Equipment

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide special termination kits from the conduit manufacturer for terminating the conduit in junction boxes. Provide kits that form a watertight seal of conduit to structure wall or grout around the conduit. Finish grout smooth and flush with the interior wall.

B. Use free draining granular backfill borrow as per Section 02061.

C. Use granular backfill borrow per Section 02056.

D. Provide maintenance markers for junction boxes along freeways and expressways.

E. Provide concrete AA(AE) for concrete collar. Refer to Section 03055.

F. Provide pre-cast polymer concrete junction boxes per the size and type specified in the plans. Boxes are made from polymer concrete.

G. Use body, ring, and lid meeting the physical and chemical requirements listed in Table 1:

Table 1

Property	ASTM Test	Value
Compressive Strength	C 109	11,000 psi
Flexural Strength	D 790	7500 psi
Tensile Strength	C 496	1700 psi
Effects of Acids	D 543	Very Resistant
Effects of Alkalies	D 543	Very Resistant

H. Provide all components with ultraviolet inhibitors per ASTM G 154.

I. Provide all components flame-resistant per ASTM D 635.

2.2 JUNCTION BOXES AND LIDS

A. Provide junction boxes and vaults that resist water absorption in accordance with ASTM D 570.

B. "Load Rating 3" for Non Wheel Loading Accessible, Behind Sidewalk
   1. In area behind sidewalk, provide boxes, rings, and lids that sustain a minimum vertical test load of 12,000 lbs over a 10 inch x 10 inch square.

C. "Load Rating 2" for Incidental Vehicular Traffic:
   1. In area not in traveled way, provide boxes, rings, and lids that sustain a minimum vertical test load of 22,500 lbs over a 10 inch x 20 inch square.
   2. Provide concrete collar per AT series Standard Drawings for all boxes that may experience incidental traffic.

D. "Load Rating 1" for Deliberate Vehicular Traffic:
   1. In any paved area immediately adjacent to the mainline, such as shoulders, snow storage areas, or vehicle pullout areas, provide boxes, rings, and lids that sustain a minimum vertical test load of 45,000 lbs over a 10 inch x 20 inch square.

E. Provide a poured-in-place 1 inch thick grout floor, with a 1 inch diameter drain, for all type I-PC, II-PC, and III-PC boxes or a box with a prefabricated floor with a 1 inch drain hole.

F. Provide lid for all junction boxes as specified by application.

G. Provide lids with a non-skid surface with minimum coefficient of friction of 0.50, per ASTM C 1028. Coatings will not be approved.

H. Manufacture lids with the following markings in the logo area, in 1 inch recessed letters:
   1. "Traffic Signal" when the junction box contains cables or wires for traffic signal, CCTV, VMS, RWIS, WIM, ramp meter, traffic monitoring, or any other ATMS element.
   2. "Electric" when the junction box contains power conductors used for traffic signal, CCTV, VMS, RWIS, WIM, ramp meter, traffic monitoring, or any other ATMS element.
   3. "Street Lighting" when the junction box contains street lighting conductors only. Inscribe "High Voltage" below the words "Street Lighting" when the junction box contains voltage above 600 V.
   4. "Communication" when the junction box contains multiduct conduit for future use.

5. "Sprinkler Control" when sprinkler control conduit enters the junction box.

I. Provide lids with recessed access point to allow removal of cover with a hook or lever. Damage to the pulling point in the lid must be repaired.

J. Provide lids with vandal-resistant stainless steel recessed bolts.

2.3 MAINTENANCE MARKERS

A. Steel posts: Refer to Section 02842.

2.4 BACKFILL

A. Compact free draining granular backfill borrow under junction boxes. Refer to Section 02061.

B. Compact granular backfill borrow around boxes. Refer to Section 02056.

2.5 DUCT SEAL

A. Waterproof, rodent proof, non-corrosive, non-oxidizing, and non-hardening when subject to temperatures ranging from -13 degrees F to 150 degrees F. Do not use foam sealant.

2.6 GROUND ROD

A. Copper-coated steel as specified.

B. ANSI/UL 467.

2.7 GROUND WIRE

A. Ground Wire: Refer to Section 02892.

PART 3 EXECUTION

3.1 JUNCTION BOX AND EXTENSION

A. Install per manufacturer's recommendations.

B. Cast conduit holes in junction box at the time of precasting or drill at the time of placement with no structural damage to the box.
   1. Holes drilled in junction box must not be more than 1/4 inch larger than conduit diameter.
   2. Seal conduit ends inside all junction boxes with at least 2 inch thick duct caulking after wires are installed.
   3. Seal vacant conduit with 2 inch thick duct caulking or a manufactured plug designed for that purpose.

C. Place the top of the junction box flush with the surrounding grade or set at the planned finished grade.

D. Hand tamp the granular backfill borrow material around the junction box. Match the top 4 inches to the composition, density, and elevation of the surrounding surface.

E. Do not install junction boxes inside of railroad right of way.

F. Field locate junction boxes to avoid steep slopes and low lying locations with poor drainage.

G. Do not install junction boxes within the traveled way, shoulders, or on approaches to signal poles.

H. Do not install conduit in corner of junction box, or within 2 inches of corner of junction box. Extend multiduct conduit 6 inches (nominal) beyond the inside wall of the junction box. Extend all other non-multiduct conduit 2 inches minimum to 3 inches maximum beyond the inside wall of the junction box. Refer to AT series Standard Drawings.

I. Enter conduit through the sides of the junction box and not from the bottom. Place the conduit at least two inches above the floor.

J. Orient the recessed access point in a location that provides both leverage and safety.

K. Saw cut concrete or other improved surfaces that require removal in the sidewalk area. Remove entire section of sidewalk. Replace with in-kind materials to match the existing grade.

L. Provide 12 inches deep free draining granular backfill borrow directly under junction box.

M. Install expansion joint material around entire periphery of ring for junction boxes installed in paved surface.

3.2 CONCRETE COLLAR

A. Refer to AT series Standard Drawings.

B. Concrete: AA(AE). Refer to Section 03055.

C. Do not install concrete collar for junction boxes in paved surface. Install concrete collars in areas of incidental traffic.

3.3 GROUND ROD

A. Install ground rod to extend maximum 2 inches above box floor.

B. Attach ground wire or locator wire with clamps.

3.4 RESTORATION

A. Restore all areas damaged during the installation of the junction boxes.

END OF SECTION

SECTION 13555

ATMS CABINET

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install or modify concrete foundations of the size and type as specified in the plans.

B. Install ATMS Equipment Cabinet.

1.2 RELATED SECTIONS

A. Section 02892: Traffic Signal

B. Section 03055: Portland Cement Concrete

C. Section 03152: Concrete Joint Control

D. Section 03211: Reinforcing Steel and Welded Wire

E. Section 13553: ATMS Conduit

F. Section 13554: Polymer Concrete Junction Box

1.3 REFERENCES

A. ASTM A 123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. ASTM A 307: Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

C. ASTM B 766: Standard Specification for Electro-deposited Coatings of Cadmium

D. National Electrical Manufacturers Association (NEMA)

1.4 SUBMITTALS

A. Submit samples of materials for approval when requested.

B. Submit two copies of the following within 15 days after receiving Notice to Proceed:
   1. List of equipment and materials (name of manufacturer, size, and identification number).
   2. Wiring diagrams and certifications.
   3. Warranties, guarantees, instruction sheets, parts list.

PART 2 PRODUCTS

2.1 CABINET FOUNDATION

A. Concrete: A(AE) required. Refer to Section 03055.

2.2 BOLTS, NUTS, AND HARDWARE

A. For cabinet mounts, provide wedge expansion type, or poured in place, anchor bolts.
   1. 3/4 inch x 8 inch expansion anchor bolts.
   2. 9000 lbs pullout strength.

B. Provide commercially available framing strut to attach transformers, breaker enclosures, disconnects, or other electrical equipment to cabinet foundation.
   1. 12-gauge, U-shaped stainless steel product with 5/8 inch diameter pre-drilled holes.
   2. Cross-section dimensions: 1 5/8 inch x 1 5/8 inch minimum.

C. For framing struts, provide wedge expansion anchor bolts to secure framing strut to foundation.
   1. 1/2 inch x 8 inch embedded a minimum of 6 inches in foundation.
   2. Shear capacity of 2500 lbs and pullout tension capacity of 2,600 lbs.

D. Provide stainless steel, galvanized, or zinc plated bolts, nuts, washers, struts, and hardware, as specified.
   1. Steel as specified. ASTM A 307.
   2. Galvanized as specified. ASTM A 123.
   3. Zinc plated as specified. ASTM B 766.

E. Provide nuts that are free-running, by hand, for total thread length.

F. Provide all bolted connections with lock washers, locking nuts, or other approved means to prevent the connection nuts from backing off.

G. Provide nipples, elbows, and grommets necessary for wiring.

2.3 CONDUIT

A. Refer to Section 13553.

B. Refer to Section 02892.

2.4 JUNCTION BOX AND GROUND ROD

A. Refer to Section 13554.

2.5 POWER SOURCE

A. Refer to Section 02892.

2.6 TRANSFORMER AND DISCONNECT

A. Submit specifications for approval.

2.7 BITUMINOUS JOINT FILLER

A. Preformed material. Refer to Section 03152.

PART 3 EXECUTION

3.1 PREPARATION

A. Use maintenance platforms when surrounding area is not paved. Platforms provide access to the cabinets for maintenance activities. Locate cabinet in an area where full access is allowed.

B. Repair any damage to existing utilities.

C. Restore area to the condition prior to beginning work.

D. Field locate cabinet location with the Engineer. Avoid areas with poor drainage. Satisfy clear zone requirements.

3.2 CONSTRUCT CABINET FOUNDATION

A. Reinforcing Steel and Welded Wire: Refer to Section 03211.

B. Verify bolt pattern, conduit runs, and foundation dimensions prior to foundation construction.
   1. Orient anchor bolts to accommodate conduit runs.
   2. Embed strut anchor bolts a minimum of 6 inches into foundation
   3. Embed cabinet anchor bolts a minimum of 6 inches into foundation.

C. Concrete: A(AE) required. Refer to Section 03055.

D. Do not weld reinforcing steel, conduit, or anchor bolts.
   1. Use tie wire to secure conduits.
   2. Use template to align and secure anchor bolts.
   3. Locate steel, conduit, or anchor bolts a minimum of 3 inches from concrete edge.

E. Place the concrete directly into the excavation. Use minimum forming above ground.

F. Provide 36 inches minimum clearance between foundation and all walls, guardrails, poles, and other above-ground features.

G. Do not extend conduit stubs in cabinet more than 3 inches above floor of foundation.

H. Conduit
   1. Install all conduit in base of cabinet in a 12 inch x 18 inch rectangle centered in the cabinet base.
   2. Refer to the Project Plans for the number, size, and orientation of all conduits entering the junction boxes.
   3. Conduit (typical) for power from cabinet with disconnect to Type I junction box
      a. One-1 1/2 inch from cabinet to disconnect.
      b. One-1 1/2 inch from disconnect to Type I junction box.
   4. Conduit (typical) for power from cabinet with disconnect/stepdown transformer to Type I junction box
      a. One-2 inch from disconnect to Type I junction box
      b. One-1 1/2 inch from disconnect to transformer
      c. One-1 1/2 inch from transformer to cabinet

   5. Conduit (typical) for communication from cabinet to Type II junction box
      a. Two-3 inch

b. Four-2 inch

6. Conduit (typical) for communication stubbed out of Type II junction box
   a. Two-3 inch
   b. Four-2 inch
   c. One-3 inch(used as a spare conduit)
7. Above ground, use galvanized rigid steel; underground, use PVC.
8. Install bushings on the ends of metallic conduit. Install end bells on non-metallic conduit.
9. Provide 1 inch minimum spacing between conduit in cabinet base. Cap conduit at both ends until used. Stub conduit a maximum of 3 inches above the concrete base.

I. Orient the cabinet to allow maintenance personnel facing the front door of the cabinet to also face the device (such as VMS, CCTV, RMS, TMS). Orient the cabinet such that the door that accesses the front face of the control equipment is adjacent to the Type II-PC junction box.

J. Trowel finish the foundation surface and level prior to cabinet installation. After the concrete base has cured, leveling can only be accomplished by grinding the top surface.

K. Bituminous filler at concrete joints. See section 03152.

3.3 INSTALL ATMS CABINET

A. Securely fasten the cabinet on concrete foundation. After the cabinet has been installed on the foundation, the cabinet door must be able to fully open and close.

B. Provide a rain-tight seal that does not degrade the NEMA 3R rating of the enclosure for all conduit fittings and chases to adjoining enclosures.

C. Isolate dissimilar materials from one another by stainless steel fittings.

D. Make all power connections as shown in plans.
   1. Isolate the neutral bus from the cabinet and equipment ground.
   2. Terminate the neutral bus at the neutral lug attached to the meter pedestal.

E. Install caulk between base of cabinet and top of foundation.

3.4 INSTALL DISCONNECT AND/OR TRANSFORMER

A. Install 12 gauge framing strut to the foundation with 3 expansion anchors per superstrut.

B. Install disconnect and transformer on the side of cabinet that faces away from the nearest traffic. If wall blocks access to disconnect, then install the disconnect and transformer on the opposite side of cabinet.

C. Ground disconnect on ground rod located in Type I junction box.

D. Ground the transformer to the control cabinet ground terminal.

E. Install disconnect and/or transformer per manufacturer's instructions.

F. Install 5/8 inch spacers on each expansion anchor between foundation and disconnect.

3.5 INSTALL WIRING

A. Conductors:
   1. Clean and dry the inside of the conduit before installing conductors.
   2. Install grounding conductor in all power circuit conduits.
   3. Use powdered soapstone, talc, or other approved lubricants when pulling conductors in conduit.
   4. Tape the ends of unused conductors and label them as spares.

B. Ground Wire:
   1. Clamp the ground wire from the cabinet ground to the ground rod in the Type II junction box.

C. Neatly arrange wiring within cabinets and junction boxes.

D. Terminate all terminal connections by a mechanical (spade) connector.

E. Identify and label all field terminals and cables.

3.6 INSTALL POWER SOURCE

A. Verify the exact location, voltage, procedure, and materials required by the power company.

B. Follow SL series Standard Drawings.

END OF SECTION

SECTION 13556

CLOSED CIRCUIT TELEVISION (CCTV) ASSEMBLY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Install all State-furnished items including CCTV assembly, pan/tilt unit, camera control receiver, pole cabinet, and freeway pole with anchor bolts.

B. Furnish and install foundation, wood pole, and any additional equipment required for a complete and operational CCTV assembly.

C. Test the installed CCTV using Department furnished software. (Furnish remainder of test equipment including laptop).

1.2 RELATED SECTIONS

A. Section 02892: Traffic Signal

B. Section 03055: Portland Cement Concrete

C. Section 03211: Reinforcing Steel and Welded Wire

D. Section 03310: Structural Concrete

E. Section 13551: General ATMS Requirements

F. Section 13554: Polymer Concrete Junction Box

1.3 REFERENCES

A. AASHTO M 31: Deformed and Plaint Billet-Steel Bars for Concrete Reinforcement

B. AASHTO M 111: Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products

C. AASHTO M 270: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges

D. AASHTO M 284 M: Epoxy Coated Reinforcing Bars

E. AASHTO Division II Section 5

F. AASHTOs Standard Specifications for Highway Bridges

G. ASTM A 153: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

H. International Municipal Signal Association (IMSA) Specifications

I. National Electric Code (NEC)

J. National Television Standards Committee (NTSC)

1.4 SUBMITTALS

A. Submit two copies of the following to the Engineer within 15 days after receiving the Notice to Proceed. (Submit samples of all materials, when requested).
   1. List of equipment and materials (name of manufacturer, size, and identification number).
   2. Detailed shop drawings, wiring diagrams, and certifications.
   3. Provide copies of all manufacturers' warranties, guarantees, instruction sheets, and parts lists.
   4. Camera Cable Test and Local Field Operations Test plan. Engineer will accept or reject these plans within ten days of receipt.

B. Submit copies of the Camera Cable Test results, including any unsuccessful and subsequently successful tests to the Engineer prior to any Field Operations testing.

C. Upon successful completion of both the Camera Cable Test and the Local Field Operations Test, demonstrating that the work is in accordance with the specifications, deliver within three days, a written Completion Notice to the Engineer along with a copy of the test results.

1.5 TESTING AND ACCEPTANCE

A. Complete the following:
   1. Camera Cable Test
   2. Local Field Operations Test

B. Notify the Engineer two days prior to CCTV installation so that the Engineer can be present to establish appropriate pan and tilt stops for the Contractor to set.

C. Notify the Engineer at least two days in advance of the proposed date for the Camera Cable Test and Local Field Operations Test. The Engineer has the right to witness such tests or to designate an individual or entity to witness such tests on the Departments behalf.

D. Perform the following Camera Cable Test as indicated following the approved test plan. Furnish all equipment, appliances, and labor necessary to test the installed camera cable between the camera assembly and the camera control receiver. Perform the following tests before any connections are made:
   1. Perform continuity test on the camera cable. Camera cable must not exhibit any discontinuities such as opens, shorts, crimps, or defects.
   2. Perform continuity tests on the stranded conductors element of the camera cable using a meter having a minimum input resistance of 20,000 ohms per volt. Show that each conductor has a resistance of not more than 16 ohms per 1000 feet of conductor.
   3. Measure the insulation resistance between the conductors and between each conductor, ground, and shielding using a meggar meter. The resistance must be infinity. Perform all resistance testing after final termination and cable installation, but prior to connection of any electronics or field devices.
   4. Replace any cable that fails to meet these parameters, or if any testing reveals defects in the cable. Retest new cable as specified above.
   5. Furnish all test equipment.

E. Perform the following Local Field Operations Test at the CCTV field site, in accordance with the approved test plans. Demonstrate the following after the camera controller assembly, other camera hardware, power supply, and connecting cabling have been installed:
   1. Verify physical construction has been completed in accordance with the plans and specifications.
   2. Inspect quality and tightness of ground and surge protector connections.
   3. Check power supply voltages and output.
   4. Connect devices to power source.
   5. Verify installation of specified cables and connections between camera, pan/tilt unit, and camera control receiver.
   6. Set the camera control address.
   7. Verify presence and quality of video image with a vector scope and a portable NTSC monitor.
   8. Test local operation of all CCTV equipment
      a. Exercise the pan, tilt, zoom, focus, iris opening, and manual iris control selection and operation, low pressure alarm (if present), pre-set positioning, and power on/off function.

b. Observe the video picture on a portable video and waveform monitor.

9. Demonstrate camera sensitivity at low light levels to meet the specified requirements.
10. Demonstrate pan/tilt speed and extent of movement to meet the specified requirements.
11. Measure video signal level at the communications interface with a waveform monitor to verify NTSC Standards.
12. Verify proper voltage of power supply.

F. Deliver within three days, a written Completion Notice to the Engineer along with a copy of the test results upon successful completion of such test.
1. In the first part of the Completion Notice, document any discrepancies.
2. Within ten days of receipt of the Completion Notice and test results, the Engineer will either accept or reject the work (specifying, if rejected, the defect of failure in the work) by delivery of written notice to the Contractor.

G. In the event the Engineer rejects the work, the Contractor will promptly remedy the defect of failure specified in Engineer's notice.
1. Provide the Engineer with a Completion Notice.
2. The Engineer may identify an independent; third party to specify what defects must be addressed in order for the work to meet the specifications.

H. The Engineer may authorize others to complete the work at the Contractors expense if the Contractor fails to remedy any identified deficiencies in the work within ten days of receipt of the Completion Notice.

PART 2 PRODUCTS

2.1 CCTV POLE OR LUMINAIRE

A. Wood Pole Mounted CCTV: provide class 5 or 6 Douglas Fir wood pole, treated with Chromated Copper Arsenate CCA Type C, 33 ft nominal length and not less than 5 ½ inch diameter at top.

B. Steel Pole Mounted CCTV: steel pole with anchor bolts provided by the Department.
1. Anchor bolts: conform to AASHTO M 270 Grade 36.
2. Nuts, washers, and anchor bolts: galvanized according to ASTM A 153.

C. Luminaire Mast Arm Mounted CCTV: provide luminaire extension per Section 02892 and SL series Standard Drawings.

2.2 CCTV STEEL POLE FOUNDATION

A. Class AA(AE) concrete. See Section 03055.

B. Reinforcing Steel
   1. Coated.
   2. AASHTO M 284 or M 111
   3. AASHTO M 31 Grade 400

C. Non-Shrink Grout.

2.3 JUNCTION BOX

A. See Section 13554.

2.4 CCTV ASSEMBLY

A. Department furnished:
   1. Camera assembly, including camera, pan/tilt unit, control receiver, environmental enclosure, and cabling.
   2. Type G Pole mount cabinet.

2.5 MOUNTING EQUIPMENT

A. Provide clamp kit, mounting hardware, pipe, shims, grommet, and all additional equipment to attach CCTV assembly to pole or mast arm.

B. Provide all stainless steel or hot-dipped galvanized fasteners and hardware unless otherwise approved. Provide copper pole grounding lug.

2.6 24VAC TRANSFORMER

A. Department furnished: 24VAC transformer for powering the CCTV enclosure.

2.7 RS-232/RS-422 CONVERTER

A. Department furnished: converter for connecting communication equipment to CCTV enclosure.

2.8 DATA SURGE SUPPRESSOR

A. General characteristics (typical):
   1. Typical application: RS-422.
   2. Surge: 36 kA.
   3. Turn-on at 10 mA: +2.8/-0.6 V dc.
   4. Resistance: 1 Ohm.
   5. Capacitance: 30 pF.
   6. Energy: 310 ft-lbs
   7. Let-through: less than +10/-1 Vp (peak open circuit voltage at max current).
   8. -3dB (600 Ohms) BW: 95Mhz
   9. Temperature: -40 degrees F to 185 degrees F Storage/Operating 122 degrees F.

2.9 VIDEO SURGE SUPPRESSOR

A. General characteristics (typical):
   1. Typical application: VLF/HF receive only, LAN, closed circuit video.
   2. Surge: 18 kA IEC 1000-4-5 8/20 ms waveform 80 ft-lbs.
   3. Turn-on Time: 4 ns for 2 kV/ns.
   4. VSWR: less than or equal to 1.1 to 1 over frequency range.
   5. Insertion Loss: less than or equal to 0.3 dB over frequency range.
   6. User Current: 2.0A dc continuous.
   7. Vibration: 1G up to 100Hz.
   8. Temperature: -50 degrees F to 185 degrees F Storage/Operating 113 degrees F.

2.10 POWER LINE SURGE SUPPRESSOR

A. Conform to the following requirements (typical):
   1. Peak surge current occurrences: 20 minimum.
   2. Peak 8x20 msec wave shape: 20K amps.
   3. Response: 250 maximum.
   4. Maximum current at 120-VAC, 60Hz: 10 amps.
   5. Series inductance: 200 mH.
   6. Temperature: NEMA TS-1.

B. Provide two stage power line surge protector that allows the connection of a radio interference filter (to prevent disruption in the event of a power surge) in the circuit between the stages. Equip each cabinet with one or more radio interference filters in the power line surge protector to provide attenuation of at least 50 dB over a range of 50 KHz to 20 MHz.

2.11 DEPARTMENT FURNISHED MATERIALS PICK UP

A. Pick up all Department furnished camera assemblies and cabinets at:
Utah Department of Transportation
Traffic Operations Center
2060 South 2760 West
Salt Lake City, UT 84104-4592

Contact the Engineer seven calendar days before pick-up date.

B. Pick up all Department furnished poles, anchor bolts, and light pole extensions at:

UDOT Complex
4501 South 2700 West
Salt Lake City, Utah 84119

PART 3 EXECUTION

3.1 INSTALLATION

A. Conform to the requirements of the NEC, current edition.

B. Load, transport, and install all state-furnished materials per the manufacturer's instructions and as shown in the plans.

C. Provide foundation, junction boxes, ground rod, grounding lug, conduit, stainless steel mounting bands, wood pole, and all additional equipment required for a complete and operational CCTV system.

D. Install all wiring, conduit, and junction boxes as shown on site plans and details.
1. Field locate all conduits and junction boxes to avoid drainage areas and steep slopes whenever possible.
2. Protect existing conductors while installing camera cables and conductors.

E. Connect the controller and all wires as specified by the manufacturer.

F. Furnish and install all incidental items, such as wire nuts, grommets, tape connectors, and electrical nuts, necessary to make the CCTV system complete.

G. After installation, the exterior of all equipment: free of all loose rust and mill scale, dirt, oil, grease and other foreign substances.

3.2 STEEL CCTV POLE FOUNDATION

A. All material and workmanship conforms to AASHTO's Standard Specifications for Highway Bridges.

B. Verify that the installation of the CCTV camera, pole, pole mount cabinet, junction boxes, and foundation in the location marked in the field has no conflict with existing utilities, underground and overhead. Comply with all utility and blue stake requirements.

C. Excavation
   1. See Section 13551.

D. Caissons conform to AASHTO Division II Section 5, Drilled Piles and Shafts. Drill caissons into either native soil or compacted fill.
   1. If formwork is required during drilling, the forms may be withdrawn during concrete placement.
   2. Cast the top of the caisson against the formwork for appearance.

E. Place concrete directly into the excavation. Use minimum forming.

F. Do not weld reinforcing steel, conduit, or anchor bolts; tie reinforcing steel and conduit securely in place.

G. Coat all reinforcing steel to conform to AASHTO M 284 or M 111 and AASHTO M 31 Grade 420, respectively. Coat the ends of cut reinforcing with approved coating.

H. All cast-in-place concrete will be class AA(AE) except where specified otherwise. Cap all conduits before placing concrete.

I. After pole is installed, place non-shrink grout between base plate and foundation surface.

J. Install weep hole in foundation per SL series Standard Drawings.

3.3 ANCHOR BOLTS

A. Refer to Section 13551.

3.4 STEEL CCTV POLES

A. Install the metal camera poles on concrete bases as described herein. Apply rust, corrosion, and anti-seize protection at all threaded assemblies by coating the mating surfaces with an approved compound.

B. Install pole such that the hand hole is facing away from traffic.

C. Install ground rod. NEC 250.

D. All fasteners and attachment hardware for bands and other equipment: stainless steel.

E. Furnish and install all incidental items, such as wire nuts, grommets, tape connectors, electrical nuts, etc., necessary to make the CCTV system complete.

F. Adjusting the anchor bolt nuts, plumb all steel poles to the vertical with all camera equipment installed.

G. Pole Mount Cabinet
   1. The Department rejects poles that are damaged by improper drilling of holes.
   2. Drill and nipple holes at each site.
   3. Touch-up by hot stick method.

3.5 WOOD CCTV POLE

A. Install wood pole below grade to a minimum depth equal to one-sixth the total pole height.

B. Tamp and compact surrounding grade to match existing soil compaction.

3.6 CCTV ASSEMBLY

A. Assemble the camera assembly and prepare for installation per the manufacturer's instructions prior to delivery to the job site.

B. Deliver the assemblies to the job site as complete units, and install as per the plan details.

3.7 CCTV CABLES

A. Install camera cables in conduit and poles. All cable runs must be continuous and must run without splices between the camera and the cabinet.

B. Keep cable ends sealed at all times during installation using an approved cable end cap. Keep cable end sealed until connectors are installed.

C. Do not violate the minimum bending radius and the maximum pulling tension recommended by the manufacturer's specifications at any time.

D. Provide 6 ft of cable slack in all cabinets.

E. Make all camera cable connections between the CCTV assembly, RS-422/RS-232 converter, and communications equipment, as required to provide a fully operational CCTV system.

3.8 CONDUCTORS

A. Domed CCTV: furnish and install 3-#12 stranded IMSA Spec 20-1 power conductor cables between the 24 VAC transformer in the cabinet and the cabinet assembly on the luminaire arm.

B. Freeway CCTV: furnish and install 3-#6 from camera assembly to cabinet.

C. Freeway CCTV with Pole Mounted Cabinet: furnish and install 3-#12 from camera assembly to cabinet.

D. Splices: not allowed between camera and cabinet.

3.9 POLE MOUNTED CABINET

A. Install cabinet such that cables enter the underside of the cabinet.

B. Arrange all equipment installed in the cabinet in a neat and orderly fashion on cabinet shelf.

C. Install pole mounted cabinet such that it faces away from traffic. Use stainless steel bands.

3.10 JUNCTION BOX

A. Refer to section 13554.

END OF SECTION

SECTION 13557

VARIABLE MESSAGE SIGN

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Install all Department-Furnished items including VMS, cabinet, controller and any additional equipment required for a complete and operational VMS assembly.

B. Furnish and install VMS tubular support structures, sign connection hardware, catwalk, cabinet foundations and any additional equipment required for a complete and operational VMS assembly.

C. Test the installed VMS. Adjust VMS viewing angle as required.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 03152: Concrete Joint Control

C. Section 05120: Structural Steel

D. Section 13551: General ATMS Requirements

E. Section 13554: ATMS Junction Box

F. Section 13555: ATMS Cabinet

1.3 REFERENCES

A. AASHTO M 31: Deformed and Plaint Billet-Steel Bars for Concrete Reinforcement

B. AASHTO M 32: Steel Wire, Plain, for Concrete Reinforcement

C. AASHTO M 111: Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products

D. AASHTO M 232: Zinc (Hot-dip Galvanized) on Iron and Steel Hardware

E. AASHTO M 270: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges

F. AASHTO M 284: Epoxy Coated Reinforcing Bar

G. ASTM A 53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

H. ASTM A 123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

I. ASTM A 307: Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

J. ASTM A 325: Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

K. ASTM B 766: Electrodeposited Coatings of Cadmium

L. ASTM F 436: Hardened Steel Washers (Metric)

M. ASTM A 563: Carbon and Alloy Steel Nuts

N. ASTM F 593: Stainless Steel Bolts, Hex Cap Screws, and Studs

O. ANSI/AASHTO/AWS D1.5: Welding Specifications

P. National Electric Code (NEC)

1.4 SUBMITTALS

A. Mill Certificates for all structural steel. Refer to Section 05120.

B. Shop Drawings for all structure steel. Refer to Section 05120.

C. Test results for all tests.

1.5 TESTING AND ACCEPTANCE

A. Complete the Local Field Operations Test.

B. Testing:
   1. Submit Local Field Operations testing plan to Engineer for approval prior to testing. Do not perform any testing until the Engineer has approved the testing plans.
   2. Submit documentation of successful completion of test to the Engineer for approval prior to final acceptance.

C. Notify the Engineer at least two days in advance of the proposed date for the Local Field Operations Test. The Engineer has the right to witness such tests or to designate an individual or entity to witness such tests.

D. Perform the following Local Field Operations Test as indicated, following the approved test plan. After all local installations are complete and the sign is functional, the Contractor will demonstrate to the Engineer all hardware, cables, and connectors have been properly installed and that all functions are in conformance with the requirements as stated in the Plans and Specifications. Contact Engineer twenty-four hours in advance of local testing. Local testing is not complete until TOC personnel are able to verify the following:
   1. Power supply voltages and the functionality of the fans and heaters for both the sign housing and controller cabinet.
   2. Accurate ambient light measurements are being read from the photocells (front, back and top).
   3. Accurate sign temperature readings are measured in the sign and controller cabinet.
   4. Sign diagnostic tests perform properly.
   5. Sign message can be displayed and blanked.
   6. Proper vertical and horizontal angle of the sign.
   7. Presence of dial-tone inside the cabinet.
   8. Sign status information can be remotely and accurately viewed from TOC.
   9. TOC can initiate sign diagnostic tests and display and then blank the sign message.

E. Upon successful completion of such tests, deliver within three days, a written Completion Notice to the Engineer along with a copy of the test results.
   1. Included in the first part of the Completion Notice will be a section specifically documenting any discrepancies.
   2. The Engineer will within ten days of receipt of the Completion Notice and test results, either accept or reject the Work (specifying, if rejected, the defect of failure in the Work) by delivery of written notice to the Contractor.

F. In the event the Engineer rejects the Work, the Contractor will promptly commence to remedy the defect of failure specified in Engineer's notice.
   1. Thereafter, the Contractor gives the Engineer a Completion Notice.

2. In the event that the Engineer has not accepted the installation after this second round of tests, the Engineer may identify an independent; third party to specify what defects must be addressed in order for the Work to meet the Specifications.

G. If Contractor fails to remedy any identified deficiencies in the Work within ten days of receipt of the Completion Notice The Engineer may authorize others to complete the work at the Contractors expense.

PART 2 PRODUCTS

2.1 VMS FOUNDATIONS

A. Concrete: Class AA(AE) required. Refer to Section 03055.

B. Reinforcing Steel:
1. Deformed billet-steel bars conforming to AASHTO M 284 and M 31 (Grade 400) respectively.
2. Coated.
3. Spiral reinforcing steel must be #15 conforming to AASHTO M32 except minimum tensile strength of 58,000 psi.

C. Anchor Bolts:
1. Conform to AASHTO M 270 Grade 36 and ASTM A 307 Specifications.
2. Thread and galvanize the upper 12 inch: free running nuts, by hand, for the entire length of the threads.
3. Galvanize the upper 14 inch of the anchor bolts, all nuts and washers, in accordance with the requirements of AASHTO M 232.
4. Hook dimension of 8 inch as shown in Standard Plans.
5. Do not weld anchor bolts to reinforcing steel.
6. Nuts: Conform to ASTM A 563 Specifications.
7. Washers: Conform to ASTM F 436 Specifications.

2.2 BITUMOUS JOINT FILLER

A. Preformed material. Refer to Section 03152.

2.3 JUNCTION BOX

A. Refer to section 13554.

2.4 VMS SUPPORTS

A. Structural Steel: General
   1. Hot dip galvanize all structural steel after fabrication in accordance with AASHTO M 111. Structural steel may be metallized using electric arc sprayed zinc wire as an alternative.
   2. Welding design and fabrication: In accordance with the ANSI/AASHTO/AWS D1.5 Specifications.
   3. Use galvanized bolts, nuts, and washers in conformance with AASHTO M 232. Lock washers required on all bolts.

B. Structural Tubing:
   1. Use low carbon steel conforming to ASTM A 53 Grade B, except that its chemical composition requirements will be: carbon 0.25 percent, phosphorus 0.04 percent, manganese 1.35 percent, and silicon 0.05 percent (the other elements are to conform to ASTM A 53 Grade B).
   2. Bolts: Conform to ASTM A 325 Specifications.
   3. Nuts: Conform to ASTM A 563 DH Specifications.
   4. Washers: Conform to ASTM F 436 Specifications. Lock washer: all bolts.
   5. Galvanize bolts, nuts, washers: AASHTO M 232.

C. All Other Structural Steel:
   1. All other shapes and plates: Conform to AASHTO M 270 Grade 250.
   2. Bolts: Conform to ASTM A 307 Specifications.
   3. Stainless Steel Bolts: Conform to ASTM F 593 Type 304 Specifications.
   4. Nuts: Conform to ASTM A 563 Specifications.
   5. Washers: Conform to ASTM F 436 Specifications. Use lock washers on all bolts.
   6. Galvanize bolts, nuts, washers: AASHTO M 232.
   7. Entire sign assembly with mounting brackets: Galvanize to AASHTO M 111.

D. Welding design and fabrication: ANSI/AASHTO/AWS D1.5 specifications.

PART 3 EXECUTION

3.1 PREPARATION

A. Type I Sign Design Criteria
   1. Dead Load: 4800 lb.
   2. Live Load: 510 lb.
   3. 100 mph wind load.
   4. Snow and ice loadings.

B. Conform to the requirements of the National Electric Code (NEC), current edition.

C. Load, transport, and install all state-furnished materials per the manufacturer's instructions and as shown in the plans.

D. Provide foundation, VMS supports, junction boxes, ground rod, grounding lug, conduit, and all additional miscellaneous items required for a complete and operational VMS.

E. Install all wiring, conduit, and junction boxes as shown on site plans and details.
   1. Field locate all conduits and junction boxes to avoid drainage areas and steep slopes whenever possible.
   2. Protect existing conductors while installing cables and conductors.

F. Furnish and install all incidental items, such as wire nuts, grommets, tape connectors, and electrical nuts, necessary to make the VMS system complete.

G. After installation, the exterior of all equipment: Free of all loose rust and mill scale, dirt, oil, grease and other foreign substances.

H. Maintenance platforms required when the surrounding areas are not paved.

I. Restore work area to the original condition or better after work is completed.

3.2 CONSTRUCTION SEQUENCE

A. Construct foundations, establishing base plate elevations in accordance with project plans.

B. Determine design height of both vertical supports, and length of horizontal support based on the 'as-built' foundation field survey. A prudent safety factor may be added to the vertical dimensions of each vertical support to assure ease of construction to vertical clearance requirements. Determine catwalk design dimensions based on survey data. Obtain Engineer's approval for all dimension changes.

C. Fabricate structural supports and catwalk. Review shop-drawings and relate to survey information to assure consistency.

D. Erect structure with sign.

E. Remove shipping supports, connect all wiring and cables in a neat and orderly fashion, verify all parts are properly seated and functional and make final adjustments to sign horizontal and vertical angles. The Engineer reserves the right to order adjustments to the sign angle during the initial installation.

3.3 VMS FOUNDATIONS

A. Excavation
   1. Perform per Section 13551.

B. Anchor Bolts:
   1. Provide anchor bolt template during installation of anchor bolts. Fabricate the bolt template of 1/4 inch thick minimum steel plate, similar to anchor plate details. Match drill to each base plate.

C. Earthwork
   1. Place compacted embankments prior to drilling.
   2. Drill Caisson forms 6 inch minimum below ground surface. Place compacted backfill before erecting post.

D. Bituminous filler at concrete joints. Refer to section 03152.

3.4 VMS SUPPORTS

A. Structural Tubing:
   1. Provide handholes for tubular overhead frame one side only.
   2. Locate inserts at the bottom of the mast arm where shown on the Standard Plans. Weld 1 ½ inch diameter insert in each hole. Thread inserts before galvanizing and provide galvanized plugs.
   3. During sign erection, the post will be racked as necessary with the use of leveling nuts to make the sign panels level. At final position, both top and bottom anchor bolt nuts are to be wrench tightened against the base plate.

B. All Other Structural Steel:
   1. One sign-mounting bracket is required at each sign Z bracket. See sign fabricator's drawings for number and location of Z brackets.
   2. Pre-tension steel rod to 11,000 lbs.
   3. During sign erection, rake post as necessary with the use of leveling nuts to make the variable message sign level. At final position both top and bottom anchor bolt nuts are to be wrench tightened against base plate.
   4. Sign placement on horizontal member may be adjusted up to 3/8 inches upward for VMS platform to match catwalk elevation.

C. Earthwork:
   1. Place and compact backfill prior to erecting supports.

3.5 VMS CABINET

A. Cabinet Foundation
   1. Concrete: A(AE) required. Refer to Section 03055.
   2. Trowel finish and level top surfaces, prior to cabinet installation. Level top surfaces of cured concrete by grinding.

B. Bolts, Nuts, and Hardware
   1. Furnish and install ¾ inch x 8 inch anchor bolts to secure cabinet. Cabinet anchor bolts: minimum pullout strength 11,000 lb.
   2. Expansion anchor bolts to secure framing strut to foundation: ½ inch diameter embedded 6 inch minimum in foundation, with shear capacity of 2500 lb and tension (pullout) capacity of 2600 lbs. Locate expansion anchors a minimum of 3 inch from any edge of concrete.
   3. Provide stainless steel, galvanized, or zinc plated bolts, nuts, and hardware.
      a. Steel as specified. ASTM A 307.
      b. Galvanized as specified. ASTM A 123.
      c. Zinc plated as specified. ASTM B 766.
   4. Provide all bolted connections with lock washers, nuts, or other approved means to prevent the connection nuts from backing off.
   5. For framing struts, provide commercially available 12-gauge, u-shaped stainless steel product with ½ inch diameter pre-drilled holes, to attach transformers, breaker enclosures, disconnects, or other electrical equipment to cabinet foundation. Provide strut with cross-section dimensions 1 7/16 inch x 1 7/16 inch minimum.
   6. Verify bolt pattern and foundation dimensions prior to foundation construction.

C. Conduit
   1. Install all conduit in base of cabinet in a 12 inch x 18 inch rectangle centered in the cabinet base. Conduit may be aligned in alternate pattern than shown in plan. Refer to plans for the number, size, and orientation of all conduits entering the junction boxes.
   2. Conduit (typical) from cabinet to Type I junction box
      One-1 ½ inch from cabinet to disconnect
      One-1 ½ inch from disconnect to Type I junction box
   3. Conduit (typical) from cabinet to Type II junction box
      Two-3 inch
      Four-2 inch

4. Conduit (typical) stubbed out of Type II junction box
   Two-3 inch
   Four-2 inch
   One-3 inch(spare)
5. All exposed conduit: metallic.
6. Install bushings on metallic conduit ends at top of concrete bases if wire or cable is installed. Install end bells on non-metallic conduit if wire or cable is installed.
7. Provide 1 inch minimum spacing between conduit in cabinet base. Cap conduit at both ends until used. Stub conduit 3 inch above the concrete base.

D. Orient the cabinet such that the front door is on the opposite side of the cabinet from the VMS to allow maintenance personnel facing the front door of the cabinet to also face the VMS. Orient the cabinet such that the door that accesses the front face of the control equipment is adjacent to the Type II junction box.

E. Disconnect and Transformer
1. Install struts as per Section 13555.
2. Install disconnect and transformer on the side of cabinet that faces away from the nearest traffic. If wall blocks access to disconnect, then install the disconnect and transformer on the opposite side of cabinet.
3. Install 0.67 inch spacers with each expansion anchor between the foundation and disconnect/transformer. Maintain a 0.67 inch gap between the disconnect/transformer and the foundation.
4. Ground the transformer to the control cabinet ground terminal.
5. Install disconnect and transformer per manufacturer's instructions.

F. Identify all field terminals.

G. For junction box installation, see Section 13554.

END OF SECTION

SECTION 13591

TRAFFIC MONITORING DETECTOR LOOP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish, install, and test detector loop and detector cable. Connect detector loop to control cabinet and provide complete functioning detection capability for loops.

1.2 RELATED SECTIONS

A. Section 02892: Traffic Signal

1.3 REFERENCES

A. International Municipal Signal Association (IMSA)

B. National Electric Code (NEC)

1.4 SUBMITTALS

A. Certified test report of detector lead-in cable compliance as specified. IMSA 50-2.

B. Samples of materials for approval when requested.

C. Two copies of the following within fifteen days after receiving a Notice to Proceed:
   1. List of equipment and materials (name of manufacturer, size, and identification number.)
   2. Manufacturers' warranties, guarantees, instruction sheets, installation details, and parts lists.

D. Detector Loop Circuit Test and Shield Isolation Test to Engineer for acceptance.

1.5 ACCEPTANCE TESTING

A. Detector Loop Circuit Test: Follow Section 02892.

B. Perform Shield Isolation Test after the loop wire is connected to the detector lead-in wire to test the continuity of the detector lead-in wire shield.

PART 2 PRODUCTS

2.1 MATERIALS

A. Use electrical components as listed and defined by the National Electric Code (NEC).

B. Follow Section 02892.

PART 3 EXECUTION

3.1 PREPARATION

A. The number of loops and number of lanes varies based on location shown in plans.

B. Conform to the National Electric Code (NEC).

3.2 SAWCUT

A. Maximize the area and width of any pavement sections that are created by the sawcuts.

B. Do not saw cut across a transverse joint in the traveled way.

C. Saw cut is allowed across a transverse joint in a shoulder slab. To maximize the pavement slabs created, position the cut approximately halfway along the joint.

D. Maximum allowable distance between saw-cut and transverse joints, or between adjacent sawcuts: 1½ ft.

E. Loop Spacing: 21½ ft between leading edges.
Maximum tolerance: 1 inch.

F. Do not install loops in cracked or spalled pavement.

G. Avoid water in active traffic during installation.

H. Shape: Refer to SL series Standard Drawings.

3.3 LOOP WIRE AND LEAD IN CABLE INSTALLATION

A. Section 02892

B. Loops: Four turns per loop, placed counter clockwise, center all loops in lane.

C. Use blunt wood sticks to push wire into saw cut. Do not use metal tools.

D. Tag each loop within the junction box at the termination of the loop wire and within the cabinet at the termination of the detector loop cable (DLC).

E. Immediately upon installation:
   1. Seal loop wire ends with waterproof coating, coil neatly, place in a junction box or a sealed plastic bag, and bury.
   2. Install a plywood shield above all buried wire ends.
   3. Do not allow loop wire ends be left exposed to the weather.

F. Install Loop Sealant
   1. Fill and encapsulate loop wires and home runs a minimum depth of 1 5/8 inch from the pavement surface.
   2. Install embedding loop sealant in saw cuts ± 1/4 inch from the top of the pavement after curing is complete.
   3. Allow sealant adequate time to cure under ambient environmental conditions before lane is re-opened to traffic, or cover loop sealant with sand or cement dust to minimize tire tracking.
   4. Refer to manufacturer's specifications regarding expansion of sealant during curing period.

G. Install detector lead-in cable to from loop wire to cabinet. Connect cable to input file in cabinet to make loop detection fully functional at cabinet controller location.

H. Maximum detector lead in cable length allowed: 660 ft.

I. Pavement Exit
   1. Drill 2 inch diameter hole at 45 degree angle at pavement edge.
   2. Install conduit originating from splicing junction box to the pavement edge. Extend conduit 3 inch into drilled hole.
   3. After loop wires are installed, seal conduit, fill the hole within 1 ½ inch of road surface with silica sand.

4. Seal remaining hole in the road surface with loop sealant.

J. Conduit Connection to Junction Box
   1. Conduit to be sealed with waterproof bushings or acceptable caulking compound.
   2. Fill voids resulting from entrance of conduit into junction box with duct seal or hydraulic cement grout.
   3. Field locate junction box to avoid drainage areas and steep slopes.

K. Splicing in junction box
   1. No splices allowed between the loop wire and controller cabinet.
   2. The only splice allowed is the transition from the loop wire to the detector lead-in cable.
   3. Carry the shield over the splice.
   4. Splice detector lead-in cable to loop wire in junction box with approved splice encapsulation kit.

L. Notify Engineer at least 72 hours prior to any installation or testing. Allow the Engineer to witness installation and testing on all equipment. Work is not complete without acceptance by the Engineer.

END OF SECTION

SECTION 13592

ROADWAY WEATHER INFORMATION SYSTEM - ENVIRONMENTAL SENSOR STATION (RWIS-ESS)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. RWIS site preparation: install buried conduit per industry standard and associated junction boxes with grounding rods, tower foundation, and fence installation per design plans or as directed by UDOT representative.

1.2 RELATED SECTIONS

A Section 02324: Compaction

B. Section 02330: Embankment

C. Section 02821: Chain Link Fencing and Gates

D. Section 03055: Portland Cement Concrete

E. Section 03211: Reinforcing Steel and Welded Wire

F. Section 03310: Structural Concrete

1.3 REFERENCES

A. National Electric Code (NEC)

PART 2 PRODUCTS

2.1 POWER

A. Use electrical components as listed and defined by the National Electric Code (NEC).

B. Supply and install conduit, ground rods, and junction boxes. Install in each conduit a detectable pull tape with (one foot) incremental measurement markings. Tensile strength will be 1,200 ft lb.

C. Install solar power array and connect with RPU per manufacturer's specifications.

2.2 RPU TOWER FOUNDATION AND SERVICE PAD

A. Use Class AA (AE) concrete per Section 03055.

2.3 TOWER GROUNDING SYSTEM

A. Wire: 32 strand, #210 weight, 7/16 inch tinned copper ground cable. For all three legs, starting from the outside ground rod, clamp wire and run wire to the ground rod three feet from the tower. Clamp the wire to the ground rod. **DO NOT cut the wire.** Then, run the wire across the top of the concrete pad to the corner of the RWIS tower. Grounding wire to be attached to the tower to be installed by the Department.

B. Ground Rod: 5/8 inch diameter 8 foot copper clad. Two per corner; one, 3 feet away and one10 feet away.

2.4 ENVIRONMENTAL SENSORS, REMOTE PROCESSING UNIT (RPU), COMMUNICATION EQUIPMENT, AND TOWER

A. All sensors to be installed by the Department.

2.5 FENCE AND GATE

A. Follow UDOT provided design specification.

PART 3 EXECUTION

3.1 GENERAL

A. Conform to the requirements of the National Electric Code (NEC).

B. Tower site location and pavement sensor placement must by approved on site by the Engineer prior to construction.

C. Provide a preliminary installation schedule to the Engineer 30 days prior to start of work.

D. Pick up State-furnished materials at the following:
Utah Department of Transportation
Traffic Operations Center (TOC)
2060 South 2760 West
Salt Lake City, Utah 84104-4592

E. Contact the Engineer seven calendar days before pick-up date.

F. Install all State-furnished materials per manufacturer's instructions, unless noted otherwise.

3.2 RPU TOWER FOUNDATION AND TOWER

A. Follow Section 03055 and Section 03211.

B. Provide all necessary grading for a flat and level site.

C. Finish all surface concrete with Ordinary Surface Finish per Section 03310.

D. Do not weld conduit to tower. Follow manufacturer's installation instructions.

E. Place the concrete directly into the excavation. Use minimum forming above ground.

F. RPU tower to be installed by the Department.

3.3 PAVEMENT SENSORS

A. To be installed by the Department.

3.4 CABINET, PROCESSING UNIT

A. To be installed by the Department.

3.5 COMMUNICATION EQUIPMENT

A. To be installed by the Department.

3.6 FENCE AND GATE

A. Furnish and install Chain Link Fence and Gate per Section 02821.

B. Furnish and install 7-foot high Type IV fence, with barbed wire and arm, with 5-foot wide gates.

C. Orient fence gates and size the fence dimensions per manufacturer or Department specifications.

END OF SECTION

SECTION 13593

WEIGH IN MOTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Construct complete weigh in motion (WIM) site, including all labor and materials required for a complete and accepted installation.

1.2 RELATED SECTIONS

A. Section 13555: ATMS Cabinet

1.3 REFERENCES

A. National Electric Code (NEC)

1.4 SUBMITTALS

A. Materials:
   1. Submit samples of materials for approval when requested.
   2. Submit two copies of the following within fifteen days after receiving a Notice to Proceed:
      a. List of equipment and materials (name of manufacturer, size, and identification number).
      b. Manufacturers' warranties, guarantees, instruction sheets, installation details, and parts lists.

B. Testing:
   1. Submit Local Field Operations Testing plan to Department for approval prior to testing. Do not perform any testing until the Department has approved the testing plans.
   2. Submit documentation of successful completion of Local Field Operations Test to the Department for approval prior to final acceptance.

1.5 ACCEPTANCE TESTING

A. Conduct the following Local Field Operations Test. Satisfy submittal requirements.

B. After all sensors, data processor, power, and cabling have been installed, verify the following:
   1. All installed hardware, cables, and connections operate correctly and that all functions are in accordance with the manufacturers' specifications.
   2. The power supply voltages and the functionality of any cabinet fans and heaters.
   3. The ability of the controller to properly process all of the relevant data from each sensor at the site.

C. Conduct the test after all construction for the site has been completed and final road surface has been constructed. It is not necessary for the communications installation to be completed at the time of the test.

D. Satisfy all additional testing requirements specific to the project.

E. Site must be commissioned by the manufacturer prior to acceptance.

PART 2 PRODUCTS

2.1 GENERAL

A. Use electrical components as listed and defined by the NEC.

2.2 GROUNDING SYSTEM

A. Wire: copper wire of the size specified.

B. Ground Wire: solid, bare, soft-drawn, copper wire as specified.

C. Ground Rod: copper coated steel of the size specified.

2.3 PIEZO ELECTRIC SENSORS

A. Piezo Electric Sensors as follows:
   1. Commercially-available "Brass Linguini"-style piezo electric sensor.
   2. Functional between -20 degrees F and 160 degrees F

3. Functional in up to 95 percent humidity
4. Manufacturer-specified operating life of three years, minimum.

B. Manufacturer's installation instructions will be provided by the Department.

2.4 CABINET

A. Provide cabinet for housing processing unit, and any additional equipment, as indicated.

B. Follow Section 13555.

PART 3 EXECUTION

3.1 PREPARATION

A. Conform to the requirements of the NEC.

B. Contact the Engineer thirty days prior to start of work, to schedule and attend a pre-installation meeting.

C. Pick up Department-furnished materials at the following:
Utah Department of Transportation
Traffic Operations Center
2060 South 2760 West
Salt Lake City, UT 84104-4592

D. Contact the Engineer seven calendar days before picking up Department-furnished materials.

E. Install all Department-furnished materials following manufacturers' instructions.

3.2 ENVIRONMENTAL SENSORS

A. Follow all manufacturer's installation instructions.

B. Piezo Install:
1. Cut straight slot, ¾ inch x ¾ inch, in one pass, perpendicular to and for the full width of the traffic lane.
2. Drill ½ inch diameter 2 inch deep holes, at 45 degrees, at 3 ft spacing, along both sides of saw cut.

3. Minimum of 6 inch between saw cut and concrete joints
4. Clean and dry slot prior to placing piezo.

C. Lead In Wires:
1. Saw cut ½ inch wide x 3 ¼ inch to 6 inch deep slot for piezo lead in wires.
2. Cover lead in wire with at least 3 inch of approved embedded sealant.
3. Provide separate slots for each piezo lead in wire.
4. Minimum of 6 inch between saw cut and concrete joints.
5. Locate all lead ins down stream of piezo.
6. Drill ½ inch hole at edge of roadway for cover on conduit.
7. One ¾ inch schedule 40 conduit for each lead in wire outside of roadway.
8. Piezo lead in wire: Long enough to reach the data recorder prior to placing 500 ft maximum.
9. Tag and number each lead in wire for identification.

D. Refer to SL series Standard Drawings for loop detector details.

E. Install all cabling between sensors and processing unit following all manufacturers' installation instructions.

3.3 CABINET AND PROCESSING UNIT

A. Install ATMS cabinet as indicated.

B. Refer to Section 13555.

END OF SECTION

SECTION 13594

FIBER OPTIC COMMUNICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish, install, and test communication system.

1.2 REFERENCES

A. ASTM A 615, Grade 60

B. Bellcore Testing Requirements

C. Electronic Industries Association (EIA) and Telecommunications Industry Association (TIA) Specifications

D. National Electric Code (NEC)

E. Telcordia Guidance

F. Underwriters Laboratory (UL)

G. USDA Rural Electrification Administration (REA) Specifications

1.3 DEFINITIONS

A. OTDR: Optical Time Domain Reflectometer

B. OSP: Outside Plant

1.4 SUBMITTALS

A. Evidence of training and experience for fiber optic staff. Include in the file for each technician a resume listing relevant education and experience, and a certificate of completion for the fiber optic training course.

B. For approval:

1. A detailed construction and installation procedure covering all aspects for the fiber optic cable installation on this project.
2. All materials for the fiber optic cable installation on this project.
3. Fiber labeling setup.

C. Prior to the splicing of any fiber cable, submit to the Engineer the part number and manufacturer of the cleave tool along with an "end angle" distribution chart which demonstrates the actual 150 cut end angles.

D. Submit to the Department and maintain on file a current calibration certificate for the OTDR being used.

E. Submit OTDR test results to the Department in a neatly bound and printed format for acceptance. Electronic submittal to Engineer on floppy disk or CD is also required.

F. Submit Power Meter/Light Source Test results to the Department for acceptance (Fiber Optic Continuity Test Form).

1.5 ACCEPTANCE TESTING

A. Contact the Engineer 48 hours prior to performing all acceptance testing (Post Termination and Splicing OTDR and Power Meter).

B. Perform all fiber optic testing with an OTDR capable of producing output files compatible with the Siecor OTDR 383PCW Version 1.21 or higher.

C. After completing the required work, use an OTDR to test one strand per buffer tube randomly selected by the Inspector. Conduct the test for each and every buffer tube running through the splice closure.

D. If the OTDR trace for any randomly selected strand shows evidence of damage, OTDR test each and every strand passing through the splice enclosure.

E. Repair any damaged fiber strands using fusion splicing methods and repeat all tests described below.

F. OTDR Testing Requirements
1. After completing the required work, test every fiber strand passing through any splice tray that was opened by the Contractor.
2. Conduct all traces with a pigtail or fiber box between the OTDR and the fiber under test.
3. Maintain minimum length of the fiber in the fiber box greater than the dead zone specified by the manufacturer.
4. Do not exceed launch transition of 6 dB.

5. Conduct all traces at both 1310 nm and 1550 nm.
6. Unless otherwise noted, unidirectional traces are acceptable.
7. Provide traces with the following information:
   a. Horizontal Axis: Distance in Feet and Kilometers.
   b. Vertical Axis: attenuation scale in dB.
   c. Traces showing attenuation versus distance.
   d. Cursors positioned at cable ends.
8. Tabulate for each trace: method, fiber type, wavelength, pulse width, refraction index, range, search threshold, reflection threshold, end threshold, warning threshold, backscatter, jumper length, file date, file time, fiber ID, cable ID, OTDR location, far end location, operator initials.
9. Provide an event table showing all events having more than 0.05 dB loss, containing event type, position from OTDR end, loss and reflectance.
10. For cables less than 3300 ft (1 km) in length, the maximum total allowable attenuation is 1.0 dB.
11. Identify fibers by strand number.
12. Submit results in printed form on 8 ½ x 11 paper in a suitable binder organized by cable and strand number.
13. A cover sheet is required for each binder indicating which cable(s) were tested, the OTDR users name, the reviewers name, the type of test performed and the date(s) of the test.
14. Cover sheets for final test results bearing the reviewers signature, the date, and a statement indicating that the installation complies with the requirements of this section is required.
15. The Contractor's employee who has reviewed the traces is required to sign or initial them. A check mark is required on all traces that satisfy the requirements identified herein. For intermediate test results, flag any discrepancies that may exist with a short description of the proposed corrective action. (e.g. resplice).
16. Submit to the Engineer on three 2 inch floppy disk or CD electronic media with a printed index.

G. Post Termination and Splicing Test
1. Test every strand in all cable segments including connectorized strands of drop cables.
2. Light Frequency: 1310 nm and 1550 nm.
3. Direction: Bidirectional.
4. Location of test: Every field location required to obtain access to each cable segment.
5. Test after terminating and splicing at all points shown on the plans.
6. Cable Tested by: Certified Contractor Staff.
7. Department inspector witnesses and approves before final approval by the Engineer.

8. Acceptance Criteria:
   a. Cable attenuation. 0.4 dB/km at 1310 nm excluding splices shown on the plans or authorized by the Engineer.
   b. Cable attenuation. 0.25 dB/km at 1550 nm excluding splices shown on the plans or authorized by the Engineer.
   c. Strand lengths are consistent.
   d. Launch Transition < 6 dB.
   e. No event > 0.30 dB.
   f. Maximum splice attenuation 0.20 dB per splice unless otherwise shown on the plans.
9. Trace available for each strand in all cable segments.

H. Power Meter Test
1. Connect the light source to the connectorized fiber at the location identified on the Fiber Optic Test form. Connect a power meter to the other end of the fiber at the location identified on the Fiber Optic Test form.
2. Turn on the light meter and record the power received at the power meter in the appropriate location on the Fiber Optic Test form.
3. Specifically indicate the fibers tested on Fiber Optic Test form. Otherwise, test each strand in every cable segment including connectorized strands of drop cables.
4. Use the light frequencies of 1310 nm and 1550 nm, or as indicated in test plans.
5. Perform the test uni-directional.
6. Test every field location required to obtain access to each cable segment.
7. A qualified member of the Contractor staff will perform all testing.
8. A Department inspector witnesses and approves the results before final approval by the Engineer.
9. Acceptance Criteria:
   a. Cable attenuation as called for in test plans.
   b. Strand lengths are consistent.
   c. Launch Transition less than 6 dB.
   d. No event less than 0.30 dB.
   e. Maximum splice attenuation 0.20 dB per splice unless otherwise shown on the plans.
   f. Trace is available for each strand indicated in test plans. Otherwise, trace will be available for each strand in each cable segment.

I. Light Source Test
1. Connect the light source to the connectorized fiber number at the location identified in the Fiber Optic Test Forms. Connect a power meter to the other end of the fiber at the location identified in the Fiber Optic Test Forms.

2. Testing:
   a. Turn the light source off and on at a rate of approximately once per second for three cycles. Observe the power meter and record the response of the meter in the appropriate location on the Fiber Optic Continuity Test form.
   b. Indicate OK if the Contractor notes the meter responding to each of the three cycles. Indicate BAD for any other responses, such as no cycles, less than three cycles, or more than three cycles.
   c. For each bad response, submit to the Engineer a statement summarizing the response.
   d. A tone modulated light source may be used, in place of the three-cycle method, to conduct this test.

J. Fiber Optic Continuity Test Form
   1. Complete the ATMS Fiber Optic Continuity Test Form included at the end of this Section and submit the completed form to the Engineer. This form identifies the specific set up location for the power meter and light source.
   2. Connect the light source to the connectorized fiber number at the location identified in the ATMS Fiber Optic Continuity Test Form. Connect a power meter to the other end of the fiber at the location identified in the ATMS Fiber Optic Continuity Test Form.
   3. Turn on the light meter and record the power received at the power meter in the appropriate location on the ATMS Fiber Optic Continuity Test Form.
   4. The Fiber Optic Continuity Test Form identifies the specific set up location for the power meter and light source.

K. Perform all work to conform to the National Electric Code.

PART 2 PRODUCTS

2.1 GENERAL

A. All materials are UL listed.

B. Provide all incidental materials including but not limited to fiber optic jumpers, cable ties, labels, data cables, and connectors.

2.2 FIBER OPTIC CABLE

A. Contact the Engineer for approval of fiber that is to be used.

B. The fiber optic cable is an Outside Plant (OSP) type, nonarmored dielectric loose tube, single mode cable.

C. Packing and Shipping (OSP Cable):

1. Ship the cable wound on spools or reels.
   a. Pack only one continuous length of cable per spool.
   b. Package the cable to prevent damage during shipping and handling.
2. When a length of cable's weight exceeds 800 lbs, a large wooden reel with wooden staves is required.
   a. Cover the cable with a thermal wrap.
   b. Secure the outer end of the cable to the reel head to prevent the cable from becoming loose in transit.
   c. Project the inner end of the cable a minimum of 6 ft into a slot in the side of the reel or into a housing on the inner slot of the drum, in such a manner to make it available for testing.
   d. Arbor hole: 1 ½ inches minimum.
3. Test tails: at least 6 ft. long.
   a. Fasten the inner end to prevent the cable from becoming loose during shipping and installation.
   b. Apply end seals to each end of the cable to prevent moisture from entering the cable.
4. Mark each reel with an identification number that can be used by the manufacturer to trace the manufacturing history of the cable and the fiber.
5. Mark each reel to indicate the direction in which it should be rolled to prevent loosening of the cable on the reel.
6. Include the manufacturer's test documentation with each reel. This documentation indicates the attenuation of each cable fiber in dB/km (dB/ft), measured at 1310 nm and 1550 nm for single mode.

D. Outside Plant (OSP) Single Mode

General Characteristics:

1. Each OSP cable is of one type with the following features: all dielectric, loose tube, conforming to PE90 outside plant cable.
2. Provide all fiber optic cable on this project from only one manufacturer who is regularly engaged in the production of this material.
3. Fiber cables:
   a. all one mode (single or multimode),
   b. single mode and multimode under one sheath construction (HYBRID CABLE), or
   c. optical fiber/copper combination (COMPOSITE).
4. Install single mode fiber optic cable for the fiber optic communication system. The fiber cable conforms to the following:
   a. Latest version of Telcordia Technologies GR20-CORE: Generic Requirement for Optical Fiber and Optical Fiber Cables;
   b. TIA/EIA-4720000-A: Generic Specification for Fiber Optic Cable;

c. United States Department of Agriculture (USDA) Rural Electrification Administration (REA) PE-90: REA Specification for Filled Fiber Optic Cables (updated per Bulletin 1753F-601 on August 4, 1994); and appropriate sectional specifications.

5. Fiber optic cable: free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification.
6. The fiber cable contains a water-blocking material in a loose tube construction with up to 12 buffer tubes wrapped around a dielectric central strength member. All fiber(s) are contained within buffer tubes, and each buffer tube has an inside diameter much greater than the total diameter of the fiber(s) it supports.
7. Each fiber or group of fibers freefloats within the tubes such that all mechanically or environmentally induced stress placed upon the cable is decoupled from the fibers. Air within the buffer tubes is displaced by the water-blocking material to prevent entry by water and to facilitate free movement of the fiber(s) within.
8. Buffer tubes: color coded in compliance with TIA/EIA598, Color Coding of Fiber Optic Cables. Construct cable with a fiber count in multiples of six. 6-36 having six fibers per buffer tube 42 and up having 12 fibers per buffer tube. Color code all fiber to comply with TIA/EIA598.
9. Each buffer tube of the cable contains water-blocking material to prevent entry of water.
   a. Water blocker: provided between the cable jacket and the outside of the buffer tubes.
   b. Binder wrapping strength member of aramid fibers: provided as a final layer prior to application of the outer jacket.
10. Outer jacket:
    a. Constructed of medium density polyethylene.
    b. Minimum thickness: 0.055 inches.
    c. Applied directly over the tensile strength members and water blocking means.
    d. Outer jacket is UV and fungus resistant.
11. Outer jacket labeling:
    a. The date of manufacture and the manufacturer's name.
    b. A numerical sequence, at intervals no greater than 10 ft, to determine the length of cable and amount of cable remaining on the reel.
    c. Utah Department of Transportation Fiber Optic Cable at an interval of no greater than 9.84 ft.
    d. Height of the markings is 1/8 inch nominal.
12. All optical fibers are 100 percent attenuation tested at the factory for compliance with performance specifications described in this section. The attenuation results of each fiber are provided with each cable reel.
13. All fiber cable is suitable for installation in underground conduit or lashed to messenger cable, and meets or exceeds the following specifications:

a. Operational Wavelength: 1310 nm and 1550 nm.
b. Optical Attenuation: at 1310 nm: 0.4 dB/km at 68 degrees F. at 1550 nm: 0.25 dB/km at 68 degrees F.
c. Optical Dispersion: at 1310 nm:. 4.5 psec/nm-km at 1550 nm:. 20 psec/nm-kmZero.
d. Dispersion Wavelength:1300 to 1320 nm, nominal.
e. Zero Dispersion Slope:. 0.092 ps/nm^2-km.
f. Fiber Core Diameter: 8.2 µm, typical.
g. Fiber Coating Diameter: 250 +/- 10 mm.
h. Fiber Cladding Diameter: 125 +/- 1 mm.
i. Core to Cladding Offset:. 0.8 mm.
j. Cladding NonCircularity:. 1.0 percent.
k. Spot Size: 9.3 +/- 0.5 µm at 1310 nm.
10.5 +/-1 mm at 1550 nm.
l. Cutoff Wavelength:. 1250 nm.
m. Crush Resistance: 300 lb/ft, length of cable.
n. Cable Outside Diameter: ½ inch, maximum.
o. Minimum Bending Radius:
Installation: 20 times cable outside diameter.
Static: 10 times cable outside diameter.
p. Operating Temperature:
Installation: -22 F to 158 F.
Storage/Operation: -40 F to 158 F
q. Humidity: 0 to 100 percent.
r. Tensile Strength:
Installation: 600 pounds
Static: 135 pounds

14. The cable is waterproof, complying with water penetration test conducted in accordance with EIA/TIA-455-82-B for fluid blocking fiber optic cable.
15. Fiber optic drop cables
a. With the number of fiber strands and connectors as shown on the plans.
b. Terminated with ST or ST compatible connectors, installed using factory approved procedures.
c. With connectors for all fiber strands that have present usage.
d. Drop cable fan out kits: heavy duty Spider design.
e. Buffer tubes: protected by the cable sheath or fan out kit. Exposed buffer tubes are not acceptable.
f. Individual fiber strands: protected by 0.11 inch Kevlar tubes.
g. Minimum tubing length is 24 inches.

E. Factory Test
   1. Fibers Tested: Each strand.
   2. Light Frequency: 1310 nm and 1550 nm.
   3. Direction: unidirectional.
   4. Location: Cable Factory.
   5. When Performed: Tested prior to shipment.
   6. Tested by: Factory Staff.
   7. Cable meets factory attenuation specifications.
      a. Cable attenuation 0.4 dB/km at 1310 nm.
      b. Cable attenuation 0.25 dB/km at 1550 nm.
      c. Strand lengths are consistent.
      d. Launch Transition < 6 dB.
      e. No event > 0.30 dB.
   8. Traces will be available for each strand in cable.

2.3 FIELD FIBER OPTIC DATA MODEM (STATE FURNISHED ITEM)

A. Designed to support full duplex asynchronous RS232 communications in a multidrop counter rotating ring, daisy chain, and two headed daisy chain topology.

B. Configurable as master submaster or local units and meeting the following specifications:
   1. Optical Loss Range: 0 - 17 dB.
   2. RS-232 Data Rate: DC to 100 kbaud.
   3. Operating Wavelength: 1310 nm.
   4. Fiber Type: Single Mode.
   5. Pilot Tone Frequency: 430 to 450 khz.
   6. Power Supply: External Transformer 120 VAC Primary, 8 to 18 VDC secondary.
   7. Operating Temperature: -35 F to + 167 F.
   8. Humidity: 0 to 98%.
   9. Optical Connector: ST.
   10. Data Connector: DB25 F.
   11. LED Indicators: TD1, RD1, TD2, RD2, Power, Fault.
   12. AntiStreaming Timeout: User Selectable 4, 8, 16, 32, or 64 seconds or disabled.
   13. Fault Output: Dry contact closure.
   14. Compatibility: optically and electrically operate with Force Model 2869 in the same circuit.
   15. Package: Shelf Mount 6 inch x 6 inch x 1 1/4 inch maximum.

2.4 FIBER OPTIC CONNECTORS

A. With the following characteristics:
   1. Factory installed or field installed ST or ST compatible connectors.
   2. Ceramic ferrules and metallic connector bodies.
   3. Maximum insertion loss: 0.50 dB. Maximum insertion loss of 1.0 dB is acceptable with approval of the Engineer.
   4. Connector back reflection: greater than 35 dB.

B. Clean all connectors with alcohol wipes and a compressed cleaning gas.

C. Furnish and install new spider fan-out kits, to replace any existing fan-out kits that must be severed in order to make ST connections.

2.5 CLOSET CONNECTOR MODULE

A. Required in existing closet connection housings and hub shelters entered by fiber optic cables.

B. Characteristics:
   1. Six fibers per module.
   2. Six ST connectors.
   3. Six strand factory made single mode pigtail.
   4. Height equivalent to four rack units high.
   5. Mate with Siecor existing CCH-04U closet connector housing.
   6. Siecor CCH-CM06-61 or equivalent.

2.6 STAND ALONE VIDEO OPTICAL TRANSMITTER

A. Physical Characteristics
   1. Maximum Size: 8 inch x 4 ¾ inch x 1 ½ inch.
   2. Maximum Weight: 2.2 lbs.
   3. Mounting Holes: Four minimum.
   4. Package: High quality aluminum, complete enclosure.
   5. Indicators: LED type, neatly labeled and visible from mounted position.
   6. User Settings: No user adjustments or settings.

B. Electrical Characteristics
   1. Application: Single Fiber Uni-Directional RS-250C Medium Haul Video Transmitter with bi-directional RS-232 data.
   2. Modulation: Frequency Modulation or digital encoding.
   3. Data Connector: DB 9 F.
   4. Data Rate: up to 19.2 kbps, suitable for bursty data.

5. Bit Error Rate: 10-9 minimum over full optical range.
6. Video Connector BNC.
7. Power Consumption: 1-Watt maximum.
8. Video Signal to Noise: 50-dB minimum unweighted over full optical range.

C. Optical Characteristics
1. Physical: ST Type Connector.
2. Optical Range: 18 dB for Single Mode Fiber, 13 dB for multi-mode fiber.
3. Operating Wavelength: 1310 nm.
4. Backreflection: Tolerance of -35 dB.
5. Reliability: Laser Mean Time Between Failure 500,000 hours.

D. Compatibility: directly interchangeable.

2.7 RACK MOUNT VIDEO OPTICAL RECEIVER

A. Physical Characteristics
1. Maximum Size: 8 inch x 4 ¾ inch x 1 ½ inch.
2. Maximum Weight: 2.2 lbs.
3. Mounting: Sliding Rack Mount Card with retainers.
4. Package: High quality aluminum, complete enclosure, compatible with rack mounting chassis.
5. Indicators: LED type, neatly labeled and visible from mounted position.
6. User Settings: No user adjustments or settings.

B. Electrical Characteristics
1. Application: Single Fiber Uni-Directional RS-250C Medium Haul Video Receiver with bi-directional RS-232 data.
2. Modulation: Frequency Modulation or digital encoding.
3. Data Connector: DB 9 F.
4. Data Rate: up to 19.2 kbps, suitable for bursty data.
5. Bit Error Rate: 10-9 minimum over full optical range.
6. Video Connector BNC.
7. Power Consumption: 1-Watt maximum.
8. Video Signal to Noise: 50-dB minimum unweighted over full optical range.

C. Optical Characteristics
1. Physical: ST Type Connector.
2. Optical Range: 18 dB for Single mode fiber, 13 dB for multi-mode fiber.
3. Operating Wavelength: 1310 nm.
4. Backreflection: Tolerance of B35 dB.
5. Reliability: Laser Mean Time Between Failure 500,000 hours.

D. Compatibility: directly interchangeable.

2.8 RACK MOUNT CHASSIS

A. Width: Suitable for mounting in EIA Standard 19 inch rack.

B. Height: Not to Exceed 4 Rack Units.

C. Depth: Not to Exceed 12 inches.

D. Capacity: Ten Rack Mount Video Optical Receivers.

E. Engineering:
   1. Designed to retain ten rack mount cards and provide clear view of indicators and labels on cards.
   2. Designed to provide easy access to all optical and electrical connectors.

F. Power Supply:
   1. Suitable for powering ten rack mount video optical receivers.
   2. UL listed.
   3. Equipped with overcurrent protection, power on indicator lamp, and power on/off switch.

G. Line Cord: 6 ft IEC Standard.

H. Input Voltage: 90 to 135 VAC.

I. Input Frequency: 47 to 63 Hz.

J. Output Ripple: 120-mV peak to peak maximum.

K. Output Voltage: Compatible with rack mount video optical receivers over full input voltage range.

2.9 RS-232 SIGNAL DISTRIBUTION UNIT

A. General
   1. Unit feeds data from one RS-232 input communication port to ten RS-232 serial output data communication ports.
   2. Provide looping input for additional signal distribution units.
   3. Compatible with all system components.
   4. One LED indicator per channel.
   5. Maximum Size: 8 inch x 2 ½ inch x 5 ½ inch.

B. Environmental
   1. Temperature Range: 50 degrees F to 105 degrees F.
   2. Humidity: 0-90 percent non condensing.
   3. Weight: Less than 6.6 lb.

C. Power
   1. Input Voltage: Unregulated 15V dc, 800mA.
   2. Transformer: 110V ac, 25 watts.

D. Data Communications
   1. Data Signal Connectors: DB-9 mating, provided.
   2. Data Signal Cable: Belden 8102 or equivalent.
   3. Transmission Distance: Up to 1000 ft at 9600 Baud.
   4. Characteristics: 1 RS-232 input with pass through.
   5. RS-232 Outputs: 10.

E. Provide standard metal rack mount shelf with unit for installation in existing EIA Standard 19 inch rack.

2.10 TYPE A AND B FIBER OPTIC CABLE SPLICE ENCLOSURE

A. Type A: For locations with more than 48 splices.
   1. Six inch diameter by 22 inch long.
   2. One three section (six entry) end plate.
   3. One blank end plate.
   4. Two or more 36 fiber count fusion splice trays.
   5. All required accessories to complete the splice.
   6. End plates are suitable for use with Coyote closures.

B. Type B: For locations with up to 48 splices.
   1. Six inch diameter by 17 inch long.
   2. One three section (six entry) end plate.
   3. One blank end plate.
   4. Four 12 fiber count fusion splice trays.
   5. All required accessories to complete the splice.
   6. End plates are suitable for use with Coyote Pup closures.

C. General Requirements
   1. Capable of handling up to six cables in butt configuration without special adapters.
   2. Nonfilled (no encapsulate), to prevent water infusion.
   3. UL rated.
   4. External Shrader valve pressurization port.
   5. Able to reenter and reassemble without special tools.
   6. Contain mountings for splice organizer assemblies.

7. Contain space for excess or un-spliced cable.
8. Provide one future cable entry kit with each splice closure.
9. Meet Telcordia Technologies/Bellcore Testing Requirements GR771CORE.
10. Corrosion resistant aluminum and stainless steel hardware.
11. Suitable for straight, butt, or branch splices.
12. Packaged with all hardware necessary for completion of splice.
13. Provisions for strain relief around the cable jacket and internal cable strength members.
14. Enclosure accepts loose tube fiber optic cables.
15. Enclosure accepts up to six cable entries in a butt splice configuration and twelve cables for an inline configuration.
16. Enclosure has a permanent neoprene gasket seal.
17. Enclosure is re-enterable without special reentry kits.
18. Enclosure has premolded three section end plates with six cable entries.
19. End plates are interchangeable with each size of closure available from the closure supplier.
20. All closures, with captive closing hardware, are from the same supplier.
21. Provide glass-filled high-density thermoplastic enclosure shells that effectively withstand corrosion, high impact and freeze thaw stresses.
22. Use torque bars to secure, support and align end plates.
23. Provide enclosure with rubber tape for sealing around cables to provide a seal that compensates for expansion and contraction associated with temperature cycling.

2.11 SPLICE ENCLOSURE END PLATE

A. Replace existing plates at splice enclosures that are modified.

B. Suitable for use with Coyote Pup closures.

C. Three section (six entry) end plate.

2.12 FIBER OPTIC JUMPER

A. Single mode fiber.

B. 0.12 inch Kevlar outer jacket.

C. ST connector required on each end.

D. Determine length based on physical distance of run. Minimum length: 6 ft.

2.13 JUMPER STORAGE PANEL

A. Two rack units high.

B. Nineteen inches wide.

C. Designed for routing of fiber optic jumpers.

D. Matte black finish.

E. Siecor CSP-02U or equivalent.

F. Furnished with cover, mounting hardware, grommets and installation manual.

2.14 RS-422/RS-232 CONVERTER

A. Converts RS-422 data between the CCTV assembly and the video optical transceiver.

B. General
1. Transmits data at distances up to 3300 ft.
2. Operate in multipoint applications.
3. 2 or 4-wire operation.
4. Speeds up to 115.2 kbps.
5. Auto-transmitter enable: baud rates up to 64 kbps.
6. Selectable half-duplex turnaround delay.
7. Selectable RTS-CTS turnaround delay.
8. Echo suppression.
9. Bias enable.
10. Terminate/Reconnect option.
11. Externally selectable loop-back test feature.
12. Operation: 4 wire, half or full-duplex, 2-wire, half-duplex.
13. CE Approval: Yes.
14. Connectors: (1) DB25 F; (1) 4-screw terminal.
15. Power: 115 VAC, 60 Hz.
16. Max Size: 9 inch x 6 inch x 2 inch.
17. Max Weight: 1.1 lb.
18. Mean time before failure: 200,000 hours.

C. Environmental
1. Operating Humidity: 0 to 95 percent non-condensing.
2. Operating Temperature: 32 to 120 degrees F.
3. Storage Temperature: -40 to 160 degrees F.

D. Interface A:
   1. RS-232 DTE/DCE selectable.
   2. Connectors: DB25 Female.
   3. Data Rate: Data rate is transparent up to 115 kbps.
   4. Distance: Standard EIA specifications apply.
   5. Leads: 2 thru 8 and 20.

E. Interface B:
   1. RS-232 or RS-485.
   2. Connectors: 4 position screw down terminal strip.
   3. Data Rate: Transparent.
   4. Distance: 4,000 ft. based on 24 AWG UTP low capacitance cable.
   5. Leads: TX+, TX-, RX+, RX-.

2.15 FIBER OPTIC SPLITTER

A. Splits the signal from a fiber optic video transmitter to two different destinations, with the following characteristics:
   1. Compatible with single mode fiber.
   2. 50:50 split of video signal, or weighted ratio as specified.
   3. Maximum dB loss of 3.6 dB.
   4. ST connectors.

2.16 COMMUNICATION SHELTERS

A. Provide prefabricated controlled environmental shelters with an alarm system for remote monitoring.

B. Construction:
   1. Materials: Solid concrete with steel rebar reinforcement. Solid heavy duty steel doors and locks. Reinforcing Steel ASTM A615-85, Grade 60.
   2. Structure: No seams below ground level. Minimum concrete compressive strength: 5000 psi at 28 days.
   3. Design Load: meet or exceed State of Utah Building Codes.
   4. Interior Dimensions: 11 ½ ft wide by 16 ½ ft long by 10 ft high.
   5. Interior Area, Volume: 190 ft^2, 1900 ft^3.
   6. Door Opening: 5 ft wide x 6 1/2 ft high.

C. Environmental
   1. Air Conditioning: 30,000 BTU HVAC system.
   2. Heater: 10 kW.
   3. Lighting: Interior four dual tube fluorescent fixtures, 40W lamps. Exterior 100W incandescent lamp.

D. Electrical
   1. 120/240 volts, single phase, 100 amps with 10 branch circuits.
   2. 100 amp generator input connector.
   3. Auto alarm system for high temp, smoke, power loss, and intrusion.
   4. Alarm terminal block.
   5. Interior copper ground bar assembly with two through wall ground sleeves.
   6. Four hour timer switch for lighting.

E. Mechanical
   1. In floor cable entry opening.
   2. Magnetic door switch with alarm.
   3. Electro-mechanical environmental control panel with manual override.
   4. Automatic high limit override.
   5. Wall mounted CO2 fire extinguisher.

PART 3 EXECUTION

3.1 INSTALLERS

A. Complete a three-day course on the installation, splicing and testing of fiber optic cable.
   1. Course: conducted by the supplier of the fiber optic product or established education provider.
   2. In house and on the job training is not acceptable.

B. Demonstrate two years total and one year continuous work experience with the splicing, termination, and testing of fiber optic cable.

C. Perform all work with qualified staff.

3.2 FIBER OPTIC CABLE INSTALLATION REQUIREMENTS

A. Notify the Engineer 48 hours in advance of fiber optic cable installation into any existing conduit or building facility.

B. The Engineer will initiate special inspection procedures to verify the condition of existing communications facilities. Such inspection may be observed by the Contractor.

C. Perform all work in facilities (e.g. conduits, junction boxes, cabinets and buildings) containing Department's existing communications equipment only in the presence of Department's representative.

D. Restore Contractor damaged facilities within 48 hours.

E. Lubricate cable with a lubricant designed for fiber optic cable installation.

F. Use shear pins or other failsafe means to prevent exceeding the maximum cable pulling tension specified by the cable manufacturer.

G. Maintain the following minimum bend radiuses:
   1. Twenty times Cable Diameter Short Term During Installation.
   2. Ten times Cable Diameter Long Term Installed.

H. Maintain the following slack requirements:
   1. Vaults: 70 ft.
   2. All Junction Boxes: 35 ft.
   3. Cabinets: 15 ft.

I. Replace any fiber optic cable segment not meeting the requirements of the specifications in its entirety between splice points shown on the plans.

J. Place the locator wire in the dedicated ¾ inch conduit as shown in the plan details.

3.3 FIBER OPTIC CABLE PREPARATION

A. Remove the jacket without damaging buffer tubes.

B. Carefully expose the fibers by removing the buffer tube with a special tool.

C. Clean the fibers and buffer tubes using a solvent designed to remove all water blocking gel from each exposed fiber.

D. Solvent requirements:
   1. Must not remove any color from individual fibers or buffer tubes.
   2. Not harmful to the polyethylene cable jacket.

E. Cleave fiber strands using a cleave tool meeting the following requirements:
   1. Ability to cut the individual fibers as close to a perfect 90 degree angle as possible.
   2. With minimum end angle averages that are less than 0.70 degree with no cuts exceeding 1.5 degrees.

3.4 ENTRY AND REENTRY OF FIBER OPTIC SPLICE CLOSURES

A. Perform all work in a suitable environment free from excess dust and moisture. Acceptable environments to work on splice closures include office type environments in buildings, splice trailers, and splicing tents with floors.

B. Do not perform fiber splicing, testing, or connecting in freezing temperatures.

C. Do not expose open splice closures and fiber ends to rain, snow, or wind-blown dust.

3.5 FUSION SPLICING

A. All fiber splicing: fusion splice method.

B. Connectors: factory made connector and pigtail or drop cable assemblies.

C. Field polishing of connectors: Not acceptable.

D. Perform fusion splices with the following:
   1. Equipment with automatic fiber alignment and automatic light injection with detection devices or profile alignment algorithms to estimate splice losses.
   2. Provide splice closure as a protection for all splices and stripped cable.
   3. House all splices in splice trays or organizers.
   4. Use glass capillaries, heat shrink tubing, or silicone sealant to provide additional protection and strain relief.
   5. Maximum splice loss allowance is 0.20 dB.

E. Install new splice enclosure end plates at each location where there is a new fusion splice in an existing splice enclosure per manufacturer's recommendations.

3.6 FIELD QUALITY CONTROL TESTING

A. Receiving Test
   1. Fibers Tested: Normally, one strand per buffer tube. Test every strand when evidence of physical damage exists or when any damaged strand is found.
   2. Light Frequency: 1310 nm and 1550 nm.
   3. Direction: Unidirectional.
   4. Location of test: Contractor's yard.
   5. Test after receiving material, before releasing to installation crew.
   6. Tested by: Qualified Contractor Staff.

7. Cable meets factory attenuation specifications.
    a. Cable attenuation 0.4 dB/km at 1310 nm.
    b. Cable attenuation 0.25 dB/km at 1550 nm.
    c. Strand lengths are consistent.
    d. Launch Transition < 6 dB.
    e. No event > 0.30 dB.
8. Trace available for one strand in every buffer tube in the cable.

B. Post Blowing/Pulling - Pre Splicing Test
1. Fibers Tested: Normally, one strand per buffer tube. Test every strand when evidence of physical damage, excessive pulling tension, kinks exists, or when any damaged strand is found.
2. Light Frequency: 1310 nm and 1550 nm.
3. Direction: Unidirectional.
4. Location of test: One field location for each cable installed.
5. Test after installing cable in duct but before splicing.
6. Tested by: Qualified Contractor Staff.
7. Witnessed/Approved by: Department inspector may witness and must approve before splicing.
8. Acceptance Criteria:
    a. Cable attenuation 0.4 dB/km at 1310 nm.
    b. Cable attenuation 0.25 dB/km at 1550 nm.
    c. Strand lengths are consistent.
    d. Launch Transition < 6 dB.
    e. No event > 0.30 dB.
9. Trace available for one strand in every buffer tube in the cable.

3.7 CABLE LABELING REQUIREMENTS

A. Label all fiber optic cables with a high quality permanent label, indicating the street name or location and type of circuit (drop cable, distribution, backbone-96 count).

B. Use Panduit MP-150-C or equivalent.

3.8 INSTALLATION OF HUB FIBER EQUIPMENT

A. Install all Hub equipment in accordance with the plans and the equipment manufacturer's recommendations.
1. Provide all mounting hardware and incidental materials, including fasteners, shelves, and brackets.
2. Provide surge protected power strips as needed for all equipment installed in buildings.

B. To gain access to the ATMS Hub, contact the Engineer at least ten working days prior to the time access is needed.

C. The Department may elect to have personnel present in Hub during any activity.

D. Install RS-232 Signal Distribution Unit securely on new shelf on existing rack at location indicated in plans.

E. Install Rack Mount Video Optical Transceivers in rack mount chassis on existing rack at location indicated in plans.

3.9 INSTALL FIELD FIBER COMMUNICATION EQUIPMENT

A. Install field communication equipment in existing signal cabinets as shown in the plans.
   1. Equipment includes stand alone video optical transmitters, field fiber optic data modems, and RS-422/RS-232 converters.
   2. Install equipment in accordance with the equipment manufacturer's recommendations, including mounting, interconnection wiring, electrical service, all mounting hardware and incidental materials, including fasteners and brackets.
   3. Provide all surge protected power strips for all equipment installed.
   4. Install equipment on existing shelf space in cabinets.

ATMS Fiber Optic Continuity Test Form						
Light Source Location	**Channel**	**Source to Strand Number**	**Power Meter Location**	**Meter to Strand Number**	**Power Meter Reading (dBm)**	**On/Off (yes or no)**

END OF SECTION

SECTION 16135

ELECTRICAL JUNCTION BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical junction boxes and extensions, including maintenance markers.

1.2 RELATED SECTIONS

A. Section 02056: Common Fill

B. Section 02061: Select Aggregate

C. Section 02842: Delineators

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 183: Structural Steel. (Metric)

C. ASTM D 256: Determining the Pendulum Impact Resistance of Notched Specimens of Plastics

D. ASTM D 543: Evaluating the Resistance of Plastics to Chemical Reagents

E. ASTM D 635: Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

F. ASTM D 638: Tensile Properties of Plastic

G. ASTM D 648: Deflection Temperature of Plastics Under Flexural Load

H. ASTM D 790: Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

I. AWS D 1.5

PART 2 PRODUCTS

2.1 PLASTIC JUNCTION AND PULL BOXES

A. Plastic body and cover meeting the physical and chemical requirements listed in Table 1 and the following:
   1. All components constructed of a high density polyethylene with ultraviolet inhibitors.
   2. Non-skid surface on lid required.
   3. Vandal resistant recessed bolts.
   4. Capacity to support a 6 ¼ inch diameter load of 5,000 lbs with a maximum lid deflection of 1 inch.
   5. Withstand a 7940 lb wheel load without cracking.

B. Minimum wall thickness of ¼ inch.

C. Self-extinguishing when tested by the industry standard. ASTM D 635.

D. Show no appreciable change in physical properties when exposed to the weather.

Table 1

Properties	ASTM Test	Value
Tensile Strength	D 638	4,300 psi
Flexural Modulus	D 790	190,000 psi
Defection Temp at 66 psi	D 648	165 degrees F.
Notched Impact	D 256	*0.107 N/m/mm*
Effect of Acids	D 543	Very Resistant
Effect of Alkalies	D 543	Very Resistant

E. Mark the junction box lid in the logo area with 1 inch letters:
   1. "Traffic Signal" when the junction box contains traffic signal conductors with or without street lighting conductors.
   2. "Street Lighting" when the junction box contains street lighting conductor only. Inscribe "High Voltage" below the words "Street Lighting" when the junction box contains voltage above 600 V.

3. “Communication” when the communication conduit is in the junction box.
4. “Sprinkler Control” when the sprinkler control conduit enters the junction box.
5. “Count Station” when the traffic count station conduit enters the junction box.

F. All ferrous metal parts: minimum chromium content of 18 percent and a minimum nickel content of 8 percent.

2.2 STEEL JUNCTION BOX

A. Provide galvanized steel junction box with welds as specified.

B. Meet requirements of:
1. AASHTO M 183
2. AWS D 1.5
3. AASHTO M 111

2.3 DUCT CAULKING

A. For junction boxes: waterproof, rodent proof, non-corrosive, non-oxidizing, and non-hardening when subject to temperatures ranging from -15 degrees F to 150 degrees F.

2.4 MAINTENANCE MARKERS

A. At junction box.

B. Steel posts: Refer to Section 02842.

2.5 BACKFILL

A. Free draining granular backfill borrow. Refer to Section 02061.

B. Granular backfill borrow. Refer to Section 02056.

PART 3 EXECUTION

3.1 INSTALLATION

A. Place the top of junction boxes flush with adjacent surface.

B. Junction box and extension:
   1. Holes drilled in junction box must not be more than 1/4 inch larger than conduit diameter. Seal conduit ends inside all non-metallic junction boxes with at least 2 inches thick duct caulking after wires are installed.
   2. Hand tamp the granular backfill borrow material around the junction box. Match the top 4 inches to the composition, density, and elevation of the surrounding surface.

END OF SECTION

SECTION 16525

HIGHWAY LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing lighting for highway, understructure, sign, bridge, parking lot, and other lighting systems.

1.2 RELATED SECTIONS

A. Section 02741: Hot Mix Asphalt (HMA)

B. Section 02842: Delineators

C. Section 02892: Traffic Signal

D. Section 03055: Portland Cement Concrete

E. Section 03211: Reinforcing Steel and Welded Wire

F. Section 03575: Flowable Fill

G. Section 05120: Structural Steel

H. Section 09972: Painting for Structural Steel

I. Section 16135: Electrical Junction Boxes

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 183: Structural Steel

C. AASHTO Standard Specification Structures Supports for Highway Signs, Luminaires, and Traffic Signals (current edition)

D. ASTM A 123 (Cabinet): Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

E. ASTM A 307: Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

F. ASTM A 570, Grade 33: Steel, Sheet and Strip, Carbon Hot-Rolled Structural Quality

G. ASTM A 576: Steel Bars, Carbon, Hot Wrought, Special Quality

H. ASTM B 3: Soft or Annealed Copper Wire

I. ASTM B 8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

J. ASTM B 29: Refined Lead

K. ASTM B 117: Operating Salt Spray (Fog) Apparatus

L. ASTM B 766: Electrodeposited Coatings of Cadmium

M. American Iron & Steel Institute (AISI)

N. American National Standards Institute (ANSI)

O. American Wire Gauge

P. Insulated Power Cable Engineers Association (IPCEA) Standards

Q. ITE/ANSI Lamp Codes

R. National Electric Code (NEC)

S. National Electrical Manufacturers Association (NEMA)

T. National Fire Protection Association (NFPA)

U. Standard Specifications for Construction and Bridges on Federal Highway Projects

V. Underwriters Laboratories (UL)

1.4 SUBMITTALS

A. Samples of all materials.

B. Wiring schematics, detailed shop drawings, and certifications within 15 calendar days after receiving the Notice to Proceed.

C. Manufacturer's warranties, guarantees, instruction sheets, and parts lists.

D. List of equipment and materials including name of manufacturer, size, and identification numbers. (Within calendar 15 days after receiving the Notice to Proceed).

1.5 QUALITY ASSURANCE

A. Electrical components must conform to the requirements of the National Electrical Code. (NEC)

1.6 ACCEPTANCE

A. Lighting Warranties and Guarantee
   1. The notice of acceptance for highway lighting work is not given until six months after the date of the inspection.
   2. During this period, all manufacturer's warranties and guarantees on Contractor- furnished electrical and mechanical equipment are enforced.
   3. At the end of the period and after all electrical and mechanical defects within the scope of warranties and guarantees are corrected, the Engineer makes written acceptance of the work completed and relieves the Contractor of further responsibility for that portion of the project.
   4. Partial acceptance does not void or alter any terms of the Contract

B. The six-month warranty period for lighting does not affect the processing of a semi- final estimate when the Contract is 95 percent or more complete, or after completion of work on the project.

PART 2 PRODUCTS

2.1 MATERIALS

A. Wire and Cable: As per American Wire Gauge.

B. Conductors:
   1. Wire up to 600 V: Single-conductor, copper cable with cross-link polyethylene insulation per ASTM B 3 and B 8, RHH-USE-RHW, as specified.
   2. Cable above 600 V: Conform to NEMA WC7. Single-conductor, stranded copper with full concentric neutral as specified.

C. Ground wire: Bare, soft-drawn copper wire per NEC 250-1, as specified.

D. Ground Rod: Copper-coated steel per ANSI/UL 467, as specified.

E. Insulation: RHH-USE-RHW grade crosslink polyethylene compound.

F. Splicing: Compression splice compatible with individual cable insulation and water seal for underground use. Comply with UL code.

G. Conduit: as indicated.
   1. Schedule 40 PVC and 80 PVC conduit and fittings rated at 200 degrees F as specified. NEMA TC-2/TC-3 UL.
   2. Galvanized rigid steel conduit and fittings as specified. Meet ANSI C 80.

2.2 JUNCTION BOXES

A. Refer to Section 16135.

2.3 POWER CABLE ROUTE MARKER

A. Meet ASTM B 29, alloy 5052-H38. 0.08 inch thick sheet aluminum as specified.

B. White and red enamel paint: Refer to Section 09972.

C. Mounting hardware: Refer to Section 05120.

D. Flanged channel mount post: Refer to Section 02842.

2.4 SPLICE, MOLDED CONNECTOR, AND FUSE HOLDER

A. Use individually insulated and water sealed compression splice.

B. Use spring-loaded, molded connector and fuse holder with 90 percent minimum conductivity as per ANSI/UL 486A, as specified.

2.5 FUSE

A. 600 V current limiting with 200,000 A interrupting rating. Meet UL Class CC.

B. Light pole fuses with rating according to Table 1.

Table 1

Voltage	Wattage	Current (Amps)
120	250/400	20
208/240	250/400	15
277/480	250/400	10

C. Lighting Circuit Fuses: Meet UL Class RK5, as specified.

D. Service Disconnect Fuses: Meet UL Class R, as specified.

2.6 POLES - GENERAL

A. Use tapered steel poles per SL Series Standard Drawings and AASHTO Standard Specifications Structural Supports for Highway Sign, Luminaires and Traffic Signals (current edition).

B. Galvanized per ASTM A 123, as specified.

C. Performance criteria:
1. Wind load: 80 mph wind with 105 mph gusts.
2. Designed for luminaire weight of 77 lbs with projected area of 3.0 ft^2.
3. Maximum allowable deflection of 4-3/4 inch (Deflection criteria is based on a 100 lb horizontal load applied at 6 inches below shaft top).

D. Pole designated for decorative lighting:
1. Provide a festoon outlet located 16 ft from the base plate with duplex receptacle and weather-proof cover.
2. As per UL Listed.

E. Light Pole Numbers:

1. General:

   a. Use 3 inch, Series C legend, green reflectorized sheeting as specified, with 1-inch vertical spacing between letters. The legend should read from top to bottom.

   b. Use 4 inch wide, white reflectorized sheeting as specified for legend backing.

   c. Meet Standard Specification for Construction and Bridges on Federal Highway Projects, FP-92 type III Flexible, for reflective sheeting.

2. Mainline Lighting:

   a. Use mile marker to two decimal places for light pole identification (ID) number and a letter to show which circuit it is attached to.

   b. Example:

3	For light pole at mile marker 302.22
0	
2	
2	
2	
A	

3. Ramp Lighting:

   a. Specify the light pole ID number consisting of the following components: the exit number, the general direction (of the ramp, collector, or frontage), the light pole number in a series numbered in the direction of travel, and a letter to identify the electrical circuit.

   b. Use the following legend codes:

E = east	C = collector
W = west	F = frontage
N = north	
S = south	

   c. Example:

3	34 indicates exit number 34, WCN identifies
4	a westbound to northbound collector ramp,
W	2 designates the second pole in a series,
C	and the B references the electrical circuit.
N	
2	
B	

F. Foundation:

1. Concrete: AA (AE). Refer to Section 03055.
2. Coated reinforcing steel. Refer to Section 03211.
3. Anchor bolts: Galvanized steel per ASTM A 307 and ASTM A 123.

2.7 POLES - MOUNTING HEIGHT UNDER 45 FEET

A. Allowable stresses for steel, as specified, except increased 40 percent for Group II and Group III loading. Meet ASTM A 570, Grade 33.

B. Breakaway base: SL Series Standard Drawings

C. Steel Base Plate: Type NS

D. Anchor bolts:
   1. Meet ASTM A 307 and A 123.
   2. Minimum yield strength of 47,800 psi, as specified.

E. Slip bolts:
   1. Cadmium-plated Type NS
   2. With nuts and washers

2.8 POLES - MOUNTING HEIGHT OVER 45 FEET (HIGH MAST)

A. Allowable steel stresses as specified. Meet ASTM A 570, Grade 33.
   1. F_b = 21,750 psi (0.66 F_y)
   2. Fv = 10,900 psi (0.33 F_y)

B. Steel base-plate. ASTM A 570, Grade 36, as specified.

C. Anchor bolts: Minimum yield strength of 55,000 psi as per ASTM A 576, as specified.

D. High mast service hoist assembly:
   1. Head frame: zinc, electroplated with yellow chromatic dip after fabrication, and a head frame cover of spun aluminum, and with six each 5 inches cast aluminum hoist cable sheaves with oil-impregnated, sintered-bronze bushings with stainless steel shaft.
   2. Aircraft cables: three each stainless steel ¼ inch x ¾ inch strand (minimum 3/16 inch).
   3. Latch shaft, cam, and hardware: stainless steel.
   4. Luminaire support ring: minimum 7-gauge galvanized steel; rising rate of at least 12 ft/min.
   5. Power cable sheaves: minimum 6 inch diameter, brushed with oil-impregnated, sintered-bronze bushings with a stainless steel shaft.
   6. Centering arm: roller-contact, spring-loaded, water-resistant, non-marking roller on stainless steel shaft.
   7. Winch: worm-gear driven, self-locking, with reversing electric motor.

E. Portable drive unit, UL Listed as heavy duty, reversing, with torque limiter, and 125 V transformer.

2.9 LUMINAIRE

A. As specified, with die cast aluminum top housing, pre-wired integral ballasts with quick disconnect plugs mounted for ease of removal.
   1. Reflectors, sockets, mounting cradles, and clamps fitted to upper housing.
   2. Optical assembly: formed aluminum reflectors with a chemically bonded, non-breakable, glass finish.
   3. Adjustable mogul base sockets: split-shell, tempered-brass, lamp grips, free-floating, spring-loaded, center contacts, and heat- and impact-resistant glass prismatic refractors.
   4. Weight: No more than 77 lbs with a projected area of not more than 3 ft^2.
   5. Mounting adjustment: Not less than 10 degrees above a horizontal position on reflector and refractor, and not less than 5 degrees of adjustment from a vertical position on the bracket arm.
   6. Glare shields: Steel or aluminum, when indicated on the plans.

B. High mast luminaire: UL 1572, and as specified.
   1. Symmetrical or asymmetrical with the asymmetrical capable of a 360 degrees rotation.
   2. Cast aluminum ballast, slipfitter mounts with adjustment of at least 3 degrees.
   3. Optical assembly: Enclosed and filtered, with heat and impact resistant tempered glass lens.

C. Understructure luminaire: NEMA FA1-1973R1979, and as specified.
   1. Specifically designed for understructure application.
   2. Die-cast aluminum housing, vandal-proof fastener, integral ballast.
   3. Optical assembly: heat- and impact-resistant, tempered glass lens, stainless steel lens guard.
   4. Adjustable sockets for minimum 60-degree beam angle.

D. Sign bridge luminaire: NEMA FA1-1973R1979, and as specified.
   1. Die-cast aluminum housing, die-cast aluminum door and integral glare shield, single piece, closed-cell gasket. Immunity to rain and snow damage.
   2. 1-3/16 inch conduit clamp support.
   3. Refractor: shock-and thermal-resistant, borosilicate, prismatic. Designed specifically for sign illumination.
   4. Integral ballast.

2.10 LUMINAIRE BALLASTS

A. Meet ANSI C82.4, C82.6 and C92.1; and ANSI/UL 1029.

B. High pressure sodium ballast.
   1. Power Factor: must maintain 90 percent for nominal secondary load, and a least 70 percent for any 10 percent voltage variation.
   2. Lamp Wattage: maintain no more than 5 percent variation.
   3. Regulation: maintain no more than 35 percent for 10 percent line-voltage variation.
   4. Must start and operate at the rated lamp wattage at ambient temperatures down to -40 degrees F for the rated life of the lamp.
   5. Must sustain lamp operation for a minimum of 4 seconds at a voltage dip of 35 percent.

C. Mercury and Metal Halide Ballast.
   1. Power Factor: minimum of 90 percent for a 10 percent voltage variation.
   2. Lamp Wattage: no more than 5 percent variation.
   3. Regulation: maintain no more than 30 percent for 10 percent line-voltage variation.
   4. Must start and operate at the rated lamp wattage at ambient temperatures down to -13 degrees F for the rated life of the lamp.
   5. Must sustain lamp operation for a minimum or 4 seconds at a voltage dip of 40 percent.

2.11 LAMP

A. Heavy duty, long life incandescent (I) lamp, as specified. Meet ITE/ANSI lamp codes: I, M, H, and S.

B. Phosphor-coated mercury (M) lamp that uses or has:
   1. Apparent color temperature of 3300 K.
   2. CIE chromaticity of X = 0.410, Y = 0.385.
   3. Rated life of no less than 24,000 hours at 10 hours per start-up.

C. Phosphor-coated metal halide (H) lamp that uses or has:
   1. Correlated color temperature of 3800 K.
   2. CIE chromaticity of X = 0.390, Y = 0.388.
   3. Rated life of no less than 15,000 hours at 10 hours per start-up.

D. Clear high pressure sodium (S) lamp that uses or has:
   1. Apparent color temperature of 2100 K.
   2. CIE chromaticity of X = 0.512, Y = 0.420.

3. Rated life of no less than 24,000 hours at 10 hours per start-up.

2.12 SERVICE DISCONNECT SWITCH

A. Meet NEMA 3R K91, Type HD.

B. 100 A Service disconnect switch with padlock, as specified.

C. Circuit Breaker
   1. 10,000 A interrupting rating for 240 V.
   2. 5,000 A interrupting rating for 480 V.

2.13 CONTROL EQUIPMENT

A. Photocell control units.
   1. Meet ANSI 136.10, NEMA Base.
   2. Solid state photo cells that match input voltage, minimum 1800 VA capacity.
   3. Crystal sensing devices with inverted turn-on and turn-off features.
   4. Fail safe in the "on" position. Turns on at 32 Lx " 10 percent.
   5. Dedicated, inverted, control circuits with turn-off values of 19 lx "25 percent.
   6. Time delay range of 5 seconds to 10 seconds.
   7. Minimum 236 ft/lb metal oxide varistor lighting arrestors.
   8. Secondary sensor diodes and transient filters.
   9. Flame-retardant, high-impact covers, and acrylic windows with ultra-violet stabilizers.
   10. Clip voltage at 400 V.

B. Lighting contactor:
   1. Hermetically sealed, steel tube mercury contacts.
   2. Manually operated, mechanically held contact.
   3. Remote, or photoelectric-operated, magnetic, electrically held contactor.
   4. Three-position slide selector with "on-off-auto" switch.

C. Control Relay: Meet ANSI/IEEE C37.13, C37.27 and C62.41.
   1. Contact rating of 3,000 W minimum.
   2. Normally open.
   3. Multiple relay: Zinc/di-chromate-plated magnet; Class B insulation rating coil; Cadmium oxide contact, dual expulsion gap lightning arrester; valve type line arrester with no less than 650 V rating.

D. Enclosure: NEMA 3R Type 4. Encase in a cabinet with padlock as specified.

E. Circuit breaker UL rated at:
   1. 240 V at 10,000 A interrupting rating.
   2. 480 V at 5,000 A interrupting rating.

2.14 SUBSTATION

A. ANSI C57.12.25 and C57.27 NEMA 260 (cabinet) as specified.

B. 480 V secondary power, IOCA oil coolant, 150 degrees F temperature rise, 60 Hz frequency, "2½ percent voltage compensation taps.

C. Foundation: Follow SL Series Standard Drawings

2.15 UNDERGROUND SERVICE PEDESTAL

A. Meet ASTM B 117, A 123 (cabinet), UL E-50076 as specified.

B. Galvanized Steel: Enclosure 0.12 inch, covers 0.08 inch. Meet ASTM A 123.

C. Bottom access opening; detachable, pad mount base; baffled ventilation louver.

D. Paint: Meet ASTM B 117. Environmental green, baked enamel over zinc-chromate primer as specified.

E. Circuit Breaker: Main, with six space metered bus and six space unmetered bus.

F. Meter socket with safety socket test blocks.

2.16 CONCRETE

A. Concrete: Class AA (AE) Section 03055

B. Hot Mix Asphalt: Section 02741

C. Flowable Fill: Section 03575

2.17 HARDWARE

A. Screws: Stainless steel.

B. Nuts, bolts, and washers:
   1. Galvanized: ASTM A 123
   2. Cadmium-plated: ASTM B 766

3. Type NS, as specified

C. Mounting bands and buckles: stainless steel, ¾ inch wide, from 0.020 inch to 0.022 inches thick meeting AISI, Type 201.

D. Padlock: Master, No. P-848.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate utility locations. Refer to Section 00727.
   1. Contact the appropriate power company at least 30 days before the desired connection date.
   2. Verify the exact location, voltage, procedures, and material required by the appropriate power company.

B. Saw cut concrete or other improved surface that requires removal in the sidewalk area. Replace with in-kind material to match the existing grade.

C. Load, transport, and install State-furnished material.

3.2 POLE FOUNDATION

A. Construct foundation following SL Series Standard Drawings.

B. Do not weld reinforcing steel, conduit, or anchor bolts.

C. Tie reinforcing steel and conduit securely in place.

D. Place the concrete directly into the excavation. Use minimum forming.

E. Align and secure anchor bolts or extensions with a template.

3.3 CONDUIT TRENCHING

A. Refer to Section 02892.

B. Conduit offset from roadway by more than 20 ft may be installed by plowing.

C. Installing high voltage power cable (exceeding 600 V);
   1. Trench should be no more than 18 inches wide and at least 3 ft deep.
   2. Place 3 inches of sand in the bottom of trench before installing cable.

3. Cover the power cables with at least 6 inches of sand.

3.4 INSTALL CONDUIT

A. Refer to Section 02892.

3.5 INSTALL WIRING

A. Refer to Section 02892.

B. Install molded connectors on the cable so that the load side retains the fuse when it is disconnected at the cable's breakaway point.

C. When splicing, use compression or split bolt, and waterproof as specified, meeting UL Listed.

D. When using 600 V or higher power cable:
   1. Provide a manufacturer's certified plot of X.Y. partial discharge.
   2. Perform a high-voltage DC field test per the industry standard before connecting to the high voltage power source.
   3. Must meet Insulated Power Cable Engineers Association (IPCEA) standards.

3.6 INSTALL CONDUCTOR

A. Install wiring in accordance with the appropriate articles of NFPA 70. Neatly arrange wiring within cabinets, junction boxes, etc.

3.7 INSTALL LUMINAIRES AND BALLASTS

A. Immediately prior to installation, clean all light control surfaces, refractors, and reflectors to provide the maximum lumen output possible. Clean in accordance with the luminaire manufacturer's recommendations.

B. Adjust luminaires with a level.

C. Adjust sign bridge luminaires for optimum and uniform light distribution.

D. High mast luminaire:
   1. Employ a representative from the luminaire company to optimize the light pattern.
   2. Obtain manufacturer's certification that the service hoist operation is correctly installed.

3.8 INSTALL POWER SOURCE CONNECTION

A. Install the grounded neutral conductor from secondary power source to the switch box.

B. Install mounting bracket within 1 ft of both top and bottom of the switch box and within 3 ft of other cabinet or fitting.

C. Provide and install material required by the appropriate power company.

D. Install padlock on the switch box door and handle.

3.9 INSTALL SUBSTATION

A. Refer to SL Series Standard Drawings.

B. Locate foundation in a well-drained area.

C. Dig a trench and backfill for the primary power cable.

D. Install padlocks on doors.

3.10 PHOTO-ELECTRIC CONTROL

A. Adjust to "North Sky" position.

3.11 POLE

A. Refer to SL Series Standard Drawings.

B. Center the shaft top over the center of the foundation after the arm extension, luminaire, and all accessories are in place or per the manufacturer's requirements.

C. Install pole identification numbers at a 45 degree angle to approaching traffic. Remove old identification numbers without damage to galvanizing.

D. Torque:
   1. Anchor bolts to 11 lb/ft.
   2. Slip bolts to 8 lb/ft, release, and re-torque to 6 lb/ft.

E. When installing items on a pole:
   1. Do not drill steel pole.

2. Use stainless steel mounting bands.

3.12 FIELD QUALITY CONTROL (ACCEPTANCE TESTS)

A. Continuity of grounding conductor to maintain 1,000 watt load at circuit ends, maintaining 95 percent of supply voltage.

B. Test for grounds in each circuit.

C. Insulation resistance of supply conductor to ground shall be no less than 40 MΩ (500 V megger meter test).

3.13 SALVAGE

A. Remove equipment to be reused or salvaged carefully so that it remains in the condition existing prior to its removal.

B Pole assembly remains the property of the Department. Transport to the location specified.

C. Remove luminaire, arm, and conductor.
1. Grease and reinstall fastener.
2. Remove foundation to a depth of 6 inches below the existing surface and backfill with local material.
3. Dispose of discarded junction box. Backfill with local material and compact to match adjacent area.

END OF SECTION

SECTION 16526

ELECTRICAL WORK BRIDGES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing bridge electrical work.

1.2 REFERENCES

A. AASHTO M 55: Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

B. ASTM A 123: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

C. ASTM A 153: Zinc Coating (Hot-Dip) on Iron and Steel Hardware

D. ASTM A 307: Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

E. ASTM B 766: Electrodeposited Coatings of Cadmium

F. National Electrical Manufacturers Association (NEMA)

G. Underwriters Laboratory (UL)

PART 2 PRODUCTS

2.1 ELECTRICAL EQUIPMENT

A. Use equipment conforming to the applicable standards:
   1. National Electrical Manufacturer's Association (NEMA)
   2. Underwriters Laboratories, Inc. (UL)
   3. Electronic Industries Association (EIA)
   4. Any local ordinances.

2.2 ANCHOR BOLTS, WASHERS, AND NUTS

A. For light poles:
   1. ASTM A 307
   2. Hot-dip galvanize after fabrication. ASTM A 153

B. Other Bolts and Anchors:
   1. ASTM A 307
   2. Electro-plated cadmium. ASTM B 766

2.3 CONDUIT AND FITTINGS

A. When the conduit is totally enclosed within concrete, use schedule 40 PVC conduit and fittings rated at 190 degrees F as specified.
   1. NEMA TC-2
   2. NEMA TC-3
   3. UL Listed

B. When the conduit is attached to the exterior surface of the structure, use galvanized rigid steel conduit and fittings as specified.
   1. Manufacture from mild steel, wrought iron, or silicon-bronze with no less than 1.25 percent silicon.
   2. UL 6
   3. ASTM A 123

2.4 JUNCTION BOXES

A. Use hot dip galvanized cast iron junction boxes of standard manufacture, free of honey comb and other defects, approved by UL as watertight, and suitable for outdoor use for high voltage applications. AASHTO M 55.

B. Use boxes a minimum size of 12 inch x 8 inch x 6 inch or of the size and type shown on the plans.

C. Hold the cover rigidly in place by screws or bolts manufactured of a non-corrosive material.

2.5 WORKMANSHIP

A. Conform to the requirements of the National Electric Code and any local ordinances that may apply.

B. Place the anchor bolts accurately. Do not bend the anchor bolts or ream the holes in the base plate.

2.6 LEAD-IN WIRES

A. Install all conduit segments with 10 gauge galvanized steel wire for future use as "lead-in" wire for electrical conductors.

B. Use wire 6 ft longer than the conduit segment.
   1. 3 ft coiled at the junction box.
   2. 3 ft folded back into the terminus of the conduit so it is easily accessible for future use.

PART 3 EXECUTION Not used

END OF SECTION

End of 2004 Standard Specifications