

Control	6462-66-001
Project	RMC - 646266001
Highway	US0059
County	FORT BEND

ADDENDUM ACKNOWLEDGMENT

Each bidder is required to acknowledge receipt of an addendum issued for a specific project. This page is provided for the purpose of acknowledging an addendum.

FAILURE TO ACKNOWLEDGE RECEIPT OF AN ADDENDUM WILL RESULT IN THE BID NOT BEING READ.

In order to properly acknowledge an addendum place a mark in the box next to the respective addendum.

- ADDENDUM NO. 1
- ADDENDUM NO. 2
- ADDENDUM NO. 3
- ADDENDUM NO. 4
- ADDENDUM NO. 5

In addition, the bidder by affixing their signature to the signature page of the proposal is acknowledging that they have taken the addendum(s) into consideration when preparing their bid and that the information contained in the addendum will be included in the contract, if awarded by the Commission or other designees.

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PROPOSAL TO THE TEXAS TRANSPORTATION COMMISSION

2014 SPECIFICATIONS

WORK CONSISTING OF ASPHALT PAVEMENT REPAIR FORT BEND COUNTY, TEXAS

The quantities in the proposal are approximate. The quantities of work and materials may be increased or decreased as considered necessary to complete the work as planned and contemplated.

This project is to be completed in 365 calendar days and will be accepted when fully completed and finished to the satisfaction of the Executive Director or designee.

Provide a proposal guaranty in the form of a Cashier's Check, Teller's Check (including an Official Check) or Bank Money Order on a State or National Bank or Savings and Loan Association, or State or Federally chartered Credit Union made payable to the Texas Transportation Commission in the following amount:

TWELVE THOUSAND (Dollars) (\$12,000)

A bid bond may be used as the required proposal guaranty. The bond form may be detached from the proposal for completion. The proposal may not be disassembled to remove the bond form. The bond must be in accordance with Item 2 of the specifications.

Any addenda issued amending this proposal and/or the plans that have been acknowledged by the bidder, become part of this proposal.

By signing the proposal the bidder certifies:

1. the only persons or parties interested in this proposal are those named and the bidder has not directly or indirectly participated in collusion, entered into an agreement or otherwise taken any action in restraint of free competitive bidding in connection with the above captioned project.
2. in the event of the award of a contract, the organization represented will secure bonds for the full amount of the contract.
3. the signatory represents and warrants that they are an authorized signatory for the organization for which the bid is submitted and they have full and complete authority to submit this bid on behalf of their firm.
4. that the certifications and representations contained in the proposal are true and accurate and the bidder intends the proposal to be taken as a genuine government record.

• **Signed: ****

(1) _____ (2) _____ (3) _____

Print Name:

(1) _____ (2) _____ (3) _____

Title:

(1) _____ (2) _____ (3) _____

Company:

(1) _____ (2) _____ (3) _____

- Signatures to comply with Item 2 of the specifications.

**Note: Complete (1) for single venture, through (2) for joint venture and through (3) for triple venture.

* **When the calendar days field contains an asterisk (*) refer to the Special Provisions and General Notes.**

NOTICE TO CONTRACTORS

ANY CONTRACTORS INTENDING TO BID ON ANY WORK TO BE AWARDED BY THIS DEPARTMENT MUST SUBMIT A SATISFACTORY “AUDITED FINANCIAL STATEMENT” AND “EXPERIENCE QUESTIONNAIRE” AT LEAST TEN DAYS PRIOR TO THE LETTING DATE.

UNIT PRICES MUST BE SUBMITTED IN ACCORDANCE WITH ITEM 2 OF THE STANDARD SPECIFICATIONS OR SPECIAL PROVISION TO ITEM 2 FOR EACH ITEM LISTED IN THIS PROPOSAL.

TEXAS DEPARTMENT OF TRANSPORTATION

BID BOND

KNOW ALL PERSONS BY THESE PRESENTS,

That we, (Contractor Name) _____

Hereinafter called the Principal, and (Surety Name) _____

a corporation or firm duly authorized to transact surety business in the State of Texas, hereinafter called the Surety, are held and firmly bound unto the Texas Department of Transportation, hereinafter called the Oblige, in the sum of not less than two percent (2%) of the department's engineer's estimate, rounded to the nearest one thousand dollars, not to exceed one hundred thousand dollars (\$100,000) as a proposal guaranty (amount displayed on the cover of the proposal), the payment of which sum will and truly be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the principal has submitted a bid for the following project identified as:

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NOW, THEREFORE, if the Oblige shall award the Contract to the Principal and the Principal shall enter into the Contract in writing with the Oblige in accordance with the terms of such bid, then this bond shall be null and void. If in the event of failure of the Principal to execute such Contract in accordance with the terms of such bid, this bond shall become the property of the Oblige, without recourse of the Principal and/or Surety, not as a penalty but as liquidated damages.

Signed this _____ Day of _____ 20_____

By: _____
(Contractor/Principal Name)

(Signature and Title of Authorized Signatory for Contractor/Principal)

*By: _____
(Surety Name)

(Signature of Attorney-in-Fact)

Impressed
Surety Seal
Only

*Attach Power of attorney (Surety) for Attorney-in-Fact

This form may be removed from the proposal.

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BIDDER'S CHECK RETURN

IMPORTANT

The space provided for the return address must be completed to facilitate the return of your bidder's check. Care must be taken to provide a legible, accurate, and complete return address, including zip code. A copy of this sheet should be used for each different return address.

NOTE

Successful bidders will receive their guaranty checks with the executed contract.

RETURN BIDDERS CHECK TO (PLEASE PRINT):

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IMPORTANT

PLEASE RETURN THIS SHEET IN ITS ENTIRETY

Please acknowledge receipt of this check(s) at your earliest convenience by signing below in longhand, in ink, and returning this acknowledgement in the enclosed self addressed envelope.

Check Received By: _____ Date: _____

Title: _____

For (Contractor's Name): _____

Project _____ County _____

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NOTICE TO THE BIDDER

In the space provided below, please enter your total bid amount for this project. Only this figure will be read publicly by the Department at the public bid opening.

It is understood and agreed by the bidder in signing this proposal that the total bid amount entered below is not binding on either the bidder or the Department. It is further agreed that **the official total bid amount for this proposal will be determined by multiplying the unit bid prices for each pay item by the respective estimated quantities shown in this proposal and then totaling all of the extended amounts.**

\$ _____
Total Bid Amount

Control 0001-03-030
 Project STP 2000(938)HES
 Highway SH 20
 County EL PASO

ALT	ITEM	DESC	SP	Bid Item Description	Unit	Quantity	Bid Price	Amount	Seq
	104	509	X	REMOV CONC (SDWLK)	MSY	266.400	\$10.000	\$2,664.00	1
							Total Bid Amount	\$2,664.00	

Signed _____
 Title _____
 Date _____

Additional Signature for Joint Venture:

Signed _____
 Title _____
 Date _____

EXAMPLE OF BID PRICES SUBMITTED BY COMPUTER PRINTOUT

EXAMPLE

EXAMPLE

EXAMPLE

EXAMPLE

EXAMPLES

BID PRICES SUBMITTED BY HAND WRITTEN FORMAT

ALT	ITEM-CODE			UNIT BID PRICE <u>ONLY</u> WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC NO	S.P. NO.				
	190	026		RED OAK 1 1/2 - 1 3/4 GAL BB	EA	9.000	1
					L	E	

Unit price for each plant in place

	249	014		FLEX BASE(DEL)(DENSOT)(TY A GR4 CL2)	TON	56,787.00	14
					L	E	

Unit price for each ton of Flexible Base

	430	001	001	CL A CONC FOR EXT STR (CULV)	CY	45.000	27
					L	E	

Unit price for each cubic yard of Concrete

	610	007	001	RDWY ILL ASSEM(TY ST 50T-8-8)(.4 KW)S	EA	13.000	7
					L	E	

Unit price of each Roadway Illumination Assembly

EXAMPLE

EXAMPLE

EXAMPLE

EXAMPLE

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ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	292	6002		ASPHALT STAB BASE (GR 2)(PG 64) DOLLARS and CENTS	TON	20.000	1
	351	6002		FLEXIBLE PAVEMENT STRUCTURE REPAIR(6") DOLLARS and CENTS	SY	1,500.000	2
	351	6004		FLEXIBLE PAVEMENT STRUCTURE REPAIR(8") DOLLARS and CENTS	SY	800.000	3
	351	6006		FLEXIBLE PAVEMENT STRUCTURE REPAIR(10") DOLLARS and CENTS	SY	400.000	4
	351	6012		FLEXIBLE PAVEMENT STRUCTURE REPAIR(2") DOLLARS and CENTS	SY	5,000.000	5
	351	6019		FLEXIBLE PAVEMENT STRUCTURE REPAIR(3") DOLLARS and CENTS	SY	400.000	6
	500	6033		MOBILIZATION (CALLOUT) DOLLARS and CENTS	EA	12.000	7
	500	6034		MOBILIZATION (EMERGENCY) DOLLARS and CENTS	EA	2.000	8
	700	6007		POTHOLE REPAIR (SAW - CUT) DOLLARS and CENTS	TON	20.000	9
	6001	6001		PORTABLE CHANGEABLE MESSAGE SIGN DOLLARS and CENTS	DAY	7.000	10

PROJECT RMC - 646266001
 COUNTY FORT BEND

Proposal Sheet
 TxDOT
 FORM 234-B I-61-5M

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	6185	6002	002	TMA (STATIONARY) and DOLLARS CENTS	DAY	25.000	11
	7016	6065		ADJUST EXISTING MANHOLE and DOLLARS CENTS	EA	5.000	12

CERTIFICATION OF INTEREST IN OTHER BID PROPOSALS FOR THIS WORK

By signing this proposal, the bidding firm and the signer certify that the following information, as indicated by checking "Yes" or "No" below, is true, accurate, and complete.

- A. Quotation(s) have been issued in this firm's name to other firm(s) interested in this work for consideration for performing a portion of this work.

_____ YES

_____ NO

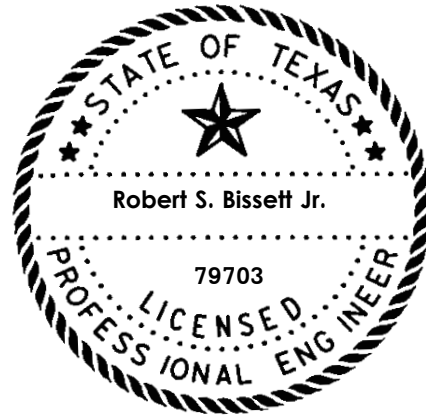
- B. If this proposal is the low bid, the bidder agrees to provide the following information prior to award of the contract.

1. Identify firms which bid as a prime contractor and from which the bidder received quotations for work on this project.
2. Identify all the firms which bid as a prime contractor to which the bidder gave quotations for work on this project.

ENGINEER SEAL

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Project RMC - 646266001
Highway US0059
County FORT BEND

The enclosed Texas Department of Transportation Specifications, Special Specifications, Special Provisions, General Notes and Specification Data in this document have been selected by me, or under my responsible supervision as being applicable to this project. Alteration of a sealed document without proper notification to the responsible engineer is an offense under the Texas Engineering Practice Act.



The seal appearing on this document was authorized by
Robert S. Bissett Jr., P.E.
JANUARY 03, 2024

County: Fort Bend

Sheet

Highway: US 59, etc.

Control: 6462-66-001

GENERAL NOTES

SUPERVISION:

All work will be scheduled and directed by, and request for payment addressed to:

Juan Mata
Fort Bend Area Maintenance Supervisor
4235 SH 36 South
Rosenberg, Texas 77471
(281) 238-7950

General:

Contractor questions on this project are to be addressed to the following individual(s):

Robert S. Bissett, Jr., P.E.,
Phone: (281) 238-7903
Email: Robert.Bissett@txdot.gov

Juan Mata
Phone: (281) 238-7950
Email: Juan.Mata@txdot.gov

Questions may be submitted via the Letting Pre-Bid Q&A web page. This webpage can be accessed from the Notice to Contractors dashboard located at the following address:

<https://tableau.txdot.gov/views/ProjectInformationDashboard/NoticetoContractors>

All questions will be reviewed by the Engineer. All questions and any corresponding responses that are generated will be posted through the same Letting Pre-Bid Q&A web page. The Letting Pre-Bid Q&A web page for each project can be accessed by using the dashboard to the project you are interested in by scrolling or filtering the dashboard using the controls on the left. Hover over the blue hyperlink for the project you want to view the Q&A for and click on the link in the window that pops up.

This is a Routine Maintenance Non-Site-Specific Call-Out contract

The Contractor will begin call out work within the required time for each work order. Work orders are expected to be completed per the contract plans within the number of days allowed for each work order. All call out work orders will have a begin date and number of working days. The Contractor will begin work within 48 hours of notification for routine call outs, unless otherwise approved by the Engineer. Work will be completed within the required number of working days. The Contractor will begin work within 4 hours of notification for emergency call outs and complete within 48 hours, unless otherwise approved by the Engineer. Failure to begin work within the required time and proceed to completion within the required time will result in the assessment of liquidated damages.

Provide one crew (7) days a week, 24 hours a day, for the duration of the contract.

Plan and execute all work in a neat manner.

Perform work on an as-needed basis where directed.

The Engineer will determine the exact location of a day's work.

Notify the Department by 7:30 a.m. when scheduled work is cancelled for any reason.

Work will not be permitted when impending bad weather or low temperatures may impair the quality of work.

Unless otherwise shown on the plans, RAP generated by this project will become the property of the Contractor for use in the current construction project or in future projects.

Superelevate the curves to match the existing surface.

Do not remove more pavement than can be replaced during the same day's allowable work schedule.

Match the contour and surface texture of the surrounding pavement as closely as possible.

The following standard detail sheets are modified:

Modified Standards

TCP (1-2)-18 (MOD)

TCP (2-2)-18 (MOD)

References to manufacturer's trade name or catalog numbers are for the purpose of identification only. Similar materials from other manufacturers are permitted if they are of equal quality, comply with the specifications for this project, and are approved, except for roadway illumination, electrical, and traffic signal items.

The cost for materials, labor, and incidentals to provide for traffic across the roadway and for ingress and egress to private property in accordance with Section 7.2.4 of the standard specifications is subsidiary to the various bid items. Restore access roadways to their original condition upon completing construction.

Grade street intersections and median openings for surface drainage.

If a foundation is to be placed where a riprap surface or an asphalt concrete surface presently exists, use caution in breaking out the existing surface for placement. Break out no greater area than is required to place the foundation. After placing the foundation, wrap the periphery with 0.5 in. pre-molded mastic expansion joint. Then replace the remaining portion of the broken out surface with Class A or Class C concrete or cold mix asphalt concrete to the exact slope, pattern,

Highway: US 59, etc.

Control: 6462-66-001

and thickness of the existing riprap or asphalt. Payment for breaking out the existing surface, wrapping the foundation, and replacing the surface is subsidiary to the various bid items.

Tolls incurred by the Contractor are incidental to the various bid items.

Procure permits and licenses, which are to be issued by the City, County, or Municipal Utility District.

General: Site Management

Locate equipment or materials, temporarily stored on State right of way during non-working hours, at least 30 feet from the edge of the pavement.

Do not mix or store materials, or store or repair equipment, on top of concrete pavement or bridge decks unless authorized by the Engineer. Permission will be granted to store materials on surfaces if no damage or discoloration will result.

Personal vehicles of employees are not permitted to park within the right of way, including sections closed to public traffic. Employees may park on the right of way at the Contractor’s office, equipment, and materials storage yard sites.

Assume ownership of debris and dispose of at an approved location. Do not dispose of debris on private property unless approved in writing by the District Engineer.

Control the dust caused by construction operations. For sweeping the base material in preparation for laying asphalt and for sweeping the finished concrete pavement, use one of the following types of sweepers or approved equal:

Tricycle Type

- Wayne Series 900
- Elgin White Wing
- Elgin Pelican

Truck Type - 4 Wheel

- M-B Cruiser II
- Wayne Model 945
- Mobile TE-3
- Mobile TE-4
- Murphy 4042

General: Traffic Control and Construction

When design details are not shown on the plans, provide signs and arrows conforming to the latest “Standard Highway Sign Designs for Texas” manual.

Existing pavement markings removed or damaged by more than 20 ft. will be replaced with temporary striping. Temporary striping shall be paint based unless otherwise directed by the engineer. This work will be considered incidental to the item of work.

General: Utilities

If the Contractor damages or causes damage (breaks, leaks, nicks, dents, gouges, etc.) to the utility, contact the utility facility owner or operator immediately.

Highway: US 59, etc.

Control: 6462-66-001

Be aware that an operational Computerized Transportation Management System (CTMS) exists within the limits of this project and that the system must remain operational throughout construction. If the Contractor damages or causes damage to this system, repair such damage within 8 hours of occurrence at no cost to the Department. In the event of system damage, notify the Director of Traffic Management Systems at 713-881-3283 within one hour of occurrence. Failure of the Contractor to repair damage to the main fiber optic cable and CCTV cable trunk lines, which convey all corridor information to TranStar, will result in the Contractor being billed for the full cost of emergency repairs.

At least 72 hours before starting work, make arrangements for locating existing Department-owned above ground and underground fiber optic, communications, power, illumination, and traffic signal cabling and conduit. Do this by calling the Department's Houston District Traffic Signal Operations Office at 713-802-5662, or by e-mailing the Department's Houston District Traffic Signal Operations Office at HOU-LocateRequest@txdot.gov, to schedule marking of underground lines on the ground. Use caution if working in these areas to avoid damaging or interfering with existing facilities.

If overhead or underground power lines need to be de-energized, contact the electrical service provider to perform this work. Costs associated with de-energizing the power lines or other protective measures required are at no expense to the Department.

If working near power lines, comply with the appropriate sections of Texas State Law and Federal Regulations relating to the type of work involved.

Item 7: Legal Relations and Responsibilities

This project does not require a U.S. Army Corps of Engineers (USACE) Section 404 Permit before letting, but if a permit is needed during construction, assume responsibility for preparing the permit application. Submit the permit application to the Department's District Environmental Section for approval. Once the permit application is approved, the Department will submit it to the USACE. Assume responsibility for the requested revisions, in coordination with the Department's District Environmental Section.

Maintain the roadway slope stability. Maintaining slope stability is subsidiary to the various bid items.

If the work is on or in the vicinity of an at-grade railroad crossing, involves incidental work on railroad right of way, or involves construction of a railroad grade separation structure, notify the railroad company's Division Engineer and the Department's Project Engineer at least 30 days before performing any work on the railroad right of way and make arrangements for railroad flaggers unless otherwise shown in the contract. Obtain the required Railroad Right of Entry Permit from the railroad company. Payment of applicable permit fees is the responsibility of the Contractor. Acquiring the Railroad Right of Entry Permit is a lengthy process, allow sufficient time for this.

Highway: US 59, etc.

Control: 6462-66-001

This project is on a hurricane evacuation route. Provide at the pre-construction meeting a written plan outlining procedures to suspend work, secure the job site, and safely handle traffic through and across the project in the event of a hurricane evacuation.

During the hurricane season (June 1 through November 30), do not close any travel lanes except when the Contractor can demonstrate that he/she can provide labor, equipment, material, a work plan, and quality of work to satisfactorily return all lanes to an open, all-weather travel surface within 3 days of receiving written or verbal notice but no later than 3 days before the predicted hurricane landfall. Construction of temporary lanes to an all-weather surface will be paid for in accordance with Article 9.7, "Payment for Extra Work and Force Account Method."

In addition to lane closures, cease work 3 days before the predicted hurricane landfall on or near the roadway that adversely impacts the flow of traffic and reduces the capacity of the highway during an evacuation. Vehicles of the Contractor, subcontractors, or material suppliers will not be allowed to enter or exit the traffic stream, including those for the purpose of material hauling and delivery, and mobilization or demobilization of equipment. When directed, this prohibition will include a reasonable time period for the evacuees to return to their point of origin.

No significant traffic generator events have been identified.

Item 8: Prosecution and Progress

Working days will be computed and charged based on a calendar day workweek in accordance with Section 8.3.1.5.

Item 292: Asphalt Treatment (Plant-Mixed)

If using the iron ore topsoil as the primary aggregate, meaning 80 percent or more by weight of the total mixture, the requirements for the water susceptibility test are waived.

Mixtures containing the iron ore topsoil are exempted from test methods TEX-217-F (Part I, separation of deleterious material and Part II, decantation test for coarse aggregate) and TEX-203-F (Sand Equivalent Test).

Assume responsibility for proportioning the materials entering the asphalt mixture, regardless of the type of plant used.

Furnish the mix designs for approval.

Compact the courses to a minimum density of 95 percent of the maximum density as determined using test method TEX-126-E.

Item 351: Flexible Pavement Structure Repair

Use asphalt stabilized base for the base material.

For base repair, place the asphalt stabilized base in compacted lifts of 4 in. maximum, unless otherwise directed.

Tack coat will be incidental to Item 351.

Use PG70-22 for asphalt binder for surface coarses. Substitution of asphalt binder not allowed for surface coarse.

Item 500: Mobilization

This contract consists of Call-out Mobilization for routine work and Emergency Mobilization for any emergency or unexpected work.

Item 502: Barricades, Signs and Traffic Handling

Use a traffic control plan for handling traffic through the various phases of construction. Follow the phasing sequence unless otherwise agreed upon by the Area Engineer and the Project Manager. Ensure this plan conforms to the latest "Texas Manual on Uniform Traffic Control Devices" and the latest Barricade and Construction (BC) Standard Sheets.

Submit changes to the traffic control plan to the Area Engineer. Provide a layout showing the construction phasing, signs, striping, and signalizations for changes to the original traffic control plan.

Furnish and maintain the barricades and warning signs, including the necessary temporary and portable traffic control devices, during the various phases of construction. Place and construct these barricades and warning signs in accordance with the latest "Texas Manual on Uniform Traffic Control Devices" for typical construction layouts.

Cover work zone signs when work related to the signs is not in progress, or any hazard related to the signs no longer exists.

Keep the delineation devices, signs, and pavement markings clean. This work is subsidiary to the Item, "Barricades, Signs, and Traffic Handling."

Erect temporary signs when exit ramps are closed or moved to new locations during construction.

If a section is not complete before the end of the workday, pull back the base material to the existing pavement edge on a 6H: 1V slope. Edge drop-offs during the hours of darkness are not permitted.

Before detouring traffic onto the main lane shoulders, remove dirt, debris, vegetation, and other deleterious material from the surface of the shoulders. Appropriately sign the detour in an approved manner. This work is subsidiary to the various bid items.

Coordinate and schedule the work with the appropriate Metro representative if requiring access to the High Occupancy Vehicle lanes.

Cover or remove the permanent signs and construction signs that are incorrect or that do not apply to the current situation for a particular phase.

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Do not mount signs on drums or barricades, except those listed in the latest Barricades and Construction standard sheets.

Use traffic cones for daytime work only; replace the cones with plastic drums during nighttime hours.

Place positive barriers to protect drop-off conditions greater than 2 ft. within the clear zone that remain overnight.

Use shadow vehicles with Truck Mounted Attenuators (TMAs) for lane and shoulder closures.

Do not reduce the existing number of lanes open to traffic except as shown on the following time schedule:

One Lane Closure/Two Lane Roadway Facility

FM 360, FM 361, FM 442, FM 762 (A. Myers Rd. to FM 1462), FM 1236, FM 1462, FM 1489, FM 1875, FM 1952, FM 1994, FM 2919, PR 72, SH 36 (Austin C/L to UA 90), SL 540, SL 541, SS 10 (SH 36 to UA 90), SS 529 & UA 90 (Wharton C/L to SH 36)

Day	Daytime Work Hours	Nighttime Work Hours	Restricted Hours
Monday Through Friday	5:00 AM - 7:00 PM	* Not Allowed	No Restrictions

One Lane Closure/Two Lane Roadway Facility

FM 359 (Waller C/L to Mason Rd.), FM 521 (SH 6 to Brazoria C/L), FM 723, FM 762 (US 59 to FM 2759), FM 1093 (Austin C/L to Main St. in Fulshear), FM 1093 EBFR (FM 359 to Harris C/L), FM 1093 WBFR (FM 359 to Harris C/L), FM 2759 (FM 762 to Thompsons), FM 2977, FM 3155, IH 10 EBFR, IH 10 WBFR, SH 36 (US 59 to FM 2218), SH 99 NBFR, SH 99 SBFR, SS 10 (UA 90 to US 59) & US 59 EB/WB FR (SS 10 to SH 99)

Day	Daytime Work Hours	Nighttime Work Hours	Restricted Hours
Monday Through Friday	9:00 AM - 3:00 PM	* Not Allowed	5:00 AM - 9:00 AM 3:00 PM - 7:00 PM

One Lane Closure/Four Lane Highway Facility

FM 1463 (US 90 to IH 10) & SS 10 (US 59 to SH 36S)

Day	Daytime Work Hours	Nighttime Work Hours	Restricted Hours
Monday Through Friday	5:00 AM - 7:00 PM	* Not Allowed	No Restrictions

One Lane Closure/Four Lane Highway Facility

FM 359 (Mason Rd. to UA 90), FM 521 (FM 2234 to SH 6), FM 762 (UA 90 to US 59), FM 762 (FM 2759 to A. Myers Rd.), FM 1092, FM 1463 (IH 10 to FM 359), FM 1464, FM 1640, FM 1876, FM 2218, FM 2234, FM 2759 (US 59 to FM 762), FM 3345, LP 762, SH 36 (UA 90 to US 59), SH 99 ML & UA 90 (SH 36 to SH 6)

Day	Daytime Work Hours	Nighttime Work Hours	Restricted Hours
Monday through Friday	9:00 AM – 3:00 PM	* Not Allowed	5:00 AM -9:00 AM 3:00 PM- 7:00 PM

One Lane Closure/Multiple Lane Highway

IH 10 ML, SH 6, US 59 ML (SS 10 to Harris C/L), US 59 EB/WB FR (SH 99 to Harris C/L) & UA 90 (SH 6 to Harris C/L)

Day	Daytime Work Hours	Nighttime Work Hours	Restricted Hours
Monday Through Friday	** Not Allowed	9:00 PM – 12:00 AM 12:00 AM - 5:00 AM	5:00 AM - 9:00 PM

Weekend One Lane Closure

FM 359, FM 360, FM 361, FM 442, FM 521, FM 723, FM 762, FM 1092, FM 1093, FM 1236, FM 1462, FM 1463, FM 1464, FM 1489, FM 1640, FM 1875, FM 1876, FM 1952, FM 1994, FM 2218, FM 2234, FM 2759, FM 2919, FM 2977, FM 3155, FM 3345, IH 10, LP 762, PR 72, SH 6, SH 36, SH 99, SL 540, SL 541, SS 10, SS 529, US 59 & UA 90

Day	Daytime Work Hours	Nighttime Work Hours	Restricted Hours
Saturday Through Sunday	** Not Allowed	8:00 PM - 12:00 AM 12:00 AM - 11:00 AM	11:00 AM - 8:00 PM

* Nighttime work allowed only with approval from the Area Engineer.

** Daytime work allowed only with approval from the Area Engineer.

The above times are approved for the traffic control conditions listed. The Area Engineer may approve other closure times if traffic counts warrant. The Area Engineer may reduce the above times for special events.

Law enforcement assistance will be required for this project and is expected to be required for major traffic control changes and lane closures. Coordinate with local law enforcement and arrange for law enforcement as directed or agreed by the Engineer. Before payment will be made, complete the “Daily Report on Law Enforcement Force Account Work” (Form 318), provided by the Department and submit daily invoices that agree with this form for any day during the month in which approved services were provided.

Highway: US 59, etc.

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Provide full-time, off-duty, uniformed, certified peace officers, as part of traffic control operations. The peace officers must be able to show proof of certification by the Texas Commission on Law Enforcement Officers Standards. The cost of the officers is paid for on a force account basis.

The number of peace officers and working hours will be determined in advance of the work and approved by the Engineer.

Use Uneven Lane Signs (CW 8-11) during resurfacing operations for elevation differences between adjacent lanes of greater than 1 in.

The Contractor Force Account "Safety Contingency" that has been established for this project is intended to be utilized for work zone enhancements, to improve the effectiveness of the Traffic Control Plan, that could not be foreseen in the project planning and design stage. These enhancements will be mutually agreed upon by the Engineer and the Contractor's Responsible Person based on weekly or more frequent traffic management reviews on the project. The Engineer may choose to use existing bid items if it does not slow the implementation of enhancement.

All work and materials furnished with this item are subsidiary to the pertinent bid items except:

- Emergency lane closures payable under Item 0500-6034
- Portable changeable message boards payable under Item 6001-6001
- Truck mounted attenuators payable under Item 6185-6002

All lane closures are considered subsidiary to the various bid items.

Item 506: Temporary Erosion, Sedimentation and Environmental Controls

The use of hay bales is not permitted as Storm Water Pollution Prevention Plan (SWP3) measures.

The Storm Water Pollution Prevention Plan (SWP3) consists of temporary erosion control measures needed and provided for under this Item. The disturbed area is less than one acre and use of erosion control measures is not anticipated. If physical conditions encountered at the job site require necessary controls, BMP installation, maintenance, and removal will be paid as extra work on a force account basis per Articles 4.4 and 9.7. Since the disturbed area is less than 5 acres, a "Notice of Intent" (NOI) is not required.

Use appropriate measures to prevent, minimize, and control the spill of hazardous materials in the construction staging area. Remove and dispose of materials in compliance with State and Federal laws.

Implement temporary and permanent erosion control measures to comply with the National Pollution Discharge Elimination System (NPDES) general permit under the Clean Water Act.

Item 585: Ride Quality for Pavement Surfaces

To eliminate the need for corrective action due to excessive deviations in the final surface layers, exercise caution to ensure satisfactory profile results in the intermediate paving layers (mixture).

Milling will not be allowed as a corrective action for excessive deviations in the final surface layer of hot-mix asphalt.

Item 3076: Dense-Graded Hot Mix Asphalt

Taper the asphalt concrete pavement at the beginning and ending points.

Use a maximum 6H:1V slope for the asphalt concrete pavement edge.

Where the 6H:1V ACP edge taper extends over onto the unsurfaced shoulders, blade off the loose existing shoulder material to provide a solid base for the outside taper edge. After placing the ACP overlay, blade this material back against the edge taper. This work is subsidiary to the various bid items.

The stockpile will be the point of sampling of coarse aggregate for test method TEX-217-F (Part II, decantation).

Do not use petroleum-based solvents in the beds of hot mix asphalt delivery vehicles.

Dilution of tack coat is not allowed.

Do not use Surface Aggregate Classification (SAC) C for this project.

For determining the Asphalt Content, only ignition ovens will be allowed.

The tack coat rate shown on the “Basis of Estimate” is an average rate for calculating tack coat quantities. Vary the rate based on the pavement conditions and other factors such as manufacturer’s recommendations and weather.

Item 6185: Truck Mounted Attenuator (TMA) and Trailer Attenuator (TA)

A shadow vehicle with Truck Mounted Attenuators (TMAs) or Trailer Attenuators (TAs) is required as shown on the appropriate Traffic Control Plan (TCP) sheets. TMAs/TAs must meet the requirements of the Compliant Work Zone Traffic Control Device List.

Level 3 Compliant TMAs/TAs are required for this project.

A total of one (1) shadow vehicle with a TMA/TA is required for the work with the exception of Pavement Marking Operations. The Contractor is responsible for determining if one or more of these operations will be ongoing at the same time to determine the total number of TMAs/TAs needed on the project.

County: Fort Bend

Sheet

Highway: US 59, etc.

Control: 6462-66-001

A total of three (3) shadow vehicles with a TMA/TA are required for Pavement Marking Operations. The Contractor is responsible for determining if one or more of these operations will be ongoing at the same time to determine the total number of TMAs/TAs needed on the project.

Basis of Estimate

Item	Description	Limit and Rate	Unit
292	Asphalt Treatment (Plant-Mixed) <ul style="list-style-type: none"> • Asphalt • Aggregate 	110 Lb. / Sq. Yd.-In. 5 % by weight 95 % by weight	TON
3076	Dense-Graded Hot Mix Asphalt <ul style="list-style-type: none"> • Asphalt • Aggregate Tack Coat <ul style="list-style-type: none"> • Applied on new HMA • Applied on Existing HMA • Applied on Milled HMA 	110 Lb. / Sq. Yd.-In. 6 % by weight 94 % by weight 0.06 Gal. / Sq. Yd. 0.09 Gal. / Sq. Yd. 0.11 Gal. / Sq. Yd.	TON GAL

CONTROL : 6462-66-001
PROJECT : RMC - 646266001
HIGHWAY : US0059
COUNTY : FORT BEND

TEXAS DEPARTMENT OF TRANSPORTATION

GOVERNING SPECIFICATIONS AND SPECIAL PROVISIONS

ALL SPECIFICATIONS AND SPECIAL PROVISIONS APPLICABLE TO THIS PROJECT ARE IDENTIFIED AS FOLLOWS:

STANDARD SPECIFICATIONS: ADOPTED BY THE TEXAS DEPARTMENT OF
----- TRANSPORTATION NOVEMBER 1, 2014.
STANDARD SPECIFICATIONS ARE INCORPORATED
INTO THE CONTRACT BY REFERENCE.

ITEMS 1 TO 9 INCL., GENERAL REQUIREMENTS AND COVENANTS
ITEM 292 ASPHALT TREATMENT (PLANT-MIXED) (300) (301) (320) <502> (520)
(585) <3096>
ITEM 351 FLEXIBLE PAVEMENT STRUCTURE REPAIR (132) (204) (247) (260)
(263) (275) (276) (292) (310) (316) (330) (334) (340) <341> <502>
<3076>
ITEM 500 MOBILIZATION
ITEM 506 TEMPORARY EROSION, SEDIMENTATION, AND ENVIRONMENTAL
CONTROLS (161) (432) (556)
ITEM 700 POT HOLE REPAIR (300) (330) (334) (340) <341> <502> (520) <3076>
<3096>

SPECIAL PROVISIONS: SPECIAL PROVISIONS WILL GOVERN AND TAKE
----- PRECEDENCE OVER THE SPECIFICATIONS ENUMERATED
HEREON WHEREVER IN CONFLICT THEREWITH.

SPECIAL PROVISION "NONDISCRIMINATION" (000---002)
SPECIAL PROVISION "CERTIFICATE OF INTERESTED PARTIES (FORM 1295)"
(000--1019)
SPECIAL PROVISION "SCHEDULE OF LIQUIDATED DAMAGES" (000--1243)
SPECIAL PROVISION "NOTICE OF CONTRACTOR PERFORMANCE EVALUATIONS"
(000---659)
SPECIAL PROVISIONS TO ITEM 2 (002---013) (002---014) (002---015)
SPECIAL PROVISIONS TO ITEM 3 (003---011) (003---013)
SPECIAL PROVISION TO ITEM 4 (004---001)
SPECIAL PROVISIONS TO ITEM 5 (005---002) (005---003)
SPECIAL PROVISIONS TO ITEM 6 (006---001) (006---012)
SPECIAL PROVISIONS TO ITEM 7 (007---004) (007---010) (007---011)

(007---013)

SPECIAL PROVISIONS TO ITEM 8 (008---030) (008---033) (008---054)

SPECIAL PROVISIONS TO ITEM 9 (009---010) (009---016)

SPECIAL PROVISION TO ITEM 247 (247---005)

SPECIAL PROVISION TO ITEM 300 (300---020)

SPECIAL PROVISION TO ITEM 316 (316---002)

SPECIAL PROVISION TO ITEM 334 (334---004)

SPECIAL PROVISION TO ITEM 340 (340---004)

SPECIAL PROVISION TO ITEM 341 (341---004)

SPECIAL PROVISION TO ITEM 342 (342---005)

SPECIAL PROVISION TO ITEM 347 (347---003)

SPECIAL PROVISION TO ITEM 348 (348---004)

SPECIAL PROVISION TO ITEM 421 (421---012)

SPECIAL PROVISION TO ITEM 440 (440---005)

SPECIAL PROVISION TO ITEM 502 (502---008)

SPECIAL PROVISION TO ITEM 506 (506---002)

SPECIAL PROVISION TO ITEM 520 (520---002)

SPECIAL PROVISION TO SPECIAL SPECIFICATION ITEM 3096 (3096--003)

SPECIAL PROVISION TO SPECIAL SPECIFICATION ITEM 6185 (6185--002)

SPECIAL SPECIFICATIONS:

ITEM 3076 DENSE-GRADED HOT-MIX ASPHALT <300><301><316><320><340>
<341><342><347><348><520><585><3079><3081><3082><3096>

ITEM 3079 PERMEABLE FRICTION COURSE (PFC) <300><301><320><342><520>
<585><3096>

ITEM 3081 THIN OVERLAY MIXTURES (TOM) <300><301><320><347><520>
<585><3096>

ITEM 3082 THIN BONDED FRICTION COURSES <210><300><301><320><342>
<348><520><585><3079><3096>

ITEM 3096 ASPHALTS, OILS, AND EMULSIONS

ITEM 6001 PORTABLE CHANGEABLE MESSAGE SIGN

ITEM 6185 TRUCK MOUNTED ATTENUATOR (TMA) AND TRAILER ATTENUATOR (TA)

ITEM 7016 WATER AND SANITARY SEWER SYSTEM <400><401><402><420><421>
<440>

GENERAL: THE ABOVE-LISTED SPECIFICATION ITEMS ARE THOSE UNDER WHICH
----- PAYMENT IS TO BE MADE. THESE, TOGETHER WITH SUCH OTHER
PERTINENT ITEMS, IF ANY, AS MAY BE REFERRED TO IN THE ABOVE-
LISTED SPECIFICATION ITEMS, AND INCLUDING THE SPECIAL
PROVISIONS LISTED ABOVE, CONSTITUTE THE COMPLETE SPECIFI-
CATIONS FOR THIS PROJECT.

CHILD SUPPORT STATEMENT

Under Section 231.006, Family Code, the vendor or applicant certifies that the individual or business entity named in this contract, bid, or application is not ineligible to receive the specified grant, loan, or payment and acknowledges that this contract may be terminated and payment may be withheld if this certification is inaccurate.

CONFLICT OF INTEREST CERTIFICATION

Pursuant to Texas Government Code Section 2261.252(b), the Department is prohibited from entering into contracts in which Department officers and employees have a financial interest.

By signing the Contract, the Contractor certifies that it is not prohibited from entering into a Contract with the Department as a result of a financial interest as defined under Texas Government Code Section 2261.252(b), and that it will exercise reasonable care and diligence to prevent any actions or conditions that could result in a conflict of interest with the Department.

The Contractor also certifies that none of the following individuals, nor any of their family members within the second degree of affinity or consanguinity, owns 1% or more interest or has a financial interest as defined under Texas Government Code Section 2261.252(b) in the Contractor:

- Any member of the Texas Transportation Commission; and
- The Department's Executive Director, General Counsel, Chief of Procurement and Field Support Operations, Director of Procurement, and Director of Contract Services.

Violation of this certification may result in action by the Department.

E-VERIFY CERTIFICATION

Pursuant to Texas Transportation Code §223.051, all TxDOT contracts for construction, maintenance, or improvement of a highway must include a provision requiring Contractors and subcontractors to use the U.S. Department of Homeland Security's E-Verify system to determine employment eligibility. By signing the contract, the Contractor certifies that prior to the award of the Contract:

- the Contractor has registered with and will, to the extent permitted by law, utilize the United States Department of Homeland Security's E-Verify system during the term of the Contract to determine the eligibility of all persons hired to perform duties within Texas during the term of the agreement; and
- the Contractor will require that all subcontractors also register with and, to the extent permitted by law, utilize the United States Department of Homeland Security's E-Verify system during the term of the subcontract to determine the eligibility of all persons hired to perform duties within Texas during the term of the agreement.

Violation of this requirement constitutes a material breach of the Contract, subjects a subcontractor to removal from the Contract, and subjects the Contractor or subcontractors to possible sanctions in accordance with Title 43, Texas Administrative Code, Chapter 10, Subchapter F, "Sanctions and Suspension for Ethical Violations by Entities Doing Business with the Department."

Certification Regarding Disclosure of Public Information

Pursuant to Subchapter J, Chapter 552, Texas Government Code, contractors executing a contract with a governmental body that results in the expenditure of at least \$1 million in public funds must:

- 1) preserve all contracting information* as provided by the records retention requirements applicable to Texas Department of Transportation (TxDOT) for the duration of the contract,
- 2) on request of TxDOT, promptly provide any contracting information related to the contract that is in the custody or possession of the entity, and
- 3) on completion of the contract, either:
 - A. provide, at no cost to TxDOT, all contracting information related to the contract that is in the custody or possession of the entity, or
 - B. preserve the contracting information related to the contract as provided by the records retention requirements applicable to TxDOT

The requirements of Subchapter J, Chapter 552, Government Code, may apply to this contract, and the contractor or vendor agrees that the contract can be terminated if the contractor or vendor knowingly or intentionally fails to comply with a requirement of that subchapter.

By entering into Contract, the Contractor agrees to:

- provide, or make available, to TxDOT and any authorized governmental investigating or auditing agency all records, including electronic and payment records related to the contract, for the same period provided by the records retention schedule applicable to TxDOT, and
- ensure that all subcontracts include a clause requiring the same.

* As defined in Government Code §552.003, "Contracting information" means the following information maintained by a governmental body or sent between a governmental body and a vendor, contractor, potential vendor, or potential contractor:

- 1) information in a voucher or contract relating to the receipt or expenditure of public funds by a governmental body;
- 2) solicitation or bid documents relating to a contract with a governmental body;
- 3) communications sent between a governmental body and a vendor, contractor, potential vendor, or potential contractor during the solicitation, evaluation, or negotiation of a contract;
- 4) documents, including bid tabulations, showing the criteria by which a governmental body evaluates each vendor, contractor, potential vendor, or potential contractor responding to a solicitation and, if applicable, an explanation of why the vendor or contractor was selected; and
- 5) communications and other information sent between a governmental body and a vendor or contractor related to the performance of a final contract with the governmental body or work performed on behalf of the governmental body.

CERTIFICATION TO NOT BOYCOTT ISRAEL

Pursuant to Texas Government Code §2271.002, the Department must include a provision requiring a written verification affirming that the Contractor does not boycott Israel, as defined in Government Code §808.001, and will not boycott Israel during the term of the contract. This provision applies to a contract that:

- 1) is with a Contractor that is not a sole proprietorship,
- 2) is with a Contractor with 10 or more full-time employees, and
- 3) has a value of \$100,000 or more.

By signing the contract, the Contractor certifies that it does not boycott Israel and will not boycott Israel during the term of this contract. "Boycott" means refusing to deal with, terminating business activities with, or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations specifically with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory, but does not include an action made for ordinary business purposes.

Violation of this certification may result in action by the Department.

CERTIFICATION TO NOT BOYCOTT ENERGY COMPANIES

Pursuant to Texas Government Code §2274.002, the Department must include a provision requiring a written verification affirming that the Contractor does not boycott energy companies, as defined in Government Code §809.001, and will not boycott energy companies during the term of the contract. This provision applies to a contract that:

- 1) is with a Contractor that is not a sole proprietorship,
- 2) is with a Contractor with 10 or more full-time employees, and
- 3) has a value of \$100,000 or more.

By signing the contract, the Contractor certifies that it does not boycott energy companies and will not boycott energy companies during the term of this contract. "Boycott" means taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations with a company because the company: (1) engages in the exploration, production, utilization, transportation, sale, or manufacturing of fossil fuel-based energy and does not commit or pledge to meet environmental standards beyond applicable federal and state law; or (2) does business with a company described by (1).

Violation of this certification may result in action by the Department.

CERTIFICATION TO NOT DISCRIMINATE AGAINST FIREARM ENTITIES OR FIREARM TRADE ASSOCIATIONS

Pursuant to Texas Government Code §2274.002, the Department must include a provision requiring a written verification affirming that the Contractor:

- 1) does not have a practice, policy, guidance, or directive that discriminates against a firearm entity or firearm trade association, as defined in Government Code §2274.001, and
- 2) will not discriminate against a firearm entity or firearm trade association during the term of the contract.

This provision applies to a contract that:

- 1) is with a Contractor that is not a sole proprietorship,
- 2) is with a Contractor with 10 or more full-time employees, and
- 3) has a value of \$100,000 or more.

By signing the contract, the Contractor certifies that it does not discriminate against a firearm entity or firearm trade association as described and will not do so during the term of this contract. "Discriminate against a firearm entity or firearm trade association" means, with respect to the entity or association, to: (1) refuse to engage in the trade of any goods or services with the entity or association based solely on its status as a firearm entity or firearm trade association; (2) refrain from continuing an existing business relationship with the entity or association based solely on its status as a firearm entity or firearm trade association; or (3) terminate an existing business relationship with the entity or association based solely on its status as a firearm entity or firearm trade association. "Discriminate against a firearm entity or firearm trade association" does not include: (1) the established policies of a merchant, retail seller, or platform that restrict or prohibit the listing or selling of ammunition, firearms, or firearm accessories; (2) a company's refusal to engage in the trade of any goods or services, decision to refrain from continuing an existing business relationship, or decision to terminate an existing business relationship to comply with federal, state, or local law, policy, or regulations or a directive by a regulatory agency, or for any traditional business reason that is specific to the customer or potential customer and not based solely on an entity's or association's status as a firearm entity or firearm trade association.

Violation of this certification may result in action by the Department.

Special Provision to Item 000

Nondiscrimination



1. DESCRIPTION

All recipients of federal financial assistance are required to comply with various nondiscrimination laws including Title VI of the Civil Rights Act of 1964, as amended, (Title VI). Title VI forbids discrimination against anyone in the United States on the grounds of race, color, or national origin by any agency receiving federal funds.

Texas Department of Transportation, as a recipient of Federal financial assistance, and under Title VI and related statutes, ensures that no person shall on the grounds of race, religion (where the primary objective of the financial assistance is to provide employment per 42 U.S.C. § 2000d-3), color, national origin, sex, age or disability be excluded from participation in, be denied the benefits of, or otherwise be subjected to discrimination under any Department programs or activities.

2. DEFINITION OF TERMS

Where the term “contractor” appears in the following six nondiscrimination clauses, the term “contractor” is understood to include all parties to contracts or agreements with the Texas Department of Transportation.

3. NONDISCRIMINATION PROVISIONS

During the performance of this contract, the contractor agrees as follows:

- 3.1. **Compliance with Regulations.** The Contractor shall comply with the Regulations relative to nondiscrimination in Federally-assisted programs of the Department of Transportation (hereinafter, “DOT”) Title 49, Code of Federal Regulations, Part 21, as they may be amended from time to time, (hereinafter referred to as the Regulations), which are herein incorporated by reference and made a part of this contract.
- 3.2. **Nondiscrimination.** The contractor, with regard to the work performed by it during the contract, shall not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor shall not participate either directly or indirectly in the discrimination prohibited by section 21.5 of the Regulations, including employment practices when the contract covers a program set forth in Appendix B of the Regulations.
- 3.3. **Solicitations for Subcontracts, Including Procurements of Materials and Equipment:** In all solicitations either by competitive bidding or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials or leases of equipment, each potential subcontractor or supplier shall be notified by the contractor of the contractor's obligations under this contract and the Regulations relative to nondiscrimination on the grounds of race, color, or national origin.
- 3.4. **Information and Reports:** The contractor shall provide all information and reports required by the Regulations or directives issued pursuant thereto, and shall permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Recipient or the Texas Department of Transportation to be pertinent to ascertain compliance with such Regulations, orders and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish this information the contractor shall so certify to the Recipient, or the Texas Department of Transportation as appropriate, and shall set forth what efforts it has made to obtain the information.

3.5. **Sanctions for Noncompliance.** In the event of the contractor's noncompliance with the nondiscrimination provisions of this contract, the Recipient shall impose such contract sanctions as it or the Texas Department of Transportation may determine to be appropriate, including, but not limited to:

- withholding of payments to the contractor under the contract until the contractor complies, and/or
- cancellation, termination or suspension of the contract, in whole or in part.

3.6. **Incorporation of Provisions.** The contractor shall include the provisions of paragraphs (1) through (6) in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Regulations, or directives issued pursuant thereto. The contractor shall take such action with respect to any subcontract or procurement as the Recipient or the Texas Department of Transportation may direct as a means of enforcing such provisions including sanctions for non-compliance: Provided, however, that, in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or supplier as a result of such direction, the contractor may request the Recipient to enter into such litigation to protect the interests of the Recipient, and, in addition, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

Special Provision 000

Certificate of Interested Parties (Form 1295)



Submit a notarized Form 1295, "Certificate of Interested Parties," in the following instances:

- at Contract execution for Contracts awarded by the Commission;
- at Contract execution for Contracts awarded by the District Engineer or Chief Engineer with an award amount of \$1,000,000 or more; at any time an existing Contract awarded by the District Engineer or Chief Engineer increases in value to \$1,000,000 or more due to changes in the Contract; at any time there is an increase of \$1,000,000 or more to an existing Contract (change orders, extensions, and renewals); or
- at any time there is a change to the information in Form 1295, when the form was filed for an existing Contract.

Form 1295 and instructions on completing and filing the form are available on the Texas Ethics Commission website.

Special Provision 000

Important Notice to Contractors



For Dollar Amount of Original Contract		Dollar Amount of Daily Contract Administration Liquidated Damages per Working Day
From More Than	To and including	
0	1,000,000	618
1,000,000	3,000,000	832
3,000,000	5,000,000	940
5,000,000	15,000,000	1317
15,000,000	25,000,000	1718
25,000,000	50,000,000	2411
50,000,000	Over 50,000,000	4265

In addition to the amount shown in Table 1, the Liquidated Damages will be increased by the amount shown in Item 8 of the General Notes for Road User Cost (RUC), when applicable.

Special Provision 000

Notice of Contractor Performance Evaluations



1. GENERAL

In accordance with Texas Transportation Code §223.012, the Engineer will evaluate Contractor performance based on quality, safety, and timeliness of the project.

2. DEFINITIONS

- 2.1. **Project Recovery Plan (PRP)**—a formal, enforceable plan developed by the Contractor, in consultation with the District, that documents the cause of noted quality, safety, and timeliness issues and specifies how the Contractor proposes to correct project-specific performance deficiencies.

In accordance with Title 43, Texas Administrative Code (TAC), §9.23, the District will request a PRP if the Contractor's performance on a project is below the Department's acceptable standards and will monitor the Contractor's compliance with the established plan.

- 2.2. **Corrective Action Plan (CAP)**—a formal, enforceable plan developed by the Contractor, and proposed for adoption by the Construction or Maintenance Division, that documents the cause of noted quality, safety, and timeliness issues and specifies how the Contractor proposes to correct statewide performance deficiencies.

In accordance with 43 TAC §9.23, the Division will request a CAP if the average of the Contractor's statewide final evaluation scores falls below the Department's acceptable standards for the review period and will monitor the Contractor's compliance with the established plan.

3. CONTRACTOR EVALUATIONS

In accordance with Title 43, Texas Administrative Code (TAC) §9.23, the Engineer will schedule evaluations at the following intervals, at minimum:

- Interim evaluations—at or within 30 days after the anniversary of the notice to proceed, for Contracts extending beyond 1 yr., and
- Final evaluation—upon project closeout.

In case of a takeover agreement, neither the Surety nor its performing Contractor will be evaluated.

In addition to regularly scheduled evaluations, the Engineer may schedule an interim evaluation at any time to formally communicate issues with quality, safety, or timeliness. Upon request, work with the Engineer to develop a PRP to document expectations for correcting deficiencies.

Comply with the PRP as directed. Failure to comply with the PRP may result in additional remedial actions available to the Engineer under Item 5, "Control of the Work." Failure to meet a PRP to the Engineer's satisfaction may result in immediate referral to the Performance Review Committee for consideration of further action against the Contractor.

The Engineer will consider and document any events outside the Contractor's control that contributed to the failure to meet performance standards or comply with a PRP, including consideration of sufficient time.

Follow the escalation ladder if there is a disagreement regarding an evaluation or disposition of a PRP. The Contractor may submit additional documentation pertaining to the dispute. The District Engineer's decision

on a Contractor's evaluation score and recommendation of action required in a PRP or follow up for non-compliance is final.

4. DIVISION OVERSIGHT

Upon request of the Construction or Maintenance Division, develop and submit for Division approval a proposed CAP to document expectations for correcting deficiencies in the performance of projects statewide.

Comply with the CAP as directed. The CAP may be modified at any time up to completion or resolution after written approval of the premise of change from the Division. Failure to meet an adopted or revised adopted CAP to the Division's satisfaction within 120 days will result in immediate referral to the Performance Review Committee for consideration of further action against the Contractor.

The Division will consider and document any events outside the Contractor's control that contributed to the failure to meet performance standards or comply with a CAP, including consideration of sufficient time and associated costs as appropriate.

5. PERFORMANCE REVIEW COMMITTEE

The Performance Review Committee, in accordance with 43 TAC §9.24, will review at minimum all final evaluations, history of compliance with PRPs, any adopted CAPs including agreed modifications, any information about events outside a Contractor's control contributing to the Contractor's performance, and any documentation submitted by the Contractor and may recommend one or more of the following actions:

- take no action,
- reduce the Contractor's bidding capacity,
- prohibit the Contractor from bidding on one or more projects,
- immediately suspend the Contractor from bidding for a specified period of time, by reducing the Contractor's bidding capacity to zero, or
- prohibit the Contractor from being awarded a Contract on which they are the apparent low bidder.

The Deputy Executive Director will determine any further action against the Contractor.

6. APPEALS PROCESS

In accordance with 43 TAC §9.25, the Contractor may appeal remedial actions determined by the Deputy Executive Director.

Special Provision to Item 2

Instructions to Bidders



Item 2, "Instructions to Bidders" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 3., "Issuing Proposal Forms," is supplemented by the following:

The Electronic State Business Daily (ESBD), the Integrated Contractor Exchange (iCX) system, and the project proposal are the official sources of advertisement and bidding information for the State and Local Lettings. Bidders should bid the project using the information found therein, including any addenda. These sources take precedence over information from other sources, including TxDOT webpages, which are unofficial and intended for informational purposes only.

Special Provision to Item 2

Instructions to Bidders



Item 2, "Instructions to Bidders," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 2.8.2., "Proposal Guaranty," third paragraph is replaced by the following.

It is the Bidder's responsibility to ensure the electronic bid bond is issued in the name or Department vendor identification numbers of the Bidder or Bidders.

Special Provision to Item 2

Instructions to Bidders



Item 2, "Instructions to Bidders," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 2.3., "Issuing Proposal Forms," is supplemented by the following:

- the Bidder or affiliate of the Bidder that was originally determined as the apparent low Bidder on a project but was deemed nonresponsive for failure to register or participate in the Department of Homeland Security's (DHS) E-Verify system as specified in Article 2.15., "Department of Homeland Security (DHS) E-Verify System," is prohibited from rebidding that specific project.

Article 2.7., "Nonresponsive Bid," is supplemented by the following:

- the Bidder failed to participate in the Department of Homeland Security's (DHS) as specified in Article 2.15., "Department of Homeland Security (DHS) E-Verify System."

Article 2.15., "Department of Homeland Security (DHS) E-Verify System," is added.

The Department will not award a Contract to a Contractor that is not registered in the DHS E-Verify system. Remain active in E-Verify throughout the life of the Contract. In addition, in accordance with paragraph six of Article 8.2., "Subcontracting," include this requirement in all subcontracts and require that subcontractors remain active in E-Verify until their work is completed.

If the apparent low Bidder does not appear in the DHS E-Verify system before award, the Contractor must submit documentation showing that they are compliant within 5 calendar days after bid opening. A Contractor that fails to comply or respond within the deadline will be declared nonresponsive. The Bidder forfeiting the proposal guaranty will not be considered in future proposals for the same work unless there has been a substantial change in the scope of the work.

The Department may recommend that the Commission:

- reject all bids, or
- award the Contract to the new apparent low Bidder, if the Department is able to verify the Bidder's participation in the DHS E-Verify system.

If the Department is unable to verify the new apparent low Bidder's participation in the DHS E-Verify system:

- the new apparent low Bidder will not be deemed nonresponsive,
- the new apparent low Bidder's guaranty will not be forfeited,
- the Department will reject all bids,
- the new apparent low Bidder will remain eligible to receive future proposals for the same project, and
- the proposal guaranty of the original low bidder will become the property of the State, not as a penalty, but as liquidated damages.

Special Provision to Item 3 Award and Execution Contract



Item 3, Award and Execution of Contract," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 4.3, "Insurance." The first sentence is voided and replaced by the following:

For construction and building Contracts, submit a certificate of insurance showing coverages in accordance with Contract requirements. For routine maintenance Contracts, refer to Article 8, "Beginning of Work."

Article 8, "Beginning of Work." The first sentence is supplemented by the following:

For a routine maintenance Contract, do not begin work until a certificate of insurance showing coverages in accordance with the Contract requirements is provided and accepted.

Special Provision to Item 3

Award and Execution of Contract



Item 3, "Award and Execution of Contract" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 4.3 "Insurance" is being amended by the following:

Table 2
Insurance Requirements

Type of Insurance	Amount of Coverage
Commercial General Liability Insurance	Not Less Than: \$600,000 each occurrence
Business Automobile Policy	Not Less Than: \$600,000 combined single limit
Workers' Compensation	Not Less Than: Statutory
All Risk Builder's Risk Insurance (For building-facilities contracts only)	100% of Contract Price

Special Provision to Item 4

Scope of Work



Item 4, "Scope of Work" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 4.4., "Changes in the Work", is supplemented by the following:

When mutually agreed in writing, the Engineer may extend the Contract if the Contractor has satisfactorily fulfilled the terms and conditions of the Contract. The extension may be for an additional period of 1 year and may include additional quantities up to the original bid quantities plus any quantities added by change order. The extension will meet the terms and conditions of the Contract. Execute the extension prior to the final acceptance of the Contract unless agreed upon by the Engineer. The Contract and the extension will be prosecuted consecutively. Only one extension will be allowed.

Special Provision to Item 5

Control of the Work



Item 5, "Control of the Work," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 5.1, "Authority of Engineer," is voided and replaced by the following.

The Engineer has the authority to observe, test, inspect, approve, and accept the work. The Engineer decides all questions about the quality and acceptability of materials, work performed, work progress, Contract interpretations, and acceptable Contract fulfillment. The Engineer has the authority to enforce and make effective these decisions.

The Engineer acts as a referee in all questions arising under the terms of the Contract. The Engineer's decisions will be final and binding.

The Engineer will pursue and document actions against the Contractor as warranted to address Contract performance issues. Contract remedies include, but are not limited to, the following:

- conducting interim performance evaluations requiring a Project Recovery Plan, in accordance with Title 43, Texas Administrative Code (TAC) §9.23,
- requiring the Contractor to remove and replace defective work, or reducing payment for defective work,
- removing an individual from the project,
- suspending the work without suspending working day charges,
- assessing standard liquidated damages to recover the Department's administrative costs, including additional project-specific liquidated damages when specified in the Contract in accordance with 43 TAC §9.22,
- withholding estimates,
- declaring the Contractor to be in default of the Contract, and
- in case of a Contractor's failure to meet a Project Recovery Plan, referring the issue directly to the Performance Review Committee for consideration of further action against the Contractor in accordance with 43 TAC §9.24.

The Engineer will consider and document any events outside the Contractor's control that contributed to the failure to meet performance standards, including consideration of sufficient time.

Follow the issue escalation ladder if there is disagreement regarding the application of Contract remedies.

Special Provision to Item 5

Control of the Work



Item 5, "Control of the Work" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 5.4, "Coordination of Plans, Specifications, and Special Provisions," the last sentence of the last paragraph is replaced by the following:

Failure to promptly notify the Engineer will constitute a waiver of all contract claims against the Department for misunderstandings or ambiguities that result from the errors, omissions, or discrepancies.

Special Provision to Item 6

Control of Materials



For this project, Item 6, "Control of Materials," of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 4., "Sampling, Testing, and Inspection," is supplemented by the following:

Meet with the Engineer and choose either the Department or a Department-selected Commercial Lab (CL) for conducting the subset of project-level sampling and testing shown in Table 1, "Select Guide Schedule Sampling and Testing." Selection may be made on a test by test basis. CLs will meet the testing turnaround times shown (includes test time and time for travel/sampling and reporting) and in all cases issue test reports as soon as possible.

If the Contractor chooses a Department-selected CL for any Table 1 sampling and testing:

- notify the Engineer, District Lab, and the CL of project scheduling that may require CL testing;
- provide the Engineer, District Lab, and CL at least 24 hours' notice by phone and e-mail;
- reimburse the Department for CL Table 1 testing using the contract fee schedule for the CL (including mileage and travel/standby time) at the minimum guide schedule testing frequencies;
- reimburse the Department for CL Table 1 testing above the minimum guide schedule frequencies for retesting when minimum frequency testing results in failures to meet specification limits;
- agree with the Engineer and CL upon a policy regarding notification for testing services;
- give any cancellation notice to the Engineer, District Lab, and CL by phone and e-mail;
- reimburse the Department a \$150 cancellation fee to cover technician time and mileage charges for previously scheduled work cancelled without adequate notice, which resulted in mobilization of technician and/or equipment by the CL; and
- all CL charges will be reimbursed to the Department by a deduction from the Contractor's monthly pay estimate.

If the CL does not meet the Table 1 turnaround times, testing charge to the Contractor will be reduced by 50% for the first late day and an additional 5% for each succeeding late day.

Approved CL project testing above the minimum testing frequencies in the Guide Schedule of Sampling and Testing, and not as the result of failing tests, will be paid by the Department.

Other project-level Guide Schedule sampling and testing not shown on Table 1 will be the responsibility of the Department.

Table 1
Select Guide Schedule Sampling and Testing (Note 1)

TxDOT Test	Test Description	Turn-Around Time (Calendar days)
SOILS/BASE		
Tex-101-E	Preparation of Soil and Flexible Base Materials for Testing (included in other tests)	
Tex-104-E	Liquid Limit of Soils (included in 106-E)	
Tex-105-E	Plastic Limit of Soils (included in 106-E)	
Tex-106-E	Calculating the Plasticity Index of Soils	7
Tex-110-E	Particle Size Analysis of Soils	6
Tex-113-E	Moisture-Density Relationship of Base Materials	7
Tex-114-E	Moisture-Density Relationship of Subgrade and Embankment Soil	7
Tex-115-E	Field Method for In-Place Density of Soils and Base Materials	2
Tex-116-E	Ball Mill Method for the Disintegration of Flexible Base Material	5
Tex-117-E, Part II	Triaxial Compression Tests For Disturbed Soils and Base Materials (Part II)	6
Tex-113-E w/ Tex-117-E	Moisture-Density Relationship of Base Materials with Triaxial Compression Tests For Disturbed Soils and Base Materials (Part II)	10
Tex-140-E	Measuring Thickness of Pavement Layer	2
Tex-145-E	Determining Sulfate Content in Soils - Colorimetric Method	4
HOT MIX ASPHALT		
Tex-200-F	Sieve Analysis of Fine and Coarse Aggregate (dry, from ignition oven with known correction factors)	1 (Note 2)
Tex-203-F	Sand Equivalent Test	3
Tex-206-F, w/ Tex-207-F, Part I, w/ Tex-227-F	(Lab-Molded Density of Production Mixture – Texas Gyrotory) Method of Compacting Test Specimens of Bituminous Mixtures with Density of Compacted Bituminous Mixtures, Part I - Bulk Specific Gravity of Compacted Bituminous Mixtures, with Theoretical Maximum Specific Gravity of Bituminous Mixtures	1 (Note 2)
Tex-207-F, Part I &/or Part VI	(In-Place Air Voids of Roadway Cores) Density of Compacted Bituminous Mixtures, Part I- Bulk Specific Gravity of Compacted Bituminous Mixtures &/or Part VI - Bulk Specific Gravity of Compacted Bituminous Mixtures Using the Vacuum Method	1 (Note 2)
Tex-207-F, Part V	Density of Compacted Bituminous Mixtures, Part V- Determining Mat Segregation using a Density-Testing Gauge	3
Tex-207-F, Part VII	Density of Compacted Bituminous Mixtures, Part VII - Determining Longitudinal Joint Density using a Density-Testing Gauge	4
Tex-212-F	Moisture Content of Bituminous Mixtures	3
Tex-217-F	Deleterious Material and Decantation Test for Coarse Aggregate	4
Tex-221-F	Sampling Aggregate for Bituminous Mixtures, Surface Treatments, and LRA (included in other tests)	
Tex-222-F	Sampling Bituminous Mixtures (included in other tests)	
Tex-224-F	Determination of Flakiness Index	3
Tex-226-F	Indirect Tensile Strength Test (production mix)	4
Tex-235-F	Determining Draindown Characteristics in Bituminous Materials	3
Tex-236-F (Correction Factors)	Asphalt Content from Asphalt Paving Mixtures by the Ignition Method (Determining Correction Factors)	4
Tex-236-F	Asphalt Content from Asphalt Paving Mixtures by the Ignition Method (Production Mixture)	1 (Note 2)
Tex-241-F w/ Tex-207-F, Part I, w/ Tex-227-F	(Lab-Molded Density of Production Mixture – Superpave Gyrotory) Superpave Gyrotory Compacting of Specimens of Bituminous Mixtures (production mixture) with Density of Compacted Bituminous Mixtures, Part I- Part I - Bulk Specific Gravity of Compacted Bituminous Mixtures, with Theoretical Maximum Specific Gravity of Bituminous Mixtures	1 (Note 2)
Tex-242-F	Hamburg Wheel-Tracking Test (production mix, molded samples)	3
Tex-244-F	Thermal Profile of Hot Mix Asphalt	1
Tex-246-F	Permeability of Water Flow of Hot Mix Asphalt	3
Tex-280-F	Flat and Elongated Particles	3
Tex-530-C	Effect of Water on Bituminous Paving Mixtures (production mix)	4

AGGREGATES		
Tex-400-A	Sampling Flexible Base, Stone, Gravel, Sand, and Mineral Aggregates	3
Tex-410-A	Abrasion of Coarse Aggregate Using the Los Angeles Machine	5
Tex-411-A	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate	12
Tex-461-A	Degradation of Coarse Aggregate by Micro-Deval Abrasion	5
CHEMICAL		
Tex-612-J	Acid Insoluble Residue for Fine Aggregate	4
GENERAL		
HMA Production Specialist [TxAPA – Level 1-A] (\$/hr)		
HMA Roadway Specialist [TxAPA – Level 1-B] (\$/hr)		
Technician Travel/Standby Time (\$/hr)		
Per Diem (\$/day – meals and lodging)		
Mileage Rate (\$/mile from closest CL location)		
Note 1 – Turn-Around Time includes test time and time for travel/sampling and reporting. Note 2 – These tests require turn-around times meeting the governing specifications. Provide test results within the stated turn-around time. CL is allowed one additional day to provide the signed and sealed report.		

Special Provision to Item 6

Control of Materials



Item 6, "Control of Materials" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 6.10., "Hazardous Materials," is voided and replaced by the following:

Comply with the requirements of Article 7.12., "Responsibility for Hazardous Materials."

Notify the Engineer immediately when a visual observation or odor indicates that materials on sites owned or controlled by the Department may contain hazardous materials. Except as noted herein, the Department is responsible for testing, removing, and disposing of hazardous materials not introduced by the Contractor. The Engineer may suspend work wholly or in part during the testing, removing, or disposing of hazardous materials, except in the case where hazardous materials are introduced by the Contractor.

Use materials that are free of hazardous materials. Notify the Engineer immediately if materials are suspected to contain hazardous materials. If materials delivered to the project by the Contractor are suspected to contain hazardous materials, have an approved commercial laboratory test the materials for the presence of hazardous materials as approved. Remove, remediate, and dispose of any of these materials found to contain hazardous materials. The work required to comply with this section will be at the Contractor's expense if materials are found to contain hazardous materials. Working day charges will not be suspended and extensions of working days will not be granted for activities related to handling hazardous material introduced by the Contractor. If suspected materials are not found to contain hazardous materials, the Department will reimburse the Contractor for hazardous materials testing and will adjust working day charges if the Contractor can show that this work impacted the critical path.

10.1. Painted Steel Requirements. Coatings on existing steel contain hazardous materials unless otherwise shown on the plans. Remove paint and dispose of steel coated with paint containing hazardous materials in accordance with the following:

10.1.1. Removing Paint From Steel For contracts that are specifically for painting steel, Item 446, "Field Cleaning and Painting Steel" will be included as a pay item. Perform work in accordance with that item.

For projects where paint must be removed to allow for the dismantling of steel or to perform other work, the Department will provide for a separate contractor (third party) to remove paint containing hazardous materials prior to or during the Contract. Remove paint covering existing steel shown not to contain hazardous materials in accordance with Item 446, "Field Cleaning and Painting Steel."

10.1.2. Removal and Disposal of Painted Steel. For steel able to be dismantled by unbolting, paint removal will not be performed by the Department. The Department will remove paint, at locations shown on the plans or as agreed, for the Contractor's cutting and dismantling purposes. Utilize Department cleaned locations for dismantling when provided or provide own means of dismantling at other locations.

Painted steel to be retained by the Department will be shown on the plans. For painted steel that contains hazardous materials, dispose of the painted steel at a steel recycling or smelting facility unless otherwise shown on the plans. Maintain and make available to the Engineer invoices and other records obtained from the facility showing the received weight of the steel and the facility name. Dispose of steel that does not contain hazardous material coatings in accordance with federal, state and local regulations.

10.2. Asbestos Requirements. The plans will indicate locations or elements where asbestos containing materials (ACM) are known to be present. Where ACM is known to exist or where previously unknown ACM has been found, the Department will arrange for abatement by a separate contractor prior to or during the Contract. Notify the Engineer of proposed dates of demolition or removal of structural elements with ACM at least 60 days before beginning work to allow the Department sufficient time for abatement.

The Department of State Health Services (DSHS), Asbestos Programs Branch, is responsible for administering the requirements of the National Emissions Standards for Hazardous Air Pollutants, 40 CFR Part 61, Subpart M and the Texas Asbestos Health Protection Rules (TAHPR). Based on EPA guidance and regulatory background information, bridges are considered to be a regulated "facility" under NESHAP. Therefore, federal standards for demolition and renovation apply.

The Department is required to notify the DSHS at least 10 working days (by postmarked date) before initiating demolition or renovation of each structure or load bearing member shown on the plans. If the actual demolition or renovation date is changed or delayed, notify the Engineer in writing of the revised dates in sufficient time to allow for the Department's notification to DSHS to be postmarked at least 10 days in advance of the actual work.

Failure to provide the above information may require the temporary suspension of work under Article 8.4., "Temporary Suspension of Work or Working Day Charges," due to reasons under the control of the Contractor. The Department retains the right to determine the actual advance notice needed for the change in date to address post office business days and staff availability.

10.3. Lead Abatement. Provide traffic control as shown on the plans, and coordinate and cooperate with the third party and the Department for managing or removing hazardous materials. Work for the traffic control shown on the plans and coordination work will not be paid for directly but will be subsidiary to pertinent Items.

Special Provision to Item 7

Legal Relations and Responsibilities



Item 7, "Legal Relations and Responsibilities," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 7.7.2., "Texas Pollutant Discharge Elimination System (TPDES) Permits and Storm Water Pollution Prevention Plans (SWP3)," is voided and replaced by the following:

7.2. Texas Pollution Discharge Elimination System (TPDES) Permits and Storm Water Pollution Prevention Plans (SWP3).

7.2.1. Projects with less than one acre of soil disturbance including required associated project specific locations (PSL's) per TPDES GP TXR 150000.

No posting or filing will be required for soil disturbances within the right of way. Adhere to the requirements of the SWP3.

7.2.2. Projects with one acre but less than five acres of soil disturbance including required associated PSL's per TPDES GP TXR 150000.

The Department will be considered a primary operator for Operational Control Over Plans and Specifications as defined in TPDES GP TXR 150000 for construction activity in the right of way. The Department will post a small site notice along with other requirements as defined in TPDES GP TXR 150000 as the entity of having operational control over plans and specifications for work shown on the plans in the right of way.

The Contractor will be considered a Primary Operator for Day-to-Day Operational Control as defined in TPDES GP TXR 150000 for construction activity in the right of way. In addition to the Department's actions, the Contractor will post a small site notice along with other requirements as defined in TPDES GP TXR 150000 as the entity of having day-to-day operational control of the work shown on the plans in the right of way. This is in addition to the Contractor being responsible for TPDES GP TXR 150000 requirements for on- right of way and off- right of way PSL's. Adhere to all requirements of the SWP3 as shown on the plans. The Contractor will be responsible for Implement the SWP3 for the project site in accordance with the plans and specifications, TPDES General Permit TXR150000, and as directed.

7.2.3. Projects with 5 acres or more of soil disturbance including required associated PSL's per TPDES GP TXR 150000.

The Department will be considered a primary operator for Operational Control Over Plans and Specifications as defined in TPDES GP TXR 150000 for construction activities in the right of way. The Department will post a large site notice, file a notice of intent (NOI), notice of change (NOC), if applicable, and a notice of termination (NOT) along with other requirements per TPDES GP TXR 150000 as the entity having operational control over plans and specifications for work shown on the plans in the right of way.

The Contractor will be considered a primary operator for Day-to-Day Operational Control as defined in TPDES GP TXR 150000 for construction activities in the right of way. In addition to the Department's actions, the Contractor shall file a NOI, NOC, if applicable, and NOT and post a large site notice along with other requirements as the entity of having day-to-day operational control of the work shown on the plans in the right of way. This is in addition to the Contractor

being responsible for TPDES GP TXR 150000 requirements for on- right of way and off- right of way PSL's. Adhere to all requirements of the SWP3 as shown on the plans.

Special Provision to Item 7

Legal Relations and Responsibilities



Item 7, "Legal Relations and Responsibilities," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 7.2.4., "Public Safety and Convenience." The first paragraph is deleted and replaced by the following.

Ensure the safety and convenience of the public and property as provided in the Contract and as directed. Keep existing roadways open to traffic or construct and maintain detours and temporary structures for safe public travel. Manage construction to minimize disruption to traffic. Maintain the roadway in a good and passable condition, including proper drainage and provide for ingress and egress to adjacent property.

If the construction of the project requires the closing of a highway, as directed, coordinate the closure with the Engineer and work to ensure all lanes and ramps possible are available during peak traffic periods before, during, and after significant traffic generator events to avoid any adverse economic impact on the municipalities during:

- dates or events as shown on the plans, and
- other dates as directed.

Special Provision to Item 007

Legal Relations and Responsibilities



Item 7, “Legal Relations and Responsibilities,” of the Standard Specifications is amended with respect to the clauses cited below.

Section 2.6., “Barricades, Signs, and Traffic Handling,” the first paragraph is voided and replaced by the following:

- 2.6. **Barricades, Signs, and Traffic Handling.** Comply with the requirements of Item 502 “Barricades, Signs, and Traffic Handling,” and as directed. Provide traffic control devices that conform to the details shown on the plans, the TMUTCD, and the Department’s Compliant Work Zone Traffic Control Device List maintained by the Traffic Safety Division. When authorized or directed, provide additional signs or traffic control devices not required by the plans.

Section 2.6.1., “Contractor Responsible Person and Alternative,” is voided and replaced by the following:

- 2.6.1. **Contractor Responsible Person and Alternative.** Designate in writing, a Contractor’s Responsible Person (CRP) and an alternate to be the representative of the Contractor who is responsible for taking or directing corrective measures regarding the traffic control. The CRP or alternate must be accessible by phone 24 hr. per day and able to respond when notified. The CRP and alternate must comply with the requirements of Section 2.6.5., “Training.”

Section 2.6.2, “Flaggers,” the first paragraph is voided and replaced by the following:

- 2.6.2. **Flaggers.** Designate in writing, a flagger instructor who will serve as a flagging supervisor and is responsible for training and assuring that all flaggers are qualified to perform flagging duties. Certify to the Engineer that all flaggers will be trained and make available upon request a list of flaggers trained to perform flagging duties.

Section 2.6.5, “Training,” is voided and replaced by the following:

- 2.6.5. **Training.** Train workers involved with the traffic control using Department-approved training as shown on the “Traffic Control Training” Material Producer List.

Coordinate enrollment, pay associated fees, and successfully complete Department-approved training or Contractor-developed training. Training is valid for the period prescribed by the provider. Except for law enforcement personnel training, refresher training is required every 4 yr. from the date of completion unless otherwise specified by the course provider. The Engineer may require training at a frequency instead of the period prescribed based on the Department’s needs. Training and associated fees will not be measured or paid for directly but are considered subsidiary to pertinent Items.

Certify to the Engineer that workers involved in traffic control and other work zone personnel have been trained and make available upon request a copy of the certification of completion to the Engineer. Ensure the following is included in the certification of completion:

- name of provider and course title,
- name of participant,
- date of completion, and
- date of expiration.

Where Contractor-developed training or a Department-approved training course does not produce a certification, maintain a log of attendees. Make the log available upon request. Ensure the log is legible and includes the following:

- printed name and signature of participant,
- name and title of trainer, and
- date of training.

2.6.5.1. **Contractor-developed Training.** Develop and deliver Contractor-developed training meeting the minimum requirements established by the Department. The outline for this training must be submitted to the Engineer for approval at the preconstruction meeting. The CRP or designated alternate may deliver the training instead of the Department-approved training. The work performed and materials furnished to develop and deliver the training will not be measured or paid for directly but will be considered subsidiary to pertinent Items.

2.6.5.1.1. **Flagger Training Minimum Requirements.** A Contractor's certified flagging instructor is permitted to train other flaggers.

2.6.5.1.2. **Optional Contractor-developed Training for Other Work Zone Personnel.** For other work zone personnel, the Contractor may provide training meeting the curriculum shown below instead of Department-approved training.

Minimum curriculum for Contractor-provided training is as follows:

Contractor-developed training must provide information on the use of personnel protection equipment, occupational hazards and health risks, and other pertinent topics related to traffic management. The type and amount of training will depend on the job duties and responsibilities. Develop training applicable to the work being performed. Develop training to include the following topics.

- The Life You Save May Be Your Own (or other similar company safety motto).
- Purpose of the training.
 - It's the Law.
 - To make work zones safer for workers and motorist.
 - To understand what is needed for traffic control.
 - To save lives including your own.
- Personal and Co-Worker Safety.
 - **High Visibility Safety Apparel.** Discuss compliant requirements; inspect regularly for fading and reduced reflective properties; if night operations are required, discuss the additional and appropriate required apparel in addition to special night work risks; if moving operations are underway, discuss appropriate safety measures specific to the situation and traffic control plan.
 - **Blind Areas.** A blind area is the area around a vehicle or piece of construction equipment not visible to the operators, either by line of sight or indirectly by mirrors. Discuss the "Circle of Safety" around equipment and vehicles; use of spotters; maintain eye contact with equipment operators; and use of hand signals.
 - **Runovers and Backovers.** Remain alert at all times; keep a safe distance from traffic; avoid turning your back to traffic and if you must then use a spotter; and stay behind protective barriers, whenever possible. Note: It is not safe to sit on or lean against a concrete barrier, these barriers can deflect four plus feet when struck by a vehicle.
 - Look out for each other, warn co-workers.
 - Be courteous to motorists.
 - Do not run across active roadways.
 - Workers must obey traffic laws and drive courteously while operating vehicles in the work zones.
 - Workers must be made aware of company distracted driving policies.
- **Night Time Operations.** Focus should be placed on projects with a nighttime element.

- **Traffic Control Training.** Basics of Traffic Control.
 - Identify work zone traffic control supervisor and other appropriate persons to report issues to when they arise.
 - Emphasize that work zone traffic control devices must be in clean and in undamaged condition. If devices have been hit but not damaged, put back in their correct place and report to traffic control supervisor. If devices have been damaged, replace with new one and report to traffic control supervisor. If devices are dirty, faded or have missing or damaged reflective tape clean or replace and report to traffic control supervisor. Show examples of non-acceptable device conditions. Discuss various types of traffic control devices to be used and where spacing requirements can be found.
 - **Channelizing Devices and Barricades with Slanted Stripes.** Stripes are to slant in the direction you want traffic to stay or move to; demonstrate this with a device.
 - **Traffic Queuing.** Workers must be made aware of traffic queuing and the dangers created by it. Workers must be instructed to immediately notify the traffic control supervisor and other supervisory personnel if traffic is queuing beyond advance warning sign and devices or construction limits.
 - **Signs.** Signs must be straight and not leaning. Report problems to the traffic control supervisor or other as designated for immediate repair. Covered signs must be fully covered. If covers are damaged or out of place, report to traffic control supervisor or other as designated.

Special Provision to Item 7

Legal Relations and Responsibilities



Item 7, "Legal Relations and Responsibilities" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 7.20., "Security Incidents," is added.

- 20.1. Reporting of Security Incidents.** Immediately notify the Department's [Cyber Security Operations Center \(CSOC\) via the Report Cybersecurity Incident Page](#) on www.txdot.gov, of any potential cybersecurity incident or breach involving Department data. A breach of system security is the unauthorized acquisition of computerized data that compromises the security, confidentiality, or integrity of sensitive personal information maintained by a person, including data that is encrypted if the person accessing the data has the key required to decrypt the data.
- 20.2. Liability for costs incurred.** The Department reserves the right to hold the Contractor liable for all costs incurred by the Department to resolve a security incident introduced by the Contractor, their Subcontractors, or their Suppliers.

Special Provision to Item 8 Prosecution and Progress



Item 8, "Prosecution and Progress" of the Standard Specification is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 8.2., "Subcontracting," is supplemented by the following paragraph, which is added as paragraph six to this article:

The Contractor certifies by signing the Contract that the Contractor will not enter into any subcontract with a subcontractor that is not registered in the Department of Homeland Security's (DHS) E-Verify system. Require that all subcontractors working on the project register and require that all subcontractors remain active in the DHS E-Verify system until their work is complete on the project.

Special Provision to Item 8 Prosecution and Progress



Item 8, "Prosecution and Progress" of the Standard Specifications is amended with respect to the clause cited below. No other clauses or requirements of this Item are waived or changed.

Article 8.7.2., "Wrongful Default," is revised and replaced by the following:

If it is determined after the Contractor is declared in default, that the Contractor was not in default, the rights and obligations of all parties will be the same as if termination had been issued for the convenience of the public as provided in Article 8.8 "Termination of Contract."

Special Provision to Item 8 Prosecution and Progress



Item 8, "Prosecution and Progress" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 3., "Computation of Contract Time for Completion." The second paragraph is voided and replaced by the following:

The development of the conceptual time determination is intended to establish the number of working days on the Contract. Upon request, the Engineer will provide the conceptual time determination schedule to the Contractor for informational purposes only. The schedule assumes generic resources, production rates, sequences of construction, and average weather conditions based on historic data. Schedule labor, equipment, procurement of materials, subcontractor work, and all other necessary means to prosecute the work within the number of working days specified by the Contract.

Special Provision to Item 009

Measurement and Payment



Item 009 "Measurement and Payment" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 9.5., "PROGRESS PAYMENTS" is supplemented with the following:

It is the Department's desire to pay a Contractor for work through the last working day of the month; however, the use of early cut-off dates for monthly estimates and MOH is a project management practice to manage workload at the Area Office level. Approval for using early cut-off dates is at the District's discretion. The earliest cut-off date for estimates is the 25th of the month.

Article 9.6., "PAYMENT FOR MATERIAL ON HAND (MOH)" first paragraph is amended as follows:

If payment for MOH is desired, request compensation for the invoice cost of acceptable nonperishable materials that have not been used in the work before the request, and that have been delivered to the work location or are in acceptable storage places. Nonperishable materials are those that do not have a shelf life or whose characteristics do not materially change when exposed to the elements. Include only materials that have been sampled, tested, approved, or certified, and are ready for incorporation into the work. Only materials which are completely constructed or fabricated on the Contractor's order for a specific Contract and are so marked and on which an approved test report has been issued are eligible. Payment for MOH may include the following types of items: concrete traffic barrier, precast concrete box culverts, concrete piling, reinforced concrete pipe, and illumination poles. Any repairs required after fabricated materials have been approved for storage will require approval of the Engineer before being made and will be made at the Contractor's expense. Include only those materials and products, when cumulated under an individual item or similar bid items, that have an invoice cost of at least \$1,000 in the request for MOH payment (e.g. For MOH eligibility, various sizes of conductor are considered similar bid items and may be cumulated to meet the threshold; for small roadside signs, the sign supports, mounting bolts, and the sign face is considered one bid item or similar bid items for more than one pay item for sign supports.) Requests for MOH are to be submitted at least two days before but not later than the estimate cutoff date unless otherwise agreed. If there is a need to request MOH after the established cut-off date, the district can make accommodation as the need arises. This needed accommodation is to be the exception, though, and not the rule.

Special Provision to Item 9

Measurement and Payment



Item 9, "Measurement and Payment" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 7.1.4.3., "Standby Equipment Costs," is voided and replaced by the following:

7.1.4.3. **Standby Equipment Costs.** Payment for standby equipment will be made in accordance with Section 9.7.1.4., "Equipment." The 15% markup will be paid when standby is associated with extra work but will not be paid when standby is associated with damages.

Section 7.1.4.3.1., "Contractor-Owned Equipment," is voided and replaced by the following:

7.1.4.3.1. **Contractor-Owned Equipment.** For Contractor-owned equipment:

- Standby will be paid at 50% of the monthly Rental Rate Blue Book rate after the regional and age adjustment factors have been applied. Operating costs will not be allowed. Calculate the standby rate as follows.

$$\text{Standby rate} = (\text{FHWA hourly rate} - \text{operating costs}) \times 50\%$$

- If an hourly rate is needed, divide the monthly Rental Rate Blue Book rate by 176.
- No more than 8 hr. of standby will be paid during a 24-hr. day period, nor more than 40 hr. per week.
- Standby costs will not be allowed during periods when the equipment would have otherwise been idle.

Special Provision to Item 247

Flexible Base



Item 247, "Flexible Base," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 247.2.1., "Aggregate." This Section is voided and replaced by the following.

Furnish aggregate of the type and grade shown on the plans and meeting the requirements shown in Table 1. Each source must meet Table 1 requirements for liquid limit, plasticity index, and wet ball mill for the grade specified. Do not use additives, such as but not limited to cement, emulsion, foamed asphalt, or lime, to modify aggregates to meet the requirements of Table 1, unless otherwise shown on the plans.

Unless otherwise shown on the plans, the unconfined compressive strength is waived when the flexible base material meets the #200 sieve requirement.

Table 1
Material Requirements

Property	Test Method	Grade 1–2 ³	Grade 3	Grade 4	Grade 5 ³
Master gradation sieve size (cumulative % retained)		–	–		–
2-1/2"		0	0		0
1-3/4"		0–10	0–10		0–5
7/8"	Tex-110-E	10–35	–		10–35
3/8"		30–65	–		35–65
#4		45–75	45–75		45–75
#40		65–90	50–85		70–90
#200 ^{1, 2}		85–95	–		–
Liquid limit, % Max	Tex-104-E	40	40	As shown on the plans	35
Plasticity index, Max		10	12		10
Plasticity index, Min	Tex-106-E	As shown on the plans	As shown on the plans		As shown on the plans
Wet ball mill, % Max		40	–		40
Wet ball mill, % Max increase passing the #40 sieve	Tex-116-E	20	–		20
Min compressive strength ² , psi		–	–		–
lateral pressure 0 psi		35	–		–
lateral pressure 3 psi	Tex-117-E	–	–		90
lateral pressure 15 psi		175	–		175

- The #200 sieve test is only required to meet the waiver of the unconfined compressive strength. The #200 sieve test requirement is only applicable to stockpile samples from Section 247.2.4.
- Compressive strength and #200 sieve test requirements are waived when the flexible base is mixed with or without existing material and treated with cement, emulsion, foamed asphalt, or lime, unless otherwise shown on the plans.
- Grade 3 may be substituted for Grade 1–2 or Grade 5 when the flexible base is mixed with or without existing material and treated with cement, emulsion, foamed asphalt, or lime, as approved. The Grade 3 flexible base must meet the wet ball mill requirements of Grade 1–2 or Grade 5.

Section 247.2.1.2.4., "Type D." The third sentence is voided and replaced by the following.

Crushed concrete must meet the requirements in Section 247.2.1.3., "Recycled Material," and be managed in a way to provide for uniform quality.

Section 247.2.1.3., "Recycled Material." This Section is voided and replaced by the following.

Reclaimed asphalt pavement (RAP) and other recycled materials may be used as shown on the plans. Request approval to blend two or more sources of recycled materials. When RAP is allowed, do not exceed 20% RAP by weight, unless otherwise shown on the plans. The percentage limitations for other recycled materials are as shown on the plans.

Provide recycled materials, other than RAP, that have a maximum sulfate content of 3,000 ppm when tested in accordance with [Tex-145-E](#). Certify accordance with [DMS-11000](#), "Evaluating and Using Nonhazardous Recyclable Materials Guidelines." In addition, recycled materials must be free of reinforcing steel and other objectionable material and have at most 1.5% deleterious material when tested in accordance with [Tex-413-A](#). The liquid limit, plasticity index, wet ball mill, and compressive strength for all recycled materials are waived. When using RAP, crush RAP so that 100% passes the 2-in. sieve and does not exceed a maximum percent loss from decantation of 5.0% when tested in accordance with [Tex-406-A](#). Test RAP without removing the asphalt. The final product must meet the requirements shown in Table 1 for the grade specified, except when the Department requires a specific amount of Department-furnished RAP be added to the blend, unless otherwise shown on the plans.

The Contractor is responsible for uniformly blending the recycled material with the flexible base material to build a stockpile to meet the percentages required. Any Contractor-furnished surplus of recycled materials must remain the property of the Contractor. Remove Contractor-owned recycled materials from the project, and dispose of them in conformance with federal, state, and local regulations before project acceptance.

Section 247.2.4., "Stockpile Approval." This Section is added.

Stockpile is approved when the Engineer's test results meet the material requirements shown in Table 1.

Section 247.2.4.1., "Sampling." This Section is added.

The Contractor and the Engineer will sample flexible base from completed stockpiles in accordance with [Tex-100-A](#). Personnel conducting sampling must be certified by the Department-approved soils and base certification program.

Sampling stockpiles may be located at the production site or at the project location. The Contractor must witness the Engineer's sampling and sample the stockpile for their own testing, and label as deemed necessary.

Sample the stockpile for the Engineer as shown on the plans. When the Contractor samples the stockpile for the Engineer, the Engineer will witness the sampling of material designated for the Engineer and the Materials and Tests Division (MTD). The Engineer will label their sampling containers as "Engineer" and "MTD," or as deemed necessary.

The Engineer will take immediate possession of the sample containers for the Engineer and MTD. The Engineer will maintain custody of the samples until all testing and reporting are completed.

Section 247.2.4.2., "Referee Testing." This Section is added.

Referee testing is applicable for stockpile testing only. MTD is the referee laboratory. MTD may designate a laboratory from the Department's MPL for *Commercial Laboratories Approved for Flexible Base Referee Requests* as the referee laboratory as deemed necessary. The designated laboratory must not perform any testing under this Item for the Engineer or Contractor.

The Contractor may request referee testing when the Engineer's test results fail to meet any of the material requirements shown in Table 1 and when the Contractor's sample from Section 247.2.4.1., "Sampling," for the same failing Department test passes. The tests must be performed by a laboratory on the Department's MPL for *Commercial Laboratories Approved for Flexible Base Referee Requests*. Submit the request by email within 5 working days after receiving failing test results from the Engineer. Include completed test reports passing the applicable requirements shown in Table 1 in the email.

Record and submit completed test reports electronically on Department-provided templates in their original format meeting the applicable material requirements shown in Table 1. Use Department-provided templates to record and calculate all test data. The Engineer and the Contractor will provide any available test results to the other party when requested.

Section 247.4.3., "Compaction." The first paragraph is voided and replaced by the following.

Compact using density control unless otherwise shown on the plans. Multiple lifts are permitted as shown on the plans or approved. Bring each layer to the moisture content directed. When necessary, sprinkle the material in accordance with Item 204, "Sprinkling." Maintain moisture during compaction within $\pm 2.0\%$ of the optimum moisture content as determined in accordance with [Tex-113-E](#).

Section 247.4.3.2., "Density Control." This Section is voided and replaced by the following.

Compact to at least 100% of the maximum dry density and within $\pm 2.0\%$ of the optimum moisture content as determined in accordance with [Tex-113-E](#), unless otherwise shown on the plans. Provide the Engineer with the beginning and ending station numbers of the area completed for testing. The Engineer will determine roadway density and moisture content of completed sections in accordance with [Tex-115-E](#), Part I. The Engineer will determine random locations for testing in accordance with [Tex-115-E](#), Part IV. Do not achieve density by drying the material after compaction.

When the density is less than 100% of the maximum dry density, the Engineer may perform additional testing to determine the extent of the area to correct. The Engineer may accept the section if no more than one of the five most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

Section 247.4.3.3., "Miscellaneous and Small Areas." This Section is added.

Miscellaneous areas are those that typically involve handwork or discontinuous paving operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Miscellaneous and small areas are not subject to random sampling procedure but may be tested as directed.

Section 247.4.6., "Ride Quality." This Section is voided and replaced by the following.

Measurement of ride quality only applies to the final travel lanes that receive a one- or two-course surface treatment for the final riding surface, unless otherwise shown on the plans. Measure the ride quality of the base course either before or after the application of the prime coat, as directed, and before placement of the surface treatment. Use a certified profiler operator on the Department's MPL. When requested, furnish the Engineer with documentation for the person certified to operate the profiler.

Provide all profile data to the Engineer in electronic data files within 3 days of measuring the ride quality using the format specified in [Tex-1001-S](#). The Engineer will use Department software to evaluate longitudinal profiles to determine areas requiring corrective action. Correct 0.1-mi. sections with an average international roughness index (IRI) value greater than 100 in. per mile to an IRI value of 100 in. per mile or less, unless otherwise shown on the plans. Re-profile and correct sections that fail to maintain ride quality before the placement of the surface treatment, as directed. Unless ride deterioration is due to environmental impact, traffic, or other incidents outside the Contractor's control, perform this work at no additional expense to the Department, as approved.

Special Provision to Item 300 Asphalt, Oils, and Emulsions



Item 300, "Asphalt, Oils, and Emulsions" of the Standard Specifications is replaced by Special Specification [3096](#), "Asphalts, Oils, and Emulsions." All Item 300 Special Provisions are no longer available, beginning with the April 2022 letting.

Special Provision to Item 316

Seal Coat



Item 316, "Seal Coat" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 4.8, "Asphalt Placement" is supplemented by the following:

4.8.5. Collect all samples in accordance with Tex-500-C, "Sampling Bituminous Materials, Pre-Molded Joint Fillers, and Joint Sealers" from the distributor and with witness by the Engineer.

At least once per project, collect split samples of each binder grade and source used. The Engineer will submit one split sample to MTD for testing and retain the other split sample.

In addition, collect one sample of each binder grade and source used on the project for each production day. The Engineer will retain these samples.

The Engineer will keep all retained samples for one yr., for hot-applied binders and cutback asphalts; or for two mo., for emulsified asphalts. The Engineer may submit retained samples to MTD for testing as necessary or as requested by MTD.

Special Provision to Item 334

Hot-Mix Cold-Laid Asphalt Concrete Pavement



Item 334, "Hot-Mix Cold-Laid Asphalt Concrete Pavement," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed hereby.

Section 334.4.1.2., "Job-Mix Formula Approval." Table 5 is voided and replaced by the following:

Table 5
Laboratory Mixture Design Properties

Property	Test Method	Requirement
Target laboratory-molded density, % ¹	Tex-207-F	94.0 ± 1.5
Hveem stability, Min	Tex-208-F	35
Cantabro loss, %, Max	Tex-245-F	10
Hydrocarbon-volatile content, %, Max	Tex-213-F	0.6
Moisture content, %, Max ²	Tex-212-F	1.0
Boil test, %, Max ³	Tex-530-C	10

1. Unless otherwise shown on the plans.
2. Unless otherwise approved.
3. Limit may be increased or eliminated when approved.

Special Provision to Item 340 Dense-Graded Hot-Mix (Small Quantity)



Item 340, "Dense-Graded Hot-Mix (Small Quantity)" of the Standard Specifications is replaced by Special Specification [3076](#), "Dense-Graded Hot-Mix Asphalt," Section 4.9.4., "Exempt Production." All Item 340 Special Provisions and bid codes are no longer available, beginning with the February 2022 letting.

Special Provision to Item 341 Dense-Graded Hot-Mix Asphalt



Item 341, "Dense-Graded Hot-Mix Asphalt" of the Standard Specifications is replaced by Special Specification [3076](#), "Dense-Graded Hot-Mix Asphalt." All Item 341 Special Provisions and bid codes are no longer available, beginning with the February 2020 letting.

Special Provision to Item 342 Permeable Friction Course (PFC)



Item 342, "Permeable Friction Course (PFC)" of the Standard Specifications is replaced by Special Specification [3079](#), "Permeable Friction Course." All Item 342 Special Provisions and bid codes are no longer available, beginning with the April 2022 letting.

Special Provision to Item 347 Thin Overlay Mixture (TOM)



Item 347, "Thin Overlay Mixture (TOM)" of the Standard Specifications is replaced by Special Specification [3081](#), "Thin Overlay Mixture (TOM)". All Item 347 Special Provisions and bid codes are no longer available, beginning with the April 2022 letting.

Special Provision to Item 348 Thin Bonded Friction Courses



Item 348, "Thin Bonded Friction Courses" of the Standard Specifications is replaced by Special Specification [3082](#), "Thin Bonded Friction Courses." All Item 348 Special Provisions and bid codes are no longer available, beginning with the April 2022 letting.

Special Provision to Item 421

Hydraulic Cement Concrete



Item 421, "Hydraulic Cement Concrete" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 421.2., "Materials," the second sentence of the first paragraph is voided and replaced by the following.

Provide aggregates from sources listed in the Department's Concrete Rated Source Quality Catalog (CRSQC).

Article 421.2.2., Supplementary Cementing Materials (SCM), is voided and replaced with the following.

Supplementary Cementitious Materials (SCM).

- **Coal Ash.** Furnish sources of fly ash, , Modified fly ash (MFA), harvested coal ash, and Ground Bottom Ash (GBA) conforming to [DMS-4610](#), "Coal Ash."
- **Slag Cement.** Furnish Slag Cement in accordance with [DMS-4620](#), "Slag Cement."
- **Silica Fume.** Furnish silica fume in accordance with [DMS-4630](#), "Silica Fume."
- **Natural Pozzolans.** Furnish Natural Pozzolans in accordance with [DMS-4635](#), "Natural Pozzolans."

Article 421.3.1.3., "Agitators and Truck and Stationary Mixers," the first paragraph is voided and replaced by the following.

Provide stationary and truck mixers capable of combining the ingredients of the concrete into a thoroughly mixed and uniform mass and capable of discharging the concrete so that the requirements of [Tex-472-A](#) are met.

Article 421.3.1.3., "Agitators and Truck and Stationary Mixers," is supplemented with the following.

Truck mixers with automated water and chemical admixture measurement and slump and slump flow monitoring equipment meeting the requirement of ASTM C94 will be allowed. Provide data every 6 mo. substantiating the accuracy of slump, slump flow, temperature, water, and chemical admixture measurements. The slump measured by the automated system must be within 1 in. of the slump measured in accordance with [Tex-415-A](#). The concrete temperature measured by the automated system must be within 1°F of concrete temperature measured in accordance with [Tex-422-A](#). The Engineer will not use the automated measurements for acceptance.

Article 421.4.2., "Mix Design Proportioning," Table 8 is voided and replaced by the following.

Table 8
Concrete Classes

Class of Concrete	Design Strength, ¹ Min f'_c (psi)	Max w/cm Ratio	Coarse Aggregate Grades ^{2,3,4}	Cement Types	Mix Design Options	Exceptions to Mix Design Options	General Usage ⁵
A	3,000	0.60	1-4, 8	I, II, I/II, IL, IP, IS, IT, V	1, 2, 4, & 7	When the cementitious material content does not exceed 520 lb./cu. yd., any coal ash or natural pozzolan listed in the MPL may be used at a cement replacement of 20% to 50%.	Curb, gutter, curb & gutter, conc. retards, sidewalks, driveways, back-up walls, anchors, non-reinforced drilled shafts
B	2,000	0.60	2-7				Riprap, traffic signal controller foundations, small roadside signs, and anchors
C ⁶	3,600	0.45	1-6	I, II, I/II, IP, IL, IS, IT, V	1-8		Drilled shafts, bridge substructure, traffic rail, culverts except top slab of direct traffic culverts, headwalls, wing walls, inlets, manholes, traffic barrier
E	3,000	0.50	2-5	I, II, I/II, IL, IP, IS, IT, V	1-8	When the cementitious material content does not exceed 520 lb./cu. yd., any coal ash or natural pozzolan listed in the MPL may be used at a cement replacement of 20% to 50%.	Seal concrete
F ⁶	Note ⁷	0.45	2-5	I, II, I/II, IP, IL, IS, IT, V			Railroad structures; occasionally for bridge piers, columns, bents, post-tension members
H ⁶	Note ⁷	0.45	3-6	I, II, I/II, III, IP, IL, IS, IT, V	1-4, 8	<p>Mix design options 1-8 allowed for cast-in-place concrete and the following precast elements unless otherwise stated in the plans:</p> <ul style="list-style-type: none"> ■ Bridge Deck Panels, ■ Retaining Wall Systems, ■ Coping, ■ Sound Walls, ■ Wall Columns, ■ Traffic Rail, ■ Traffic Barrier, ■ Long/Arch Span Culverts, and ■ precast concrete products included in Item 462, "Concrete Box Culverts and Drains, Item 464, "Reinforced Concrete Pipe," and Item 465, "Junction Boxes, Manholes, and Inlets." <p>Do not use Type III cement in mass placement concrete. Up to 20% of blended cement may be replaced with listed SCMs when Option 4 is used for precast concrete. Options 6, & 7 allowed for cast-in-place Class H concrete.</p>	Precast concrete, post-tension members
S ⁶	4,000	0.45	2-5	I, II, I/II, IP, IL, IS, IT, V	1-8		Bridge slabs, top slabs of direct traffic culverts, approach slabs

Class of Concrete	Design Strength, ¹ Min f_c (psi)	Max w/cm Ratio	Coarse Aggregate Grades ^{2,3,4}	Cement Types	Mix Design Options	Exceptions to Mix Design Options	General Usage ⁵
P	See Item 360, "Concrete Pavement."	0.50	2-3	I, II, I/II, IL, IP, IS, IT, V	1-8	When the cementitious material content does not exceed 520 lb./cu. yd., any coal ash or natural pozzolan listed in the MPL's may be used at a cement replacement of 20% to 50%.	Concrete pavement
CO ⁶	4,600	0.40	6	I, II, I/II, IP, IL, IS, IT, V	1-8		Bridge deck concrete overlay
LMC ⁶	4,000	0.40	6-8				Latex-modified concrete overlay
SS ⁶	3,600	0.45	4-6	I, II, I/II, IP, IL, IS, IT, V	1-8	Use a Min cementitious material content of 658 lb./cu. yd. of concrete. Limit the alkali loading to 4.0 lbs./cu. yd. or less when using Option 7.	Slurry displacement shafts, underwater drilled shafts
K ⁶	Note ⁷	0.40	Note ⁷	I, II, I/II, III, IP, IL, IS, IT, V	1-8		Note ⁷
HES	Note ⁷	0.45	Note ⁷	I, IL, II, I/II, III		Mix design options do not apply. 700 lb. of cementitious material per cubic yard limit does not apply.	Concrete pavement, concrete pavement repair
"X" (HPC) <small>6,8,9</small>	Note ¹⁰	0.45	Note ¹⁰	I, II, I/II, III, IP, IL, IS, IT, V	1-4, & 8	Max coal ash replacement for Option 3 may be increased to 50%. Up to 20% of a blended cement may be replaced with listed SCMs for Option 4. Do not use Option 8 for precast concrete.	
"X" (SRC) <small>6,8,9</small>	Note ¹⁰	0.45	Note ¹⁰	I/II, II, IP, IL (MS or HS), IS, IT (MS or HS), V	1-4, & 7	When using coal ash, only use coal ashes allowed for SRC as listed in the Coal Ash MPL. Type III-MS may be used where allowed. Type I, Type IL, and Type III cements may be used when natural pozzolans are used or when coal ashes allowed for SRC as listed in the Coal Ash MPL are used, and with a Max w/cm of 0.40. Up to 20% of blended cement may be replaced with listed SCMs when Option 4 is used for precast concrete. Use Option 7 for precast concrete where allowed.	

- Design strength must be attained within 56 days.
- Do not use Grade 1 coarse aggregate except in massive foundations with 4 in. Min clear spacing between reinforcing steel bars, unless otherwise permitted. Do not use Grade 1 aggregate in drilled shafts.
- Use Grade 8 aggregate in extruded curbs unless otherwise approved.
- Other grades of coarse aggregate maybe used in non-structural concrete classes when allowed by the Engineer.
- For information only.
- Structural concrete classes.
- As shown on the plans or specified.
- "X" denotes class of concrete shown on the plans or specified.
- (HPC): High Performance Concrete, (SRC): Sulfate Resistant Concrete.
- Same as class of concrete shown on the plans.

Article 421.4.2.2., “Aggregates,” is supplemented by the following.

Use the following equation to determine if the aggregate combination meets the sand equivalency requirement when blending fine aggregate or using an intermediate aggregate:

$$\frac{(SE_1 \times P_1) + (SE_2 \times P_2) + (SE_{ia} \times P_{ia})}{100} \geq 80\%$$

where:

SE_1 = sand equivalency (%) of fine aggregate 1

SE_2 = sand equivalency (%) of fine aggregate 2

SE_{ia} = sand equivalency (%) of intermediate aggregate passing the 3/8 in. sieve

P_1 = percent by weight of fine aggregate 1 of the fine aggregate blend

P_2 = percent by weight of fine aggregate 2 of the fine aggregate blend

P_{ia} = percent by weight of intermediate aggregate passing the 3/8 in. sieve

Article 421.4.2.3., Chemical Admixtures,” the second paragraph is voided and replaced with the following.

Use a 30% calcium nitrite solution when a corrosion-inhibiting admixture is required. Dose the admixture at the rate of gallons of admixture per cubic yard of concrete shown on the plans. Use set retarding admixtures, as needed, to control setting time to ensure concrete containing corrosion inhibiting admixtures remain workable for the entire duration of the concrete placement. Perform setting time testing and slump loss testing during trial batch testing.

Article 421.4.2.5., “Slump,” the second paragraph is voided and not replaced. Table 9 is voided and replaced with below:

Table 9
Placement Slump Requirements

General Usage	Placement Slump Range, ^{1,2} in.
Walls (over 9 in. thick), caps, columns, piers	3 – 7
Bridge slabs, top slabs of direct traffic culverts, approach slabs, concrete overlays, latex-modified concrete for bridge deck overlays	3 – 6
Inlets, manholes, walls (less than 9 in. thick), bridge railing, culverts, concrete traffic barrier, concrete pavement (formed)	4 – 6
Precast concrete	4 – 9
Underwater concrete placements	6 – 8-1/2
Drilled shafts, slurry displaced and underwater drilled shafts	See Item 416, “Drilled Shaft Foundations.”
Curb, gutter, curb and gutter, concrete retards, sidewalk, driveways, seal concrete, anchors, riprap, small roadside sign foundations, concrete pavement repair, concrete repair	As approved

1. Max slump values may be increase above these values shown using chemical admixtures, provided the admixture treated concrete has the same or lower water-to-cementitious ratio and does not exhibit segregation or excessive bleeding. Request approval to increase slump limits in advance for proper evaluation by the Engineer.
2. For fiber reinforced concrete, perform slump before addition of fibers.

Article 421.4.2.6., “Mix Design Options,” is voided and replaced with the following.

Option 1. Replace cement with at least the minimum dosage listed in the MPL for the coal ash or natural pozzolan used in the mixture. Do not replace more than 50% of the cement. Conduct Option 8 testing as listed on the MPL.

Option 2. Replace 35% to 50% of the cement with slag cement.

Option 3. Replace 35% to 50% of the cement with a combination of coal ash, slag cement, natural pozzolan, or at least 3% silica fume; however, no more than 10% may be silica fume.

Option 4. Use Type IP, Type IS, or Type IT cement as allowed in Table 8 for each class of concrete. When replacing blended cements with additional SCM's, the replacement limits in Option 3 will apply to the final cementitious mixture. When using coal

ash or natural pozzolans not having a minimum dosage listed in the MPL in the final cementitious mixture, perform Option 8 testing.

Option 5. Option 5 is left intentionally blank.

Option 6. Use a lithium nitrate admixture at a minimum dosage determined by testing conducted in accordance with [Tex-471-A](#). Before use of the mix, provide an annual certified test report signed and sealed by a licensed professional engineer, from a laboratory listed on the MPL, certified by the Materials and Tests Division as being capable of testing according to [Tex-471-A](#).

Option 7. Ensure the total alkali contribution from the cement in the concrete does not exceed 3.5 lb. per cubic yard of concrete when using hydraulic cement not containing SCMs calculated as follows:

$$\text{lb. alkali per cu. yd.} = \frac{(\text{lb. cement per cu. yd.}) \times (\% \text{ Na}_2\text{O equivalent in cement})}{100}$$

In the above calculation, use the maximum cement alkali content reported on the cement mill certificate.

Option 8. Use Table 10 when deviating from Options 1–3 or when required by the Coal Ash MPL. Perform required testing annually and submit results to the Engineer. Laboratories performing ASTM C1260, ASTM C1567, and ASTM C1293 testing must be listed on the MPL. Before use of the mix, provide a certified test report signed and sealed by a licensed professional engineer demonstrating the proposed mixture in accordance with the requirements of Table 10.

Provide a certified test report signed and sealed by a licensed professional engineer, when HPC is required, and less than 20% of the cement is replaced with SCMs, demonstrating ASTM C1876 test results indicate the uniaxial resistivity of the concrete is greater than 15.6 kΩ-cm tested immediately after either of the following curing schedules:

- Moisture cure specimens 56 days at 73°F.
- Moisture cure specimens 7 days at 73°F followed by 21 days at 100°F.

Table 10
Option 8 Testing and Mix Design Requirements

Scenario	ASTM C1260 Result		Testing Requirements for Mix Design Materials or Prescriptive Mix Design Options
	Mix Design Fine Aggregate	Mix Design Coarse Aggregate	
A	> 0.10%	> 0.10%	Determine the dosage of SCMs needed to limit the 14-day expansion of each aggregate ¹ to 0.10% when tested individually in accordance with ASTM C1567.
B	≤ 0.10%	≤ 0.10%	Use the Min replacement listed in the Coal Ash MPL, or when Option 8 is listed on the MPL, use a Min of 40% coal ash with a Max CaO ² content of 25%, or use any ternary combination which replaces 35% to 50% of cement.
	≤ 0.10%	ASTM C1293 1 yr. Expansion ≤ 0.04%	Use a minimum of 20% of any coal ash; or Use any ternary combination which replaces 20% to 50% of cement.
C	≤ 0.10%	> 0.10%	Determine the dosage of SCMs needed to limit the 14-day expansion of coarse and intermediate ¹ aggregate to ≤0.10% when tested individually in accordance with ASTM C1567.
D	> 0.10%	≤ 0.10%	Use the Min replacement listed in the Coal Ash MPL, or when Option 8 is listed on the MPL, use a Min of 40% coal ash with a Max CaO ² content of 25%, or use any ternary combination which replaces 35% to 50% of cement.
	> 0.10%	ASTM C1293 1 yr. Expansion ≤ 0.04%	Determine the dosage of SCMs needed to limit the 14-day expansion of each fine aggregate to ≤0.10% when individually tested in accordance with ASTM C1567.

1. Intermediate size aggregates will fall under the requirements of mix design coarse aggregate.
2. Average the CaO content from the previous ten values as listed on the test certificate.

Article 421.4.2.7., “Optimized Aggregate Gradation (OAG) Concrete,” the first sentence of the first paragraph is voided and replaced by the following.

The gradations requirements in Table 4 and Table 6 do not apply when OAG concrete is specified or used by the Contractor unless otherwise shown on the plans.

The fineness modulus for fine aggregate listed in Table 5, does not apply when OAG concrete is used,

Article 421.4.6.2., Delivering Concrete,” the third paragraph is supplemented by the following.

When truck mixers are equipped with automated water or chemical admixture measurement and slump or slump flow monitoring equipment, the addition of water or chemical admixtures during transit is allowed. Reports generated by this equipment must be submitted to the Engineer daily.

Article 421.4.6.2., “Delivering Concrete,” the fifth paragraph is voided and replaced with the following. Begin the discharge of concrete delivered in truck mixers within the times listed in Table 14. Concrete delivered after these times, and concrete that has not begun to discharge within these times will be rejected.

Article 421.4.8.3., “Testing of Fresh Concrete,” is voided and replaced with the following.

Testing Concrete. The Engineer, unless specified in other Items or shown on the plans, will test the fresh and hardened concrete in accordance with the following methods:

- Slump. [Tex-415-A](#);
- Air Content. [Tex-414-A](#) or [Tex-416-A](#);
- Temperature. [Tex-422-A](#);
- Making and Curing Strength Specimens. [Tex-447-A](#);
- Compressive Strength. [Tex-418-A](#);
- Flexural Strength. [Tex-448-A](#); and
- Maturity. [Tex-426-A](#).

Flexural strength and maturity specimens will not be made unless specified in other items or shown on the plans.

Concrete with slump less than minimum required after all addition of water withheld will be rejected, unless otherwise allowed by the Engineer. Concrete with slump exceeding maximum allowed may be used at the Contractor's option. If used, Engineer will make, test, and evaluate strength specimens as specified in Article 421.5., "Acceptance of Concrete." Acceptance of concrete not meeting air content or temperature requirements will be determined by Engineer. Fresh concrete exhibiting segregation and excessive bleeding will be rejected.

Article 421.4.8.3.1., "Job-Control Testing," is voided and not replaced.

Special Provision to Item 440

Reinforcement for Concrete



Item 440, "Reinforcement for Concrete," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 440.2., "Materials," is supplemented with the following.

- 2.7. **Welded Deformed Bar Mat Reinforcement.** Provide welded deformed bar mats in accordance with ASTM A184 except as otherwise noted in this Specification. Fabricate welded bar mats from deformed steel bars in accordance with ASTM A706 by securely connecting every intersection with a process of electrical resistance welding that employs the principle of fusion combined with pressure. The bars must be assembled by automatic machines or by other suitable mechanical means that will assure accurate spacing and alignment of all bars of the finished product.
- 2.14. **Zinc-Coated, Hot-Dip Galvanized Class I or Class II Steel Reinforcement.** Provide zinc-coated, hot-dip galvanized Class I or Class II steel reinforcement in accordance with ASTM A767, Grade 60 or Grade 75, when shown on the plans and as allowed.
- 2.15. **Continuously Hot-Dip Galvanized Reinforcement (CGR).** Provide CGR in accordance with ASTM A1094 steel reinforcement, Grade 60 or Grade 75, when shown on the plans and as allowed.

Section 440.2.1., "Approved Mills." The second paragraph is voided and not replaced.

Section 440.2.5., "Weldable Reinforcing Steel," is supplemented with the following.

All welding operations must be performed before hot-dip galvanizing.

Section 440.2.8., "Mechanical Couplers," is voided and replaced with the following.

Use couplers of the type specified in [DMS-4510](#), "Mechanical Couplers for Reinforcing Steel," Section 4510.6.1., "General Requirements," when mechanical splices in reinforcing steel bars are shown on the plans.

Furnish only couplers pre-qualified in accordance with [DMS-4510](#), "Mechanical Couplers for Reinforcing Steel." Ensure sleeve-wedge type couplers are not used on coated reinforcing. Sample mechanical couplers in accordance with [Tex-743-I](#) for testing before use on individual projects. Test the mechanical couplers for every project in which mechanical couplers are used in accordance with [Tex-744-I](#). Furnish couplers only at locations shown on the plans.

Furnish couplers for stainless reinforcing steel with the same alloy designation as the reinforcing steel.

Provide hot-dip or mechanically galvanized couplers when splicing galvanized reinforcing or CGR.

Section 440.2.11., "Low Carbon/Chromium Reinforcing Steel." The first sentence is voided and replaced by the following.

Provide deformed steel bars in accordance with ASTM A1035, Grade 100, Type CS, when low-carbon, chromium-reinforcing steel is required on the plans. Type CM will be permitted only if specified on the plans.

Section 440.3.1., "Bending," is supplemented with the following.

Do not bend hot-dip galvanized reinforcement. Only minor positioning adjustments are permitted.

Bending of CGR is permitted after galvanizing.

Section 440.3.5., “Placing.” The following will be added to the fourth paragraph.

Use Class 1 or Class 1A supports with CGR. Provide epoxy- or plastic-coated tie wires and clips for use with epoxy-coated reinforcing steel.

Section 440.3.6.3., “Repairing Coating,” is supplemented with the following:

Repair damaged galvanized surfaces in accordance with Section 445.3.5.2., “Repair Processes.”

Special Provision to Item 502

Barricades, Signs and Traffic Handling



Item 502, "Barricades, Signs and Traffic Handling" of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 502.1., "Description," is supplemented by the following:

Temporary work-zone (TWZ) traffic control devices manufactured after December 31, 2019, must have been successfully tested to the crashworthiness requirements of the 2016 edition of the Manual for Assessing Safety Hardware (MASH). Such devices manufactured on or before this date and successfully tested to NCHRP Report 350 or the 2009 edition of MASH may continue to be used throughout their normal service lives. An exception to the manufacture date applies when, based on the project's date of letting, a category of MASH-2016 compliant TWZ traffic control devices are not approved, or are not self-certified after the December 31, 2019, date. In such case, devices that meet NCHRP-350 or MASH-2009 may be used regardless of the manufacture date.

Such TWZ traffic control devices include: portable sign supports, barricades, portable traffic barriers designated exclusively for use in temporary work zones, crash cushions designated exclusively for use in temporary work zones, longitudinal channelizers, truck and trailer mounted attenuators. Category I Devices (i.e., lightweight devices) such as cones, tubular markers and drums without lights or signs attached however, may be self-certified by the vendor or provider, with documentation provided to Department or as are shown on Department's Compliant Work Zone Traffic Control Device List.

Article 502.4., "Payment," is supplemented by the following:

Truck mounted attenuators and trailer attenuators will be paid for under Special Specification, "Truck Mounted Attenuator (TMA) and Trailer Attenuator (TA)." Portable Changeable Message Signs will be paid for under Special Specification, "Portable Changeable Message Sign." Portable Traffic Signals will be paid for under Special Specification, "Portable Traffic Signals."

Special Provision to Item 506

Temporary Erosion, Sedimentation, and Environmental Controls



For this project, Item 506, "Temporary Erosion, Sedimentation, and Environmental Controls," of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 506.1., "Description," is voided and replaced by the following:

Install, maintain, and remove erosion, sedimentation, and environmental control measures to prevent or reduce the discharge of pollutants in accordance with the Storm Water Pollution Prevention Plan (SWP3) or as directed. Ensure the installation and maintenance of control measures is performed in accordance with the manufacturer's or designer's specifications. Erosion and sediment control devices must be selected from the "Erosion Control Approved Products" or "Sediment Control Approved Products" lists. Perform work in a manner to prevent degradation of receiving waters, facilitate project construction, and comply with applicable federal, state, and local regulations.

Article 506.3., "Qualifications, Training, and Employee Requirements," is voided and not replaced.

Section 506.4.1., "Contractor Responsibilities," Section 506.4.2., "Implementation," and Section 506.4.3., "General," are voided and replaced by the following:

4.1. **Contractor Responsibilities.** Implement the SWP3 for the project site in accordance with the plans and specifications, and as directed. Coordinate storm water management with all other work on the project. Develop and implement an SWP3 for project-specific material supply plants within and outside of the Department's right of way in accordance with the specific or general storm water permit requirements. Prevent water pollution from storm water associated with construction activity from entering any surface water or private property on or adjacent to the project site.

4.2. **Implementation.**

4.2.1. **Commencement.** Implement the SWP3 as shown and as directed. Contractor proposed recommendations for changes will be allowed as approved. Do not implement changes until approval has been received and changes have been incorporated into the plans by the Engineer. Minor adjustments to meet field conditions are allowed and will be recorded by the Engineer in the SWP3.

Implement control measures before the commencement of activities that result in soil disturbance. Phase and minimize the soil disturbance to the areas shown on the plans. Coordinate temporary control measures with permanent control measures and all other work activities on the project to assure economical, effective, safe, continuous water pollution prevention. Provide control measures that are appropriate to the construction means, methods, and sequencing allowed by the Contract.

Do not prolong final grading and shaping. Preserve vegetation where possible throughout the project and minimize clearing, grubbing, and excavation within stream banks, bed, and approach sections.

4.3. **General.**

4.3.1. **Temporary Alterations or Control Measure Removal.** Altering or removal of control measures is allowed when control measures are restored within the same working day.

- 4.3.2. **Stabilization.** Initiate stabilization for disturbed areas no more than 14 days after the construction activities in that portion of the site has temporarily or permanently ceased. Establish a uniform vegetative cover or use another stabilization practice as approved.
- 4.3.3. **Finished Work.** Upon the Engineer's acceptance of vegetative cover or other stabilization practice, remove and dispose of all temporary control measures unless otherwise directed. Complete soil disturbing activities and establish a uniform perennial vegetative cover. A project will not be considered for acceptance until a vegetative cover of 70% density of existing adjacent undisturbed areas is obtained or equivalent permanent stabilization is obtained as approved.
- 4.3.4. **Restricted Activities and Required Precautions.** Do not discharge onto the ground or surface waters any pollutants such as chemicals, raw sewage, fuels, lubricants, coolants, hydraulic fluids, bitumens, or any other petroleum product. Operate and maintain equipment on site in a manner as to prevent actual or potential water pollution. Manage, control, and dispose of litter on site such that no adverse impacts to water quality occur. Prevent dust from creating a potential or actual unsafe condition, public nuisance, or condition endangering the value, utility, or appearance of any property. Wash out concrete trucks only in approved contained areas. Use appropriate controls to minimize the offsite transport of suspended sediments and other pollutants if it is necessary to pump or channel standing water (i.e. dewatering). Prevent discharges that would contribute to a violation of Edwards Aquifer Rules, water quality standards, the impairment of a listed water body, or other state or federal law.

Section 506.4.4., "Installation, Maintenance, and Removal Work." The first paragraph is voided and replaced by the following.

Perform work in accordance with the SWP3, and according to the manufacturers' guidelines. Install and maintain the integrity of temporary erosion and sedimentation control devices to accumulate silt and debris until soil disturbing activities are completed and permanent erosion control features are in place or the disturbed area has been adequately stabilized as determined by the Engineer.

Section 506.4.5., "Monitoring and Documentation," is voided and not replaced.

Section 506.6.5.2., "Maintenance Earthwork for Erosion and Sediment Control for Cleaning and/or Restoring Control Measures," is voided and replaced by the following:

Earthwork needed to remove and obliterate of erosion-control features will not be paid for directly but is subsidiary to pertinent Items unless otherwise shown on the plans.

Sprinkling and rolling required by this Item will not be paid for directly but will be subsidiary to this Item.

Special Provision to Item 520

Weighing and Measuring Equipment



Item 520, "Weighing and Measuring Equipment" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 520.2., "Equipment." The third paragraph is voided and replaced by the following.

Calibrate truck scales using weights certified by the Texas Department of Agriculture (TDA) or an equivalent agency as approved. Provide a written calibration report from a scale mechanic for truck scale calibrations. Cease plant operations during the checking operation. Do not use inaccurate or inadequate scales. Bring performance errors as close to zero as practicable when adjusting equipment.

Article 520.2., "Equipment." The fourth paragraph is amended to include the following:

At the Contractors option, an electronic ticket delivery system (e-ticketing) may be used instead of printed tickets. The use of e-ticketing will require written approval of the Engineer. At a minimum, the approved system will:

- Provide electronic, real-time e-tickets meeting the requirements of the applicable bid items;
- Automatically generate e-tickets using software and hardware fully integrated with the automated scale system used to weigh the material, and be designed in such a way that data input cannot be altered by the Contractor or the Engineer;
- Provide the Engineer access to the e-ticketing data in real-time with a web-based or app-based system compatible with iOS;
- Provide offline capabilities to prevent data loss if power or connectivity is lost;
- Require both the Contractor and the Engineer to accept or reject the e-ticket and provide the ability to record the information required by the applicable bid items, as well as any comments. Record the time of the approval/rejection and include it in the summary spreadsheet described below. Provide each party the capability to edit their respective actions and any entered information;

The Contractor may discontinue use of the e-ticket system and provide printed tickets as needed to meet the requirements of the applicable bid items.

Special Provision to Special Specification 3096

Asphalts, Oils, and Emulsions



Special Specification 3096, "Asphalts, Oils, and Emulsions," is amended with respect to the clause cited below. No other clause or requirements of this Item are waived or changed.

Section 3096.2.2., Table 3 Polymer-Modified Asphalt Cement has been voided and replaced by the following:

Table 3
Polymer-Modified Asphalt Cement

Property	Test Procedure	Polymer-Modified Viscosity Grade											
		AC-12-5TR		NT-HA ¹		AC-15P		AC-20XP		AC-10-2TR		AC-20-5TR	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Polymer		TR				SBS				SBS			
Polymer content, % (solids basis)	Tex-533-C or Tex-553-C	5.0	-	-	-	3.0	-	-	-	2.0	-	5.0	-
Dynamic shear, G*/sin δ, 82°C, 10 rad/s, kPa	T 315	-	-	1.0	-	-	-	-	-	-	-	-	-
Dynamic shear, G*/sin δ, 64°C, 10 rad/s, kPa	T 315	-	-	-	-	-	-	1.0	-	-	-	1.0	-
Dynamic shear, G*/sin δ, 58°C, 10 rad/s, kPa	T 315	1.0	-	-	-	-	-	-	-	1.0	-	-	-
Viscosity													
140°F, poise	T 202	1,200	-	-	-	1,500	-	2,000	-	1,000	-	2,000	-
275°F, poise	T 202	-	-	-	-	-	8.0	-	-	-	8.0	-	10.0
275°F, Pa-s	T 316	-	-	-	4.0	-	-	-	-	-	-	-	-
Penetration, 77°F, 100 g, 5 sec.	T 49	110	150	-	25	100	150	75	115	95	130	75	115
Elastic recovery, 50°F, %	Tex-539-C	55				55	-	55	-	30	-	55	-
Polymer separation	Tex-540-C	None		-		None		None		None		None	
Flash point, C.O.C., °F	T 48	425		425		425	-	425	-	425	-	425	-
Tests on residue from RTFOT aging and pressure aging:	T 240 and R 28												
Creep stiffness	T 313												
S, -18°C, MPa		-	300	-	-	-	300	-	300	-	300	-	300
m-value, -18°C		0.300	-	-	-	0.300	-	0.300	-	0.300	-	0.300	-

1. This is a hot-applied TRAIL product.

Section 3096.2.5., Diluted Emulsions tables has been added.

Diluted Emulsions. Provide emulsified asphalt that is homogeneous, does not separate after thorough mixing, and meets the requirements for the specified type and grade in Tables 12A, and 12B, where the suffixes 50/50, 40/60, and 30/70 mean 50% emulsion diluted with 50% water; 40% emulsion diluted with 60% water, and 30% emulsion diluted with 70% water, respectively. For example, CSS-1H 40/60 means 40% CSS-1H diluted with 60% water and AE-P 30/70 means 30% AE-P diluted with 70% water.

Table 12A
Diluted CSS-1H

Property	Test Procedure	Type-Grade					
		Diluted Slow-Setting					
		CSS-1H 50/50		CSS-1H 40/60		CSS-1H 30/70	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec.	T 72	Report Only		Report Only		Report Only	
Distillation test: Residue by distillation, % by wt. Oil distillate, % by volume of emulsion	T 59	30	–	24	–	18	–
		–	0.5	–	0.5	–	0.5
Tests on residue from distillation:							
Penetration, 77°F, 100 g, 5 sec.	T 49	40	110	40	110	40	110
Solubility, %	T 44	97.5	–	97.5	–	97.5	–
Ductility, 77°F, 5 cm/min., cm	T 51	80	–	80	–	80	–

Table 12B
Diluted AE-P

Property	Test Procedure	Type-Grade					
		Diluted Slow-Setting					
		AE-P 50/50		AE-P 40/60		AE-P 30/70	
		Min	Max	Min	Min	Max	Min
Viscosity, Saybolt Furol 122°F, sec.	T 72	Report Only		Report Only		Report Only	
Asphalt emulsion distillation to 500°F followed by Cutback asphalt distillation of residue to 680°F: Residue after both distillations, % by wt. Total oil distillate from both distillations, % by volume of emulsion	T 59 & T 78	20	–	16	–	12	–
		12.5	20	10.0	16	7.5	12
Tests on residue after all distillations:							
Solubility, %	T 44	97.5	–	97.5	–	97.5	–
Float test, 122°F, sec.	T 50	50	200	50	200	50	200

Special Provision to Special Specification 6185

Truck Mounted Attenuator (TMA) and Trailer Attenuator (TA)



Item 6185, "Truck Mounted Attenuator (TMA) and Trailer Attenuator (TA)" of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 4. "Measurement", is voided and replaced by the following:

- 4.1. **Truck Mounted Attenuator/Trailer Attenuator (Stationary).** This Item will be measured by the day. TMA/TAs must be set up in a work area and operational before a calendar day can be considered measurable. A day will be measured for each TMA/TA set up and operational on the worksite.
- 4.2. **Truck Mounted Attenuator/Trailer Attenuator (Mobile Operation).** This Item will be measured by the hour or by the day. The time begins once the TMA/TA is ready for operation at the predetermined site and stops when notified by the Engineer. When measurement by the hour is specified, a minimum of 4 hr. will be paid each day for each operating TMA/TA used in a mobile operation. When measurement by the day is specified, a day will be measured for each TMA/TA set up and operational on the worksite.

Special Specification 3076

Dense-Graded Hot-Mix Asphalt



1. DESCRIPTION

Construct a hot-mix asphalt (HMA) pavement layer composed of a compacted, dense-graded mixture of aggregate and asphalt binder mixed hot in a mixing plant. Payment adjustments will apply to HMA placed under this specification unless the HMA is deemed exempt in accordance with Section 3076.4.9.4., "Exempt Production."

2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

Notify the Engineer of all material sources and before changing any material source or formulation. The Engineer will verify that the specification requirements are met when the Contractor makes a source or formulation change, and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time during the project to verify specification compliance in accordance with Item 6, "Control of Materials."

- 2.1. **Aggregate.** Furnish aggregates from sources that conform to the requirements shown in Table 1 and as specified in this Section. Aggregate requirements in this Section, including those shown in Table 1, may be modified or eliminated when shown on the plans. Additional aggregate requirements may be specified when shown on the plans. Provide aggregate stockpiles that meet the definitions in this Section for coarse, intermediate, or fine aggregate. Aggregate from reclaimed asphalt pavement (RAP) is not required to meet Table 1 requirements unless otherwise shown on the plans. Supply aggregates that meet the definitions in [Tex-100-E](#) for crushed gravel or crushed stone. The Engineer will designate the plant or the quarry as the sampling location. Provide samples from materials produced for the project. The Engineer will establish the Surface Aggregate Classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests listed in Table 1. Document all test results on the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis given in [Tex-200-F](#), Part II.

- 2.1.1. **Coarse Aggregate.** Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve. Aggregates from sources listed in the Department's *Bituminous Rated Source Quality Catalog* (BRSQC) are preapproved for use. Use only the rated values for hot-mix listed in the BRSQC. Rated values for surface treatment (ST) do not apply to coarse aggregate sources used in hot-mix asphalt.

For sources not listed on the Department's BRSQC:

- build an individual stockpile for each material;
- request the Department test the stockpile for specification compliance; and
- once approved, do not add material to the stockpile unless otherwise approved.

Provide aggregate from non-listed sources only when tested by the Engineer and approved before use. Allow 30 calendar days for the Engineer to sample, test, and report results for non-listed sources.

Provide coarse aggregate with at least the minimum SAC shown on the plans. SAC requirements only apply to aggregates used on the surface of travel lanes. SAC requirements apply to aggregates used on surfaces other than travel lanes when shown on the plans. The SAC for sources on the Department's *Aggregate Quality Monitoring Program (AQMP)* ([Tex-499-A](#)) is listed in the BRSQC.

- 2.1.1.1. **Blending Class A and Class B Aggregates.** Class B aggregate meeting all other requirements in Table 1 may be blended with a Class A aggregate to meet requirements for Class A materials, unless otherwise shown on the plans. Ensure that at least 50% by weight, or volume if required, of the material retained on the No. 4 sieve comes from the Class A aggregate source when blending Class A and B aggregates to meet a Class A requirement unless otherwise shown on the plans. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. Coarse aggregate from RAP and Recycled Asphalt Shingles (RAS) will be considered as Class B aggregate for blending purposes.

The Engineer may perform tests at any time during production, when the Contractor blends Class A and B aggregates to meet a Class A requirement, to ensure that at least 50% by weight, or volume if required, of the material retained on the No. 4 sieve comes from the Class A aggregate source. The Engineer will use the Department's mix design template, when electing to verify conformance, to calculate the percent of Class A aggregate retained on the No. 4 sieve by inputting the bin percentages shown from readouts in the control room at the time of production and stockpile gradations measured at the time of production. The Engineer may determine the gradations based on either washed or dry sieve analysis from samples obtained from individual aggregate cold feed bins or aggregate stockpiles. The Engineer may perform spot checks using the gradations supplied by the Contractor on the mixture design report as an input for the template; however, a failing spot check will require confirmation with a stockpile gradation determined by the Engineer.

- 2.1.1.2. **Micro-Deval Abrasion.** The Engineer will perform a minimum of one Micro-Deval abrasion test in accordance with [Tex-461-A](#) for each coarse aggregate source used in the mixture design that has a Rated Source Soundness Magnesium (RSSM) loss value greater than 15 as listed in the BRSQC. The Engineer will perform testing before the start of production and may perform additional testing at any time during production. The Engineer may obtain the coarse aggregate samples from each coarse aggregate source or may require the Contractor to obtain the samples. The Engineer may waive all Micro-Deval testing based on a satisfactory test history of the same aggregate source.

The Engineer will estimate the magnesium sulfate soundness loss for each coarse aggregate source, when tested, using the following formula:

$$Mg_{est.} = (RSSM)(MD_{act.}/RSMD)$$

where:

$Mg_{est.}$ = magnesium sulfate soundness loss

$MD_{act.}$ = actual Micro-Deval percent loss

$RSMD$ = Rated Source Micro-Deval

When the estimated magnesium sulfate soundness loss is greater than the maximum magnesium sulfate soundness loss specified, the coarse aggregate source will not be allowed for use unless otherwise approved. The Engineer will consult the Soils and Aggregates Section of the Materials and Tests Division, and additional testing may be required before granting approval.

- 2.1.2. **Intermediate Aggregate.** Aggregates not meeting the definition of coarse or fine aggregate will be defined as intermediate aggregate. Supply intermediate aggregates, when used that are free from organic impurities. The Engineer may test the intermediate aggregate in accordance with [Tex-408-A](#) to verify the material is free from organic impurities. Supply intermediate aggregate from coarse aggregate sources, when used that meet the requirements shown in Table 1 unless otherwise approved.

Test the stockpile if 10% or more of the stockpile is retained on the No. 4 sieve, and verify that it meets the requirements in Table 1 for crushed face count ([Tex-460-A](#)) and flat and elongated particles ([Tex-280-F](#)).

2.1.3.

Fine Aggregate. Fine aggregates consist of manufactured sands, screenings, and field sands. Fine aggregate stockpiles must meet the gradation requirements in Table 2. Supply fine aggregates that are free from organic impurities. The Engineer may test the fine aggregate in accordance with [Tex-408-A](#) to verify the material is free from organic impurities. Unless otherwise shown on the plans, up to 10% of the total aggregate may be field sand or other uncrushed fine aggregate. Use fine aggregate, with the exception of field sand, from coarse aggregate sources that meet the requirements shown in Table 1 unless otherwise approved.

Test the stockpile if 10% or more of the stockpile is retained on the No. 4 sieve and verify that it meets the requirements in Table 1 for crushed face count ([Tex-460-A](#)) and flat and elongated particles ([Tex-280-F](#)).

Table 1
Aggregate Quality Requirements

Property	Test Method	Requirement
Coarse Aggregate		
SAC	Tex-499-A (AQMP)	As shown on the plans
Deleterious material, %, Max	Tex-217-F , Part I	1.5
Decantation, %, Max	Tex-217-F , Part II	1.5
Micro-Deval abrasion, %	Tex-461-A	Note 1
Los Angeles abrasion, %, Max	Tex-410-A	40
Magnesium sulfate soundness, 5 cycles, %, Max	Tex-411-A	30
Crushed face count, ² %, Min	Tex-460-A , Part I	85
Flat and elongated particles @ 5:1, %, Max	Tex-280-F	10
Fine Aggregate		
Linear shrinkage, %, Max	Tex-107-E	3
Sand equivalent, %, Min	Tex-203-F	45

- Used to estimate the magnesium sulfate soundness loss in accordance with Section 3076.2.1.1.2., "Micro-Deval Abrasion."
- Only applies to crushed gravel.

Table 2
Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Weight or Volume
3/8"	100
#8	70–100
#200	0–30

2.2.

Mineral Filler. Mineral filler consists of finely divided mineral matter such as agricultural lime, crusher fines, hydrated lime, or fly ash. Mineral filler is allowed unless otherwise shown on the plans. Use no more than 2% hydrated lime or fly ash unless otherwise shown on the plans. Use no more than 1% hydrated lime if a substitute binder is used unless otherwise shown on the plans or allowed. Test all mineral fillers except hydrated lime and fly ash in accordance with [Tex-107-E](#) to ensure specification compliance. The plans may require or disallow specific mineral fillers. Provide mineral filler, when used, that:

- is sufficiently dry, free-flowing, and free from clumps and foreign matter as determined by the Engineer;
- does not exceed 3% linear shrinkage when tested in accordance with [Tex-107-E](#); and
- meets the gradation requirements in Table 3, unless otherwise shown on the plans.

Table 3
Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Weight or Volume
#8	100
#200	55–100

2.3.

Baghouse Fines. Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.

2.4.

Asphalt Binder. Furnish the type and grade of performance-graded (PG) asphalt specified on the plans.

- 2.5. **Tack Coat.** Furnish CSS-1H, SS-1H, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions." Specialized tack coat materials listed on the Department's MPL are allowed or required when shown on the plans. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.
- 2.6. **Additives.** Use the type and rate of additive specified when shown on the plans. Additives that facilitate mixing, compaction, or improve the quality of the mixture are allowed when approved. Provide the Engineer with documentation such as the bill of lading showing the quantity of additives used in the project unless otherwise directed.
- 2.6.1. **Lime and Liquid Antistripping Agent.** When lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime into the drum.
- 2.6.2. **Warm Mix Asphalt (WMA).** Warm Mix Asphalt (WMA) is defined as HMA that is produced within a target temperature discharge range of 215°F and 275°F using approved WMA additives or processes from the Department's MPL.
- WMA is allowed for use on all projects and is required when shown on the plans. When WMA is required, the maximum placement or target discharge temperature for WMA will be set at a value below 275°F.
- Department-approved WMA additives or processes may be used to facilitate mixing and compaction of HMA produced at target discharge temperatures above 275°F; however, such mixtures will not be defined as WMA.
- 2.6.3. **Compaction Aid.** Compaction Aid is defined as a chemical warm mix additive that is used to produce an asphalt mixture at a discharge temperature greater than 275°F.
- Compaction Aid is allowed for use on all projects and is required when shown on the plans.
- 2.7. **Recycled Materials.** Use of RAP and RAS is permitted unless otherwise shown on the plans. Use of RAS is restricted to only intermediate and base mixes unless otherwise shown on the plans. Do not exceed the maximum allowable percentages of RAP and RAS shown in Table 4. The allowable percentages shown in Table 4 may be decreased or increased when shown on the plans. Determine the asphalt binder content and gradation of the RAP and RAS stockpiles for mixture design purposes in accordance with [Tex-236-F](#), Part I. The Engineer may verify the asphalt binder content of the stockpiles at any time during production. Perform other tests on RAP and RAS when shown on the plans. Asphalt binder from RAP and RAS is designated as recycled asphalt binder. Calculate and ensure that the ratio of the recycled asphalt binder to total binder does not exceed the percentages shown in Table 5 during mixture design and HMA production when RAP or RAS is used. Use a separate cold feed bin for each stockpile of RAP and RAS during HMA production.
- Surface, intermediate, and base mixes referenced in Tables 4 and 5 are defined as follows:
- **Surface.** The final HMA lift placed at the top of the pavement structure or placed directly below mixtures produced in accordance with Items 316, 342, 347, or 348;
 - **Intermediate.** Mixtures placed below an HMA surface mix and less than or equal to 8.0 in. from the riding surface; and
 - **Base.** Mixtures placed greater than 8.0 in. from the riding surface. Unless otherwise shown on the plans, mixtures used for bond breaker are defined as base mixtures.
- 2.7.1. **RAP.** RAP is salvaged, milled, pulverized, broken, or crushed asphalt pavement. Fractionated RAP is defined as a stockpile that contains RAP material with a minimum of 95.0% passing the 3/8-in. or 1/2-in. sieve, before burning in the ignition oven, unless otherwise approved. The Engineer may allow the Contractor to use an alternate to the 3/8-in. or 1/2-in. screen to fractionate the RAP.

Use of Contractor-owned RAP including HMA plant waste is permitted unless otherwise shown on the plans. Department-owned RAP stockpiles are available for the Contractor's use when the stockpile locations are shown on the plans. If Department-owned RAP is available for the Contractor's use, the Contractor may use Contractor-owned fractionated RAP and replace it with an equal quantity of Department-owned RAP. Department-owned RAP generated through required work on the Contract is available for the Contractor's use when shown on the plans. Perform any necessary tests to ensure Contractor- or Department-owned RAP is appropriate for use. The Department will not perform any tests or assume any liability for the quality of the Department-owned RAP unless otherwise shown on the plans. The Contractor will retain ownership of RAP generated on the project when shown on the plans.

Do not use Department- or Contractor-owned RAP contaminated with dirt or other objectionable materials. Do not use Department- or Contractor-owned RAP if the decantation value exceeds 5% and the plasticity index is greater than 8. Test the stockpiled RAP for decantation in accordance with [Tex-406-A](#), Part I. Determine the plasticity index in accordance with [Tex-106-E](#) if the decantation value exceeds 5%. The decantation and plasticity index requirements do not apply to RAP samples with asphalt removed by extraction or ignition.

Do not intermingle Contractor-owned RAP stockpiles with Department-owned RAP stockpiles. Remove unused Contractor-owned RAP material from the project site upon completion of the project. Return unused Department-owned RAP to the designated stockpile location.

Table 4
Maximum Allowable Amounts of RAP¹

Maximum Allowable Fractionated RAP (%)		
Surface	Intermediate	Base
15.0	25.0	30.0

1. Must also meet the recycled binder to total binder ratio shown in Table 5.

2.7.2.

RAS. Use of post-manufactured RAS or post-consumer RAS (tear-offs) is not permitted in surface mixtures unless otherwise shown on the plans. RAS may be used in intermediate and base mixtures unless otherwise shown on the plans. Up to 3% RAS may be used separately or as a replacement for fractionated RAP in accordance with Table 4 and Table 5. RAS is defined as processed asphalt shingle material from manufacturing of asphalt roofing shingles or from re-roofing residential structures. Post-manufactured RAS is processed manufacturer's shingle scrap by-product. Post-consumer RAS is processed shingle scrap removed from residential structures. Comply with all regulatory requirements stipulated for RAS by the TCEQ. RAS may be used separately or in conjunction with RAP.

Process the RAS by ambient grinding or granulating such that 100% of the particles pass the 3/8 in. sieve when tested in accordance with [Tex-200-F](#), Part I. Perform a sieve analysis on processed RAS material before extraction (or ignition) of the asphalt binder.

Add sand meeting the requirements of Table 1 and Table 2 or fine RAP to RAS stockpiles if needed to keep the processed material workable. Any stockpile that contains RAS will be considered a RAS stockpile and be limited to no more than 3.0% of the HMA mixture in accordance with Table 4.

Certify compliance of the RAS with [DMS-11000](#), "Evaluating and Using Nonhazardous Recyclable Materials Guidelines." Treat RAS as an established nonhazardous recyclable material if it has not come into contact with any hazardous materials. Use RAS from shingle sources on the Department's MPL. Remove substantially all materials before use that are not part of the shingle, such as wood, paper, metal, plastic, and felt paper. Determine the deleterious content of RAS material for mixture design purposes in accordance with [Tex-217-F](#), Part III. Do not use RAS if deleterious materials are more than 0.5% of the stockpiled RAS unless otherwise approved. Submit a sample for approval before submitting the mixture design. The Department will perform the testing for deleterious material of RAS to determine specification compliance.

2.8.

Substitute Binders. Unless otherwise shown on the plans, the Contractor may use a substitute PG binder listed in Table 5 instead of the PG binder originally specified, if using recycled materials, and if the substitute PG binder and mixture made with the substitute PG binder meet the following:

- the substitute binder meets the specification requirements for the substitute binder grade in accordance with Section 300.2.10., "Performance-Graded Binders;" and
- the mixture has less than 10.0 mm of rutting on the Hamburg Wheel test ([Tex-242-F](#)) after the number of passes required for the originally specified binder. Use of substitute PG binders may only be allowed at the discretion of the Engineer if the Hamburg Wheel test results are between 10.0 mm and 12.5 mm.

Table 5
Allowable Substitute PG Binders and Maximum Recycled Binder Ratios

Originally Specified PG Binder	Allowable Substitute PG Binder for Surface Mixes	Allowable Substitute PG Binder for Intermediate and Base Mixes	Maximum Ratio of Recycled Binder ¹ to Total Binder (%)		
			Surface	Intermediate	Base
76-22 ^{4,5}	70-22	70-22	10.0	20.0	25.0
70-22 ^{2,5}	N/A	64-22	10.0	20.0	25.0
64-22 ^{2,3}	N/A	N/A	10.0	20.0	25.0
76-28 ^{4,5}	70-28	70-28	10.0	20.0	25.0
70-28 ^{2,5}	N/A	64-28	10.0	20.0	25.0
64-28 ^{2,3}	N/A	N/A	10.0	20.0	25.0

1. Combined recycled binder from RAP and RAS. RAS is not permitted in surface mixtures unless otherwise shown on the plans.
2. Binder substitution is not allowed for surface mixtures.
3. Binder substitution is not allowed for intermediate and base mixtures.
4. Use no more than 10.0% recycled binder in surface mixtures when using this originally specified PG binder.
5. Use no more than 20.0% recycled binder when using this originally specified PG binder for intermediate mixtures. Use no more than 25.0% recycled binder when using this originally specified PG binder for base mixtures.

3.

EQUIPMENT

Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement."

4.

CONSTRUCTION

Produce, haul, place, and compact the specified paving mixture. In addition to tests required by the specification, Contractors may perform other QC tests as deemed necessary. At any time during the project, the Engineer may perform production and placement tests as deemed necessary in accordance with Item 5, "Control of the Work." Schedule and participate in a mandatory pre-paving meeting with the Engineer on or before the first day of paving unless otherwise shown on the plans.

4.1.

Certification. Personnel certified by the Department-approved hot-mix asphalt certification program must conduct all mixture designs, sampling, and testing in accordance with Table 6. Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning production and when personnel changes are made. Provide a mixture design developed and signed by a Level 2 certified specialist. Provide Level 1A certified specialists at the plant during production operations. Provide Level 1B certified specialists to conduct placement tests. Provide AGG101 certified specialists for aggregate testing.

Table 6
Test Methods, Test Responsibility, and Minimum Certification Levels

Test Description	Test Method	Contractor	Engineer	Level ¹
1. Aggregate and Recycled Material Testing				
Sampling	Tex-221-F	✓	✓	1A/AGG101
Dry sieve	Tex-200-F , Part I	✓	✓	1A/AGG101
Washed sieve	Tex-200-F , Part II	✓	✓	1A/AGG101
Deleterious material	Tex-217-F , Parts I & III	✓	✓	AGG101
Decantation	Tex-217-F , Part II	✓	✓	AGG101
Los Angeles abrasion	Tex-410-A		✓	TxDOT
Magnesium sulfate soundness	Tex-411-A		✓	TxDOT
Micro-Deval abrasion	Tex-461-A		✓	AGG101
Crushed face count	Tex-460-A	✓	✓	AGG101
Flat and elongated particles	Tex-280-F	✓	✓	AGG101
Linear shrinkage	Tex-107-E	✓	✓	AGG101
Sand equivalent	Tex-203-F	✓	✓	AGG101
Organic impurities	Tex-408-A	✓	✓	AGG101
2. Asphalt Binder & Tack Coat Sampling				
Asphalt binder sampling	Tex-500-C , Part II	✓	✓	1A/1B
Tack coat sampling	Tex-500-C , Part III	✓	✓	1A/1B
3. Mix Design & Verification				
Design and JMF changes	Tex-204-F	✓	✓	2
Mixing	Tex-205-F	✓	✓	2
Molding (TGC)	Tex-206-F	✓	✓	1A
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F , Parts I & VI	✓	✓	1A
Rice gravity	Tex-227-F , Part II	✓	✓	1A
Ignition oven correction factors ²	Tex-236-F , Part II	✓	✓	2
Indirect tensile strength	Tex-226-F	✓	✓	1A
Hamburg Wheel test	Tex-242-F	✓	✓	1A
Boil test	Tex-530-C	✓	✓	1A
4. Production Testing				
Selecting production random numbers	Tex-225-F , Part I		✓	1A
Mixture sampling	Tex-222-F	✓	✓	1A/1B
Molding (TGC)	Tex-206-F	✓	✓	1A
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F , Parts I & VI	✓	✓	1A
Rice gravity	Tex-227-F , Part II	✓	✓	1A
Gradation & asphalt binder content ²	Tex-236-F , Part I	✓	✓	1A
Control charts	Tex-233-F	✓	✓	1A
Moisture content	Tex-212-F , Part II	✓	✓	1A/AGG101
Hamburg Wheel test	Tex-242-F	✓	✓	1A
Micro-Deval abrasion	Tex-461-A		✓	AGG101
Boil test	Tex-530-C	✓	✓	1A
Abson recovery	Tex-211-F		✓	TxDOT
5. Placement Testing				
Selecting placement random numbers	Tex-225-F , Part II		✓	1B
Trimming roadway cores	Tex-251-F , Parts I & II	✓	✓	1A/1B
In-place air voids	Tex-207-F , Parts I & VI	✓	✓	1A
In-place density (nuclear method)	Tex-207-F , Part III	✓		1B
Establish rolling pattern	Tex-207-F , Part IV	✓		1B
Control charts	Tex-233-F	✓	✓	1A
Ride quality measurement	Tex-1001-S	✓	✓	Note 3
Segregation (density profile)	Tex-207-F , Part V	✓	✓	1B
Longitudinal joint density	Tex-207-F , Part VII	✓	✓	1B
Thermal profile	Tex-244-F	✓	✓	1B
Shear Bond Strength Test	Tex-249-F		✓	TxDOT

- Level 1A, 1B, AGG101, and 2 are certification levels provided by the Hot Mix Asphalt Center certification program.
- Refer to Section 3076.4.9.2.3., "Production Testing," for exceptions to using an ignition oven.
- Profiler and operator are required to be certified at the Texas A&M Transportation Institute facility when Surface Test Type B is specified.

4.2.

Reporting and Responsibilities. Use Department-provided templates to record and calculate all test data, including mixture design, production and placement QC/QA, control charts, thermal profiles, segregation density profiles, and longitudinal joint density. Obtain the current version of the templates at <http://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/forms/site-manager.html> or from the Engineer. The Engineer and the Contractor will provide any available test results to the other party when requested. The maximum allowable time for the Contractor and Engineer to exchange test data is as given in Table 7 unless otherwise approved. The Engineer and the Contractor will immediately report to the other party any test result that requires suspension of production or placement, a payment adjustment less than 1.000, or that fails to meet the specification requirements. Record and electronically submit all test results and pertinent information on Department-provided templates.

Subsequent sublots placed after test results are available to the Contractor, which require suspension of operations, may be considered unauthorized work. Unauthorized work will be accepted or rejected at the discretion of the Engineer in accordance with Article 5.3., "Conformity with Plans, Specifications, and Special Provisions."

Table 7
Reporting Schedule

Description	Reported By	Reported To	To Be Reported Within
Production Quality Control			
Gradation ¹	Contractor	Engineer	1 working day of completion of the subplot
Asphalt binder content ¹			
Laboratory-molded density ²			
Moisture content ³			
Boil test ³			
Production Quality Assurance			
Gradation ³	Engineer	Contractor	1 working day of completion of the subplot
Asphalt binder content ³			
Laboratory-molded density ¹			
Hamburg Wheel test ⁴			
Boil test ³			
Binder tests ⁴			
Placement Quality Control			
In-place air voids ²	Contractor	Engineer	1 working day of completion of the lot
Segregation ¹			
Longitudinal joint density ¹			
Thermal profile ¹			
Placement Quality Assurance			
In-place air voids ¹	Engineer	Contractor	1 working day after receiving the trimmed cores ⁵
Segregation ³			1 working day of completion of the lot
Longitudinal joint density ³			
Thermal profile ³			
Aging ratio ⁴			
Payment adjustment summary	Engineer	Contractor	2 working days of performing all required tests and receiving Contractor test data

1. These tests are required on every subplot.
2. Optional test. When performed on split samples, report the results as soon as they become available.
3. To be performed at the frequency specified in Table 16 or as shown on the plans.
4. To be reported as soon as the results become available.
5. 2 days are allowed if cores cannot be dried to constant weight within 1 day.

The Engineer will use the Department-provided template to calculate all payment adjustment factors for the lot. Sublot samples may be discarded after the Engineer and Contractor sign off on the payment adjustment summary documentation for the lot.

Use the procedures described in [Tex-233-F](#) to plot the results of all quality control (QC) and quality assurance (QA) testing. Update the control charts as soon as test results for each subplot become available. Make the control charts readily accessible at the field laboratory. The Engineer may suspend production for failure to update control charts.

- 4.3. **Quality Control Plan (QCP).** Develop and follow the QCP in detail. Obtain approval for changes to the QCP made during the project. The Engineer may suspend operations if the Contractor fails to comply with the QCP.

Submit a written QCP before the mandatory pre-paving meeting. Receive approval of the QCP before beginning production. Include the following items in the QCP:

- 4.3.1. **Project Personnel.** For project personnel, include:

- a list of individuals responsible for QC with authority to take corrective action;
- current contact information for each individual listed; and
- current copies of certification documents for individuals performing specified QC functions.

- 4.3.2. **Material Delivery and Storage.** For material delivery and storage, include:

- the sequence of material processing, delivery, and minimum quantities to assure continuous plant operations;
- aggregate stockpiling procedures to avoid contamination and segregation;
- frequency, type, and timing of aggregate stockpile testing to assure conformance of material requirements before mixture production; and
- procedure for monitoring the quality and variability of asphalt binder.

- 4.3.3. **Production.** For production, include:

- loader operation procedures to avoid contamination in cold bins;
- procedures for calibrating and controlling cold feeds;
- procedures to eliminate debris or oversized material;
- procedures for adding and verifying rates of each applicable mixture component (e.g., aggregate, asphalt binder, RAP, RAS, lime, liquid antistripping, WMA);
- procedures for reporting job control test results; and
- procedures to avoid segregation and drain-down in the silo.

- 4.3.4. **Loading and Transporting.** For loading and transporting, include:

- type and application method for release agents; and
- truck loading procedures to avoid segregation.

- 4.3.5. **Placement and Compaction.** For placement and compaction, include:

- proposed agenda for mandatory pre-paving meeting, including date and location;
- proposed paving plan (e.g., paving widths, joint offsets, and lift thicknesses);
- type and application method for release agents in the paver and on rollers, shovels, lutes, and other utensils;
- procedures for the transfer of mixture into the paver, while avoiding segregation and preventing material spillage;
- process to balance production, delivery, paving, and compaction to achieve continuous placement operations and good ride quality;
- paver operations (e.g., operation of wings, height of mixture in auger chamber) to avoid physical and thermal segregation and other surface irregularities; and
- procedures to construct quality longitudinal and transverse joints.

4.4. Mixture Design.

4.4.1. **Design Requirements.** The Contractor will design the mixture using a Superpave Gyrotory Compactor (SGC). A Texas Gyrotory Compactor (TGC) may be used when shown on the plans. Use the dense-graded design procedure provided in [Tex-204-F](#). Design the mixture to meet the requirements listed in Tables 1, 2, 3, 4, 5, 8, 9, and 10.

4.4.1.1. **Design Number of Gyration (Ndesign) When The SGC Is Used.** Design the mixture at 50 gyrations (Ndesign). Use a target laboratory-molded density of 96.0% to design the mixture; however, adjustments can be made to the Ndesign value as noted in Table 9. The Ndesign level may be reduced to at least 35 gyrations at the Contractor's discretion.

Use an approved laboratory from the Department's MPL to perform the Hamburg Wheel test, and provide results with the mixture design, or provide the laboratory mixture and request that the Department perform the Hamburg Wheel test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the laboratory mixture design.

The Engineer will provide the mixture design when shown on the plans. The Contractor may submit a new mixture design at any time during the project. The Engineer will verify and approve all mixture designs (JMF1) before the Contractor can begin production.

Provide the Engineer with a mixture design report using the Department-provided template. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- asphalt binder content and aggregate gradation of RAP and RAS stockpiles;
- the target laboratory-molded density (or Ndesign level when using the SGC);
- results of all applicable tests;
- the mixing and molding temperatures;
- the signature of the Level 2 person or persons that performed the design;
- the date the mixture design was performed; and
- a unique identification number for the mixture design.

**Table 8
Master Gradation Limits (% Passing by Weight or Volume) and VMA Requirements**

Sieve Size	B Fine Base	C Coarse Surface	D Fine Surface	F Fine Mixture
2"	–	–	–	–
1-1/2"	100.0 ¹	–	–	–
1"	98.0–100.0	100.0 ¹	–	–
3/4"	84.0–98.0	95.0–100.0	100.0 ¹	–
1/2"	–	–	98.0–100.0	100.0 ¹
3/8"	60.0–80.0	70.0–85.0	85.0–100.0	98.0–100.0
#4	40.0–60.0	43.0–63.0	50.0–70.0	70.0–90.0
#8	29.0–43.0	32.0–44.0	35.0–46.0	38.0–48.0
#30	13.0–28.0	14.0–28.0	15.0–29.0	12.0–27.0
#50	6.0–20.0	7.0–21.0	7.0–20.0	6.0–19.0
#200	2.0–7.0	2.0–7.0	2.0–7.0	2.0–7.0
Design VMA, % Minimum				
–	13.0	14.0	15.0	16.0
Production (Plant-Produced) VMA, % Minimum				
–	12.5	13.5	14.5	15.5

1. Defined as maximum sieve size. No tolerance allowed.

Table 9
Laboratory Mixture Design Properties

Mixture Property	Test Method	Requirement
Target laboratory-molded density, % (SGC)	Tex-207-F	96.0
Design gyrations (N _{design} for SGC)	Tex-241-F	50 ¹
Indirect tensile strength (dry), psi	Tex-226-F	85–200 ²
Boil test ³	Tex-530-C	–

- Adjust within a range of 35–100 gyrations when shown on the plans or specification or when mutually agreed between the Engineer and Contractor.
- The Engineer may allow the IDT strength to exceed 200 psi if the corresponding Hamburg Wheel rut depth is greater than 3.0 mm and less than 12.5 mm.
- Used to establish baseline for comparison to production results. May be waived when approved.

Table 10
Hamburg Wheel Test Requirements

High-Temperature Binder Grade	Test Method	Minimum # of Passes @ 12.5 mm ¹ Rut Depth, Tested @ 50°C
PG 64 or lower	Tex-242-F	10,000 ²
PG 70		15,000 ³
PG 76 or higher		20,000

- When the rut depth at the required minimum number of passes is less than 3 mm, the Engineer may require the Contractor to increase the target laboratory-molded density (TGC) by 0.5% to no more than 97.5% or lower the N_{design} level (SGC) to at least 35 gyrations.
- May be decreased to at least 5,000 passes when shown on the plans.
- May be decreased to at least 10,000 passes when shown on the plans.

- 4.4.1.2. **Target Laboratory-Molded Density When The TGC Is Used.** Design the mixture at a 96.5% target laboratory-molded density. Increase the target laboratory-molded density to 97.0% or 97.5% at the Contractor's discretion or when shown on the plans or specification.
- 4.4.2. **Job-Mix Formula Approval.** The job-mix formula (JMF) is the combined aggregate gradation, target laboratory-molded density (or N_{design} level), and target asphalt percentage used to establish target values for hot-mix production. JMF1 is the original laboratory mixture design used to produce the trial batch. When WMA is used, JMF1 may be designed and submitted to the Engineer without including the WMA additive. When WMA is used, document the additive or process used and recommended rate on the JMF1 submittal. The Engineer and the Contractor will verify JMF1 based on plant-produced mixture from the trial batch unless otherwise approved. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF1. The Department may require the Contractor to reimburse the Department for verification tests if more than 2 trial batches per design are required.
- 4.4.2.1. **Contractor's Responsibilities.**
- 4.4.2.1.1. **Providing Gyrotory Compactor.** Use a SGC calibrated in accordance with [Tex-241-F](#) to design the mixture in accordance with [Tex-204-F](#), Part IV, for molding production samples. Locate the SGC, if used, at the Engineer's field laboratory and make the SGC available to the Engineer for use in molding production samples. Furnish a TGC calibrated in accordance with [Tex-914-K](#) when shown on the plans to design the mixture in accordance with [Tex-204-F](#), Part I, for molding production samples.
- 4.4.2.1.2. **Gyrotory Compactor Correlation Factors.** Use [Tex-206-F](#), Part II, to perform a gyrotory compactor correlation when the Engineer uses a different gyrotory compactor. Apply the correlation factor to all subsequent production test results.
- 4.4.2.1.3. **Submitting JMF1.** Furnish a mix design report (JMF1) with representative samples of all component materials and request approval to produce the trial batch. Provide approximately 10,000 g of the design mixture if opting to have the Department perform the Hamburg Wheel test on the laboratory mixture, and request that the Department perform the test.

- 4.4.2.1.4. **Supplying Aggregates.** Provide approximately 40 lb. of each aggregate stockpile unless otherwise directed.
- 4.4.2.1.5. **Supplying Asphalt.** Provide at least 1 gal. of the asphalt material and enough quantities of any additives proposed for use.
- 4.4.2.1.6. **Ignition Oven Correction Factors.** Determine the aggregate and asphalt correction factors from the ignition oven in accordance with [Tex-236-F](#), Part II. Provide correction factors that are not more than 12 months old. Provide the Engineer with split samples of the mixtures before the trial batch production, including all additives (except water), and blank samples used to determine the correction factors for the ignition oven used for QA testing during production. Correction factors established from a previously approved mixture design may be used for the current mixture design if the mixture design and ignition oven are the same as previously used, unless otherwise directed.
- 4.4.2.1.7. **Boil Test.** Perform the test and retain the tested sample from [Tex-530-C](#) until completion of the project or as directed. Use this sample for comparison purposes during production. The Engineer may waive the requirement for the boil test.
- 4.4.2.1.8. **Trial Batch Production.** Provide a plant-produced trial batch upon receiving conditional approval of JMF1 and authorization to produce a trial batch, including the WMA additive or process if applicable, for verification testing of JMF1 and development of JMF2. Produce a trial batch mixture that meets the requirements in Table 4, Table 5, and Table 11. The Engineer may accept test results from recent production of the same mixture instead of a new trial batch.
- 4.4.2.1.9. **Trial Batch Production Equipment.** Use only equipment and materials proposed for use on the project to produce the trial batch.
- 4.4.2.1.10. **Trial Batch Quantity.** Produce enough quantity of the trial batch to ensure that the mixture meets the specification requirements.
- 4.4.2.1.11. **Number of Trial Batches.** Produce trial batches as necessary to obtain a mixture that meets the specification requirements.
- 4.4.2.1.12. **Trial Batch Sampling.** Obtain a representative sample of the trial batch and split it into 3 equal portions in accordance with [Tex-222-F](#). Label these portions as "Contractor," "Engineer," and "Referee." Deliver samples to the appropriate laboratory as directed.
- 4.4.2.1.13. **Trial Batch Testing.** Test the trial batch to ensure the mixture produced using the proposed JMF1 meets the mixture requirements in Table 11. Ensure the trial batch mixture is also in compliance with the Hamburg Wheel requirement in Table 10. Use a Department-approved laboratory to perform the Hamburg Wheel test on the trial batch mixture or request that the Department perform the Hamburg Wheel test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the trial batch. Provide the Engineer with a copy of the trial batch test results.
- 4.4.2.1.14. **Development of JMF2.** Evaluate the trial batch test results after the Engineer grants full approval of JMF1 based on results from the trial batch, determine the optimum mixture proportions, and submit as JMF2. Adjust the asphalt binder content or gradation to achieve the specified target laboratory-molded density. The asphalt binder content established for JMF2 is not required to be within any tolerance of the optimum asphalt binder content established for JMF1; however, mixture produced using JMF2 must meet the voids in mineral aggregates (VMA) requirements for production shown in Table 8. If the optimum asphalt binder content for JMF2 is more than 0.5% lower than the optimum asphalt binder content for JMF1, the Engineer may perform or require the Contractor to perform [Tex-226-F](#) on Lot 1 production to confirm the indirect tensile strength does not exceed 200 psi. Verify that JMF2 meets the mixture requirements in Table 5.
- 4.4.2.1.15. **Mixture Production.** Use JMF2 to produce Lot 1 as described in Section 3076.4.9.3.1.1., "Lot 1 Placement," after receiving approval for JMF2 and a passing result from the Department's or a Department-approved

laboratory's Hamburg Wheel test on the trial batch. If desired, proceed to Lot 1 production, once JMF2 is approved, at the Contractor's risk without receiving the results from the Department's Hamburg Wheel test on the trial batch.

Notify the Engineer if electing to proceed without Hamburg Wheel test results from the trial batch. Note that the Engineer may require up to the entire subplot of any mixture failing the Hamburg Wheel test to be removed and replaced at the Contractor's expense.

4.4.2.1.16. **Development of JMF3.** Evaluate the test results from Lot 1, determine the optimum mixture proportions, and submit as JMF3 for use in Lot 2.

4.4.2.1.17. **JMF Adjustments.** If JMF adjustments are necessary to achieve the specified requirements, make the adjustments before beginning a new lot. The adjusted JMF must:

- be provided to the Engineer in writing before the start of a new lot;
- be numbered in sequence to the previous JMF;
- meet the mixture requirements in Table 4 and Table 5;
- meet the master gradation limits shown in Table 8; and
- be within the operational tolerances of JMF2 listed in Table 11.

4.4.2.1.18. **Requesting Referee Testing.** Use referee testing, if needed, in accordance with Section 3076.4.9.1., "Referee Testing," to resolve testing differences with the Engineer.

Table 11
Operational Tolerances

Description	Test Method	Allowable Difference Between Trial Batch and JMF1 Target	Allowable Difference from Current JMF Target	Allowable Difference between Contractor and Engineer ¹
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	Must be Within Master Grading Limits in Table 8	±5.0 ^{2,3}	±5.0
Individual % retained for sieves smaller than #8 and larger than #200			±3.0 ^{2,3}	±3.0
% passing the #200 sieve			±2.0 ^{2,3}	±1.6
Asphalt binder content, %	Tex-236-F	±0.5	±0.3 ³	±0.3
Laboratory-molded density, %	Tex-207-F	±1.0	±1.0	±1.0
In-place air voids, %		N/A	N/A	±1.0
Laboratory-molded bulk specific gravity		N/A	N/A	±0.020
VMA, %, min	Tex-204-F	Note ⁴	Note ⁴	N/A
Theoretical maximum specific (Rice) gravity	Tex-227-F	N/A	N/A	±0.020

1. Contractor may request referee testing only when values exceed these tolerances.
2. When within these tolerances, mixture production gradations may fall outside the master grading limits; however, the % passing the #200 will be considered out of tolerance when outside the master grading limits.
3. Only applies to mixture produced for Lot 1 and higher.
4. Test and verify that Table 8 requirements are met.

4.4.2.2. **Engineer's Responsibilities.**

4.4.2.2.1. **Gyratory Compactor.** For SGC mixtures designed in accordance with [Tex-204-F](#), Part IV, the Engineer will use a Department SGC, calibrated in accordance with [Tex-241-F](#), to mold samples for laboratory mixture design verification. For molding trial batch and production specimens, the Engineer will use the Contractor-provided SGC at the field laboratory or provide and use a Department SGC at an alternate location. The Engineer will make the Contractor-provided SGC in the Department field laboratory available to the Contractor for molding verification samples.

For TGC mixtures designed in accordance with [Tex-204-F](#), Part I, the Engineer will use a Department TGC, calibrated in accordance with [Tex-914-K](#), to mold samples for trial batch and production testing. The Engineer will make the Department TGC and the Department field laboratory available to the Contractor for molding verification samples, if requested by the Contractor.

4.4.2.2.2. **Conditional Approval of JMF1 and Authorizing Trial Batch.** The Engineer will review and verify conformance of the following information within 2 working days of receipt:

- the Contractor's mix design report (JMF1);
- the Contractor-provided Hamburg Wheel test results;
- all required materials including aggregates, asphalt, additives, and recycled materials; and
- the mixture specifications.

The Engineer will grant the Contractor conditional approval of JMF1 if the information provided on the paper copy of JMF1 indicates that the Contractor's mixture design meets the specifications. When the Contractor does not provide Hamburg Wheel test results with laboratory mixture design, 10 working days are allowed for conditional approval of JMF1. The Engineer will base full approval of JMF1 on the test results on mixture from the trial batch.

Unless waived, the Engineer will determine the Micro-Deval abrasion loss in accordance with Section 3076.2.1.1.2., "Micro-Deval Abrasion." If the Engineer's test results are pending after two working days, conditional approval of JMF1 will still be granted within two working days of receiving JMF1. When the Engineer's test results become available, they will be used for specification compliance.

After conditionally approving JMF1, including either Contractor- or Department-supplied Hamburg Wheel test results, the Contractor is authorized to produce a trial batch.

4.4.2.2.3. **Hamburg Wheel Testing of JMF1.** If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the laboratory mixture, the Engineer will mold samples in accordance with [Tex-242-F](#) to verify compliance with the Hamburg Wheel test requirement in Table 10.

4.4.2.2.4. **Ignition Oven Correction Factors.** The Engineer will use the split samples provided by the Contractor to determine the aggregate and asphalt correction factors for the ignition oven used for QA testing during production in accordance with [Tex-236-F](#), Part II. Provide correction factors that are not more than 12 months old.

4.4.2.2.5. **Testing the Trial Batch.** Within 1 full working day, the Engineer will sample and test the trial batch to ensure that the mixture meets the requirements in Table 11. If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the trial batch mixture, the Engineer will mold samples in accordance with [Tex-242-F](#) to verify compliance with the Hamburg Wheel test requirement in Table 10.

The Engineer will have the option to perform the following tests on the trial batch:

- [Tex-226-F](#), to verify that the indirect tensile strength meets the requirement shown in Table 9; and
- [Tex-530-C](#), to retain and use for comparison purposes during production.

4.4.2.2.6. **Full Approval of JMF1.** The Engineer will grant full approval of JMF1 and authorize the Contractor to proceed with developing JMF2 if the Engineer's results for the trial batch meet the requirements in Table 11. The Engineer will notify the Contractor that an additional trial batch is required if the trial batch does not meet these requirements.

4.4.2.2.7. **Approval of JMF2.** The Engineer will approve JMF2 within one working day if the mixture meets the requirements in Table 5 and the gradation meets the master grading limits shown in Table 8. The asphalt binder content established for JMF2 is not required to be within any tolerance of the optimum asphalt binder content established for JMF1; however, mixture produced using JMF2 must meet the VMA requirements shown in Table 8. If the optimum asphalt binder content for JMF2 is more than 0.5% lower than the optimum asphalt binder content for JMF1, the Engineer may perform or require the Contractor to perform [Tex-226-F](#) on Lot 1 production to confirm the indirect tensile strength does not exceed 200 psi.

4.4.2.2.8. **Approval of Lot 1 Production.** The Engineer will authorize the Contractor to proceed with Lot 1 production (using JMF2) as soon as a passing result is achieved from the Department's or a Department-approved laboratory's Hamburg Wheel test on the trial batch. The Contractor may proceed at its own risk with Lot 1 production without the results from the Hamburg Wheel test on the trial batch.

If the Department's or Department-approved laboratory's sample from the trial batch fails the Hamburg Wheel test, the Engineer will suspend production until further Hamburg Wheel tests meet the specified values. The Engineer may require up to the entire subplot of any mixture failing the Hamburg Wheel test be removed and replaced at the Contractor's expense.

4.4.2.2.9. **Approval of JMF3 and Subsequent JMF Changes.** JMF3 and subsequent JMF changes are approved if they meet the mixture requirements shown in Table 4, Table 5, and the master grading limits shown in Table 8, and are within the operational tolerances of JMF2 shown in Table 11.

4.5. **Production Operations.** Perform a new trial batch when the plant or plant location is changed. Take corrective action and receive approval to proceed after any production suspension for noncompliance to the specification. Submit a new mix design and perform a new trial batch when the asphalt binder content of:

- any RAP stockpile used in the mix is more than 0.5% higher than the value shown on the mixture design report; or
- RAS stockpile used in the mix is more than 2.0% higher than the value shown on the mixture design report.

4.5.1. **Storage and Heating of Materials.** Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions," or outside the manufacturer's recommended values. Provide the Engineer with daily records of asphalt binder and hot-mix asphalt discharge temperatures (in legible and discernible increments) in accordance with Item 320, "Equipment for Asphalt Concrete Pavement," unless otherwise directed. Do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr. unless otherwise approved.

4.5.2. **Mixing and Discharge of Materials.** Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed the maximum production temperatures listed in Table 12 (or 275°F for WMA). The Department will not pay for or allow placement of any mixture produced above the maximum production temperatures listed in Table 12.

Table 12
Maximum Production Temperature

High-Temperature Binder Grade ¹	Maximum Production Temperature
PG 64	325°F
PG 70	335°F
PG 76	345°F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.

Produce WMA within the target discharge temperature range of 215°F and 275°F when WMA is required. Take corrective action any time the discharge temperature of the WMA exceeds the target discharge range. The Engineer may suspend production operations if the Contractor's corrective action is not successful at controlling the production temperature within the target discharge range. Note that when WMA is produced, it may be necessary to adjust burners to ensure complete combustion such that no burner fuel residue remains in the mixture.

Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant. Determine the moisture content, if requested, by oven-drying in accordance with

[Tex-212-F](#), Part II, and verify that the mixture contains no more than 0.2% of moisture by weight. Obtain the sample immediately after discharging the mixture into the truck, and perform the test promptly.

- 4.6. **Hauling Operations.** Clean all truck beds before use to ensure that mixture is not contaminated. Use a release agent shown on the Department's MPL to coat the inside bed of the truck when necessary.

Use equipment for hauling as defined in Section 3076.4.7.3.3., "Hauling Equipment." Use other hauling equipment only when allowed.

- 4.7. **Placement Operations.** Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer approximately every hour, or as directed. Use a hand-held thermal camera or infrared thermometer, when a thermal imaging system is not used, to measure and record the internal temperature of the mixture as discharged from the truck or Material Transfer Device (MTD) before or as the mix enters the paver and an approximate station number or GPS coordinates on each ticket. Calculate the daily yield and cumulative yield for the specified lift and provide to the Engineer at the end of paving operations for each day unless otherwise directed. The Engineer may suspend production if the Contractor fails to produce and provide haul tickets and yield calculations by the end of paving operations for each day.

Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of hot-mix by at least 6 in. Place mixture so that longitudinal joints on the surface course coincide with lane lines and are not placed in the wheel path, or as directed. Ensure that all finished surfaces will drain properly. Place the mixture at the rate or thickness shown on the plans. The Engineer will use the guidelines in Table 13 to determine the compacted lift thickness of each layer when multiple lifts are required. The thickness determined is based on the rate of 110 lb./sq. yd. for each inch of pavement unless otherwise shown on the plans.

Table 13
Compacted Lift Thickness and Required Core Height

Mixture Type	Compacted Lift Thickness Guidelines		Minimum Untrimmed Core Height (in.) Eligible for Testing
	Minimum (in.)	Maximum (in.)	
B	2.50	5.00	1.75
C	2.00	4.00	1.50
D	1.50	3.00	1.25
F	1.25	2.50	1.25

- 4.7.1. **Weather Conditions.**

- 4.7.1.1. **When Using a Thermal Imaging System.** Place mixture when the roadway surface is dry and the roadway surface temperature is at or above the temperatures listed in Table 14A. The Engineer may restrict the Contractor from paving surface mixtures if the ambient temperature is likely to drop below 32°F within 12 hr. of paving. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. Provide output data from the thermal imaging system to demonstrate to the Engineer that no recurring severe thermal segregation exists in accordance with Section 3076.4.7.3.1.2., "Thermal Imaging System."

Table 14A
Minimum Pavement Surface Temperatures

High-Temperature Binder Grade ¹	Minimum Pavement Surface Temperatures (°F)	
	Subsurface Layers or Night Paving Operations	Surface Layers Placed in Daylight Operations
PG 64	35	40
PG 70	45 ²	50 ²
PG 76	45 ²	50 ²

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. Contractors may pave at temperatures 10°F lower than these values when a chemical WMA additive is used as a compaction aid in the mixture or when using WMA.

4.7.1.2.

When Not Using a Thermal Imaging System. When using a thermal camera instead of the thermal imaging system, place mixture when the roadway surface temperature is at or above the temperatures listed in Table 14B unless otherwise approved or as shown on the plans. Measure the roadway surface temperature with a hand-held thermal camera or infrared thermometer. The Engineer may allow mixture placement to begin before the roadway surface reaches the required temperature if conditions are such that the roadway surface will reach the required temperature within 2 hr. of beginning placement operations. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. The Engineer may restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hr. of paving.

Table 14B
Minimum Pavement Surface Temperatures

High-Temperature Binder Grade ¹	Minimum Pavement Surface Temperatures (°F)	
	Subsurface Layers or Night Paving Operations	Surface Layers Placed in Daylight Operations
PG 64	45	50
PG 70	55 ²	60 ²
PG 76	60 ²	60 ²

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. Contractors may pave at temperatures 10°F lower than these values when a chemical WMA additive is used as a compaction aid in the mixture, when using WMA, or utilizing a paving process with equipment that eliminates thermal segregation. In such cases, for each sublot and in the presence of the Engineer, use a hand-held thermal camera operated in accordance with [Tex-244-F](#) to demonstrate to the satisfaction of the Engineer that the uncompacted mat has no more than 10°F of thermal segregation.

4.7.2.

Tack Coat.

4.7.2.1.

Application. Clean the surface before placing the tack coat. The Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area. Apply a uniform tack coat at the specified rate unless otherwise directed. Apply the tack coat in a uniform manner to avoid streaks and other irregular patterns. Apply the tack coat to all surfaces that will come in contact with the subsequent HMA placement, unless otherwise directed. Allow adequate time for emulsion to break completely before placing any material. Prevent splattering of tack coat when placed adjacent to curb, gutter, and structures. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

4.7.2.2.

Sampling. The Engineer will obtain at least one sample of the tack coat binder per project in accordance with [Tex-500-C](#), Part III, and test it to verify compliance with Item 300, "Asphalts, Oils, and Emulsions." The Engineer will notify the Contractor when the sampling will occur and will witness the collection of the sample from the asphalt distributor immediately before use.

For emulsions, the Engineer may test as often as necessary to ensure the residual of the emulsion is greater than or equal to the specification requirement in Item 300, "Asphalts, Oils, and Emulsions."

- 4.7.3. **Lay-Down Operations.** Use the placement temperatures in Table 15 to establish the minimum placement temperature of the mixture delivered to the paver.

Table 15
Minimum Mixture Placement Temperature

High-Temperature Binder Grade ¹	Minimum Placement Temperature (Before Entering Paver) ^{2,3}
PG 64	260°F
PG 70	270°F
PG 76	280°F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. Minimum placement temperatures may be reduced 10°F if using a chemical WMA additive as a compaction aid.
3. When using WMA, the minimum placement temperature is 215°F.

- 4.7.3.1. **Thermal Profile.** Use a hand-held thermal camera or a thermal imaging system to obtain a continuous thermal profile in accordance with [Tex-244-F](#). Thermal profiles are not applicable in areas described in Section 3076.4.9.3.1.4., “Miscellaneous Areas.”
- 4.7.3.1.1. **Thermal Segregation.**
- 4.7.3.1.1.1. **Moderate.** Any areas that have a temperature differential greater than 25°F, but not exceeding 50°F, are deemed as moderate thermal segregation.
- 4.7.3.1.1.2. **Severe.** Any areas that have a temperature differential greater than 50°F are deemed as severe thermal segregation.
- 4.7.3.1.2. **Thermal Imaging System.** Review the output results when a thermal imaging system is used, and provide the automated report described in [Tex-244-F](#) to the Engineer daily unless otherwise directed. Modify the paving process as necessary to eliminate any recurring (moderate or severe) thermal segregation identified by the thermal imaging system. The Engineer may suspend paving operations if the Contractor cannot successfully modify the paving process to eliminate recurring severe thermal segregation. Density profiles are not required and not applicable when using a thermal imaging system. Provide the Engineer with electronic copies of all daily data files that can be used with the thermal imaging system software to generate temperature profile plots daily or upon completion of the project or as requested by the Engineer.
- 4.7.3.1.3. **Thermal Camera.** When using a thermal camera instead of the thermal imaging system, take immediate corrective action to eliminate recurring moderate thermal segregation when a hand-held thermal camera is used. Evaluate areas with moderate thermal segregation by performing density profiles in accordance with Section 3076.4.9.3.3.2., “Segregation (Density Profile).” Provide the Engineer with the thermal profile of every subplot within one working day of the completion of each lot. When requested by the Engineer, provide the thermal images generated using the thermal camera. Report the results of each thermal profile in accordance with Section 3076.4.2., “Reporting and Responsibilities.” The Engineer will use a hand-held thermal camera to obtain a thermal profile at least once per project. No production or placement payment adjustments greater than 1.000 will be paid for any subplot that contains severe thermal segregation. Suspend operations and take immediate corrective action to eliminate severe thermal segregation unless otherwise directed. Resume operations when the Engineer determines that subsequent production will meet the requirements of this Section. Evaluate areas with severe thermal segregation by performing density profiles in accordance with Section 3076.4.9.3.3.2., “Segregation (Density Profile).” Remove and replace the material in any areas that have both severe thermal segregation and a failing result for Segregation (Density Profile) unless otherwise directed. The subplot in question may receive a production and placement payment adjustment greater than 1.000, if applicable, when the defective material is successfully removed and replaced.
- 4.7.3.2. **Windrow Operations.** Operate windrow pickup equipment so that when hot-mix is placed in windrows, substantially all the mixture deposited on the roadbed is picked up and loaded into the paver.

4.7.3.3. **Hauling Equipment.** Use belly dumps, live bottom, or end dump trucks to haul and transfer mixture; however, with exception of paving miscellaneous areas, end dump trucks are only allowed when used in conjunction with an MTD with remixing capability or when a thermal imaging system is used unless otherwise allowed.

4.7.3.4. **Screed Heaters.** Turn off screed heaters to prevent overheating of the mat if the paver stops for more than 5 min. The Engineer may evaluate the suspect area in accordance with Section 3076.4.9.3.3.4., "Recovered Asphalt Dynamic Shear Rheometer (DSR)," if the screed heater remains on for more than 5 min. while the paver is stopped.

4.8. **Compaction.** Compact the pavement uniformly to contain between 3.8% and 8.5% in-place air voids. Take immediate corrective action to bring the operation within 3.8% and 8.5% when the in-place air voids exceed the range of these tolerances. The Engineer will allow paving to resume when the proposed corrective action is likely to yield between 3.8% and 8.5% in-place air voids.

Obtain cores in areas placed under Exempt Production, as directed, at locations determined by the Engineer. The Engineer may test these cores and suspend operations or require removal and replacement if the in-place air voids are less than 2.7% or more than 9.9%. Areas defined in Section 3076.4.9.3.1.4., "Miscellaneous Areas," are not subject to in-place air void determination.

Furnish the type, size, and number of rollers required for compaction as approved. Use additional rollers as required to remove any roller marks. Use only water or an approved release agent on rollers, tamps, and other compaction equipment unless otherwise directed.

Use the control strip method shown in [Tex-207-F](#), Part IV, on the first day of production to establish the rolling pattern that will produce the desired in-place air voids unless otherwise directed.

Use tamps to thoroughly compact the edges of the pavement along curbs, headers, and similar structures and in locations that will not allow thorough compaction with rollers. The Engineer may require rolling with a trench roller on widened areas, in trenches, and in other limited areas.

Complete all compaction operations before the pavement temperature drops below 160°F unless otherwise allowed. The Engineer may allow compaction with a light finish roller operated in static mode for pavement temperatures below 160°F.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic unless otherwise directed. Sprinkle the finished mat with water or limewater, when directed, to expedite opening the roadway to traffic.

4.9. **Acceptance Plan.** Payment adjustments for the material will be in accordance with Article 3076.6., "Payment."

Sample and test the hot-mix on a lot and subplot basis. Suspend production until test results or other information indicates to the satisfaction of the Engineer that the next material produced or placed will result in payment factors of at least 1.000, if the production payment factor given in Section 3076.6.1., "Production Payment Adjustment Factors," for two consecutive lots or the placement pay factor given in Section 3076.6.2., "Placement Payment Adjustment Factors," for two consecutive lots is below 1.000.

4.9.1. **Referee Testing.** The Materials and Tests Division is the referee laboratory. The Contractor may request referee testing if a "remove and replace" condition is determined based on the Engineer's test results, or if the differences between Contractor and Engineer test results exceed the maximum allowable difference shown in Table 11 and the differences cannot be resolved. The Contractor may also request referee testing if the Engineer's test results require suspension of production and the Contractor's test results are within specification limits. Make the request within five working days after receiving test results and cores from the Engineer. Referee tests will be performed only on the subplot in question and only for the particular tests in question. Allow 10 working days from the time the referee laboratory receives the samples for test results to

be reported. The Department may require the Contractor to reimburse the Department for referee tests if more than three referee tests per project are required and the Engineer's test results are closer to the referee test results than the Contractor's test results.

The Materials and Tests Division will determine the laboratory-molded density based on the molded specific gravity and the maximum theoretical specific gravity of the referee sample. The in-place air voids will be determined based on the bulk specific gravity of the cores, as determined by the referee laboratory and the Engineer's average maximum theoretical specific gravity for the lot. With the exception of "remove and replace" conditions, referee test results are final and will establish payment adjustment factors for the subplot in question. The Contractor may decline referee testing and accept the Engineer's test results when the placement payment adjustment factor for any subplot results in a "remove and replace" condition. Placement sublots subject to be removed and replaced will be further evaluated in accordance with Section 3076.6.2.2., "Placement Sublots Subject to Removal and Replacement."

4.9.2. **Production Acceptance.**

4.9.2.1. **Production Lot.** A production lot consists of four equal sublots. The default quantity for Lot 1 is 1,000 tons; however, when requested by the Contractor, the Engineer may increase the quantity for Lot 1 to no more than 4,000 tons. The Engineer will select subsequent lot sizes based on the anticipated daily production such that approximately three to four sublots are produced each day. The lot size will be between 1,000 tons and 4,000 tons. The Engineer may change the lot size before the Contractor begins any lot.

If the optimum asphalt binder content for JMF2 is more than 0.5% lower than the optimum asphalt binder content for JMF1, the Engineer may perform or require the Contractor to perform [Tex-226-F](#) on Lot 1 to confirm the indirect tensile strength does not exceed 200 psi. Take corrective action to bring the mixture within specification compliance if the indirect tensile strength exceeds 200 psi unless otherwise directed.

4.9.2.1.1. **Incomplete Production Lots.** If a lot is begun but cannot be completed, such as on the last day of production or in other circumstances deemed appropriate, the Engineer may close the lot. Adjust the payment for the incomplete lot in accordance with Section 3076.6.1., "Production Payment Adjustment Factors." Close all lots within five working days unless otherwise allowed.

4.9.2.2. **Production Sampling.**

4.9.2.2.1. **Mixture Sampling.** Obtain hot-mix samples from trucks at the plant in accordance with [Tex-222-F](#). The sampler will split each sample into three equal portions in accordance with [Tex-200-F](#) and label these portions as "Contractor," "Engineer," and "Referee." The Engineer will perform or witness the sample splitting and take immediate possession of the samples labeled "Engineer" and "Referee." The Engineer will maintain the custody of the samples labeled "Engineer" and "Referee" until the Department's testing is completed.

4.9.2.2.1.1. **Random Sample.** At the beginning of the project, the Engineer will select random numbers for all production sublots. Determine sample locations in accordance with [Tex-225-F](#). Take one sample for each subplot at the randomly selected location. The Engineer will perform or witness the sampling of production sublots.

4.9.2.2.1.2. **Blind Sample.** For one subplot per lot, the Engineer will obtain and test a "blind" sample instead of the random sample collected by the Contractor. Test either the "blind" or the random sample; however, referee testing (if applicable) will be based on a comparison of results from the "blind" sample. The location of the Engineer's "blind" sample will not be disclosed to the Contractor. The Engineer's "blind" sample may be randomly selected in accordance with [Tex-225-F](#) for any subplot or selected at the discretion of the Engineer. The Engineer will use the Contractor's split sample for sublots not sampled by the Engineer.

4.9.2.2.2. **Informational Shear Bond Strength Testing.** Select one random subplot from Lot 2 or higher for shear bond strength testing. Obtain full depth cores in accordance with [Tex-249-F](#). Label the cores with the Control Section Job (CSJ), producer of the tack coat, mix type, shot rate, lot, and subplot number and provide to the

Engineer. The Engineer will ship the cores to the Materials and Tests Division or district laboratory for shear bond strength testing. Results from these tests will not be used for specification compliance.

- 4.9.2.2.3. **Asphalt Binder Sampling.** Obtain a 1-qt. sample of the asphalt binder witnessed by the Engineer for each lot of mixture produced. The Contractor will notify the Engineer when the sampling will occur. Obtain the sample at approximately the same time the mixture random sample is obtained. Sample from a port located immediately upstream from the mixing drum or pug mill and upstream from the introduction of any additives in accordance with [Tex-500-C](#), Part II. Label the can with the corresponding lot and subplot numbers, producer, producer facility location, grade, district, date sampled, and project information including highway and CSJ. The Engineer will retain these samples for one year. The Engineer may also obtain independent samples. If obtaining an independent asphalt binder sample and upon request of the Contractor, the Engineer will split a sample of the asphalt binder with the Contractor.

At least once per project, the Engineer will collect split samples of each binder grade and source used. The Engineer will submit one split sample to MTD to verify compliance with Item 300, "Asphalts, Oils, and Emulsions" and will retain the other split sample for one year.

- 4.9.2.3. **Production Testing.** The Contractor and Engineer must perform production tests in accordance with Table 16. The Contractor has the option to verify the Engineer's test results on split samples provided by the Engineer. Determine compliance with operational tolerances listed in Table 11 for all sublots.

Take immediate corrective action if the Engineer's laboratory-molded density on any subplot is less than 95.0% or greater than 97.0% to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractor's corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

The Engineer may allow alternate methods for determining the asphalt binder content and aggregate gradation if the aggregate mineralogy is such that [Tex-236-F](#), Part I does not yield reliable results. Provide evidence that results from [Tex-236-F](#), Part I are not reliable before requesting permission to use an alternate method unless otherwise directed. Use the applicable test procedure as directed if an alternate test method is allowed.

Table 16
Production and Placement Testing Frequency

Description	Test Method	Minimum Contractor Testing Frequency	Minimum Engineer Testing Frequency
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	1 per subplot	1 per 12 sublots ¹
Individual % retained for sieves smaller than #8 and larger than #200			
% passing the #200 sieve			
Laboratory-molded density	Tex-207-F	N/A	1 per subplot ¹
Laboratory-molded bulk specific gravity			
In-place air voids			
VMA	Tex-204-F	1 per subplot	1 per project
Segregation (density profile) ²	Tex-207-F , Part V		
Longitudinal joint density	Tex-207-F , Part VII	When directed	1 per subplot ¹
Moisture content	Tex-212-F , Part II	N/A	
Theoretical maximum specific (Rice) gravity	Tex-227-F	1 per subplot	1 per lot ¹
Asphalt binder content	Tex-236-F	N/A	1 per project
Hamburg Wheel test	Tex-242-F	N/A	
Recycled Asphalt Shingles (RAS) ³	Tex-217-F , Part III	1 per subplot	
Thermal profile ²	Tex-244-F	1 per lot (sample only) ⁴	
Asphalt binder sampling and testing	Tex-500-C , Part II	N/A	
Tack coat sampling and testing	Tex-500-C , Part III	1 per lot	
Boil test ⁵	Tex-530-C	1 per project (sample only)	
Shear Bond Strength Test ⁶	Tex-249-F		

1. For production defined in Section 3076.4.9.4., "Exempt Production," the Engineer will test one per day if 100 tons or more are produced. For Exempt Production, no testing is required when less than 100 tons are produced.
2. Not required when a thermal imaging system is used.
3. Testing performed by the Materials and Tests Division or designated laboratory.
4. Obtain witnessed by the Engineer. The Engineer will retain these samples for one year.
5. The Engineer may reduce or waive the sampling and testing requirements based on a satisfactory test history.
6. Testing performed by the Materials and Tests Division or District for informational purposes only.

4.9.2.4. **Operational Tolerances.** Control the production process within the operational tolerances listed in Table 11. When production is suspended, the Engineer will allow production to resume when test results or other information indicates the next mixture produced will be within the operational tolerances.

4.9.2.4.1. **Gradation.** Suspend operation and take corrective action if any aggregate is retained on the maximum sieve size shown in Table 8. A subplot is defined as out of tolerance if either the Engineer's or the Contractor's test results are out of operational tolerance. Suspend production when test results for gradation exceed the operational tolerances in Table 11 for three consecutive sublots on the same sieve or four consecutive sublots on any sieve unless otherwise directed. The consecutive sublots may be from more than one lot.

4.9.2.4.2. **Asphalt Binder Content.** A subplot is defined as out of operational tolerance if either the Engineer's or the Contractor's test results exceed the values listed in Table 11. No production or placement payment adjustments greater than 1.000 will be paid for any subplot that is out of operational tolerance for asphalt binder content. Suspend production and shipment of the mixture if the Engineer's or the Contractor's asphalt binder content deviates from the current JMF by more than 0.5% for any subplot.

4.9.2.4.3. **Voids in Mineral Aggregates (VMA).** The Engineer will determine the VMA for every subplot. For sublots when the Engineer does not determine asphalt binder content, the Engineer will use the asphalt binder content results from QC testing performed by the Contractor to determine VMA.

Take immediate corrective action if the VMA value for any subplot is less than the minimum VMA requirement for production listed in Table 8. Suspend production and shipment of the mixture if the Engineer's VMA results on two consecutive sublots are below the minimum VMA requirement for production listed in Table 8. No production or placement payment adjustments greater than 1.000 will be paid for any subplot that does not

meet the minimum VMA requirement for production listed in Table 8 based on the Engineer's VMA determination.

Suspend production and shipment of the mixture if the Engineer's VMA result is more than 0.5% below the minimum VMA requirement for production listed in Table 8. In addition to suspending production, the Engineer may require removal and replacement or may allow the subplot to be left in place without payment.

- 4.9.2.4.4. **Hamburg Wheel Test.** The Engineer may perform a Hamburg Wheel test at any time during production, including when the boil test indicates a change in quality from the materials submitted for JMF1. In addition to testing production samples, the Engineer may obtain cores and perform Hamburg Wheel tests on any areas of the roadway where rutting is observed. Suspend production until further Hamburg Wheel tests meet the specified values when the production or core samples fail the Hamburg Wheel test criteria in Table 10. Core samples, if taken, will be obtained from the center of the finished mat or other areas excluding the vehicle wheel paths. The Engineer may require up to the entire subplot of any mixture failing the Hamburg Wheel test to be removed and replaced at the Contractor's expense.

If the Department's or Department approved laboratory's Hamburg Wheel test results in a "remove and replace" condition, the Contractor may request that the Department confirm the results by re-testing the failing material. The Materials and Tests Division will perform the Hamburg Wheel tests and determine the final disposition of the material in question based on the Department's test results.

- 4.9.2.5. **Individual Loads of Hot-Mix.** The Engineer can reject individual truckloads of hot-mix. When a load of hot-mix is rejected for reasons other than temperature, contamination, or excessive uncoated particles, the Contractor may request that the rejected load be tested. Make this request within 4 hr. of rejection. The Engineer will sample and test the mixture. If test results are within the operational tolerances shown in Table 11, payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load.

4.9.3. **Placement Acceptance.**

- 4.9.3.1. **Placement Lot.** A placement lot consists of four placement sublots. A placement subplot consists of the area placed during a production subplot.

- 4.9.3.1.1. **Lot 1 Placement.** Placement payment adjustments greater than 1.000 for Lot 1 will be in accordance with Section 3076.6.2., "Placement Payment Adjustment Factors"; however, no placement adjustment less than 1.000 will be assessed for any subplot placed in Lot 1 when the in-place air voids are greater than or equal to 2.7% and less than or equal to 9.9%. Remove and replace any subplot with in-place air voids less than 2.7% or greater than 9.9%.

- 4.9.3.1.2. **Incomplete Placement Lots.** An incomplete placement lot consists of the area placed as described in Section 3076.4.9.2.1.1., "Incomplete Production Lots," excluding areas defined in Section 3076.4.9.3.1.4., "Miscellaneous Areas." Placement sampling is required if the random sample plan for production resulted in a sample being obtained from an incomplete production subplot.

- 4.9.3.1.3. **Shoulders, Ramps, Etc.** Shoulders, ramps, intersections, acceleration lanes, deceleration lanes, and turn lanes are subject to in-place air void determination and payment adjustments unless designated on the plans as not eligible for in-place air void determination. Intersections may be considered miscellaneous areas when determined by the Engineer.

- 4.9.3.1.4. **Miscellaneous Areas.** Miscellaneous areas include areas that typically involve significant handwork or discontinuous paving operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Temporary detours are subject to in-place air void determination when shown on the plans. Miscellaneous areas also include level-ups and thin overlays when the layer thickness specified on the plans is less than the minimum untrimmed core height eligible for testing shown in Table 13. The specified layer thickness is based on the rate of 110 lb./sq. yd. for each inch of

pavement unless another rate is shown on the plans. When “level up” is listed as part of the item bid description code, a payment adjustment factor of 1.000 will be assigned for all placement sublots as described in Article 3076.6, “Payment.” Miscellaneous areas are not eligible for random placement sampling locations. Compact miscellaneous areas in accordance with Section 3076.4.8., “Compaction.” Miscellaneous areas are not subject to in-place air void determination, thermal profiles testing, segregation (density profiles), or longitudinal joint density evaluations.

4.9.3.2.

Placement Sampling. The Engineer will select random numbers for all placement sublots at the beginning of the project. The Engineer will provide the Contractor with the placement random numbers immediately after the subplot is completed. Mark the roadway location at the completion of each subplot and record the station number. Determine one random sample location for each placement subplot in accordance with [Tex-225-F](#). Adjust the random sample location by no more than necessary to achieve a 2-ft. clearance if the location is within 2 ft. of a joint or pavement edge.

Shoulders, ramps, intersections, acceleration lanes, deceleration lanes, and turn lanes are always eligible for selection as a random sample location; however, if a random sample location falls on one of these areas and the area is designated on the plans as not subject to in-place air void determination, cores will not be taken for the subplot and a 1.000 pay factor will be assigned to that subplot.

Provide the equipment and means to obtain and trim roadway cores on site. On-site is defined as in close proximity to where the cores are taken. Obtain the cores within one working day of the time the placement subplot is completed unless otherwise approved. Obtain two 6-in. diameter cores side-by-side from within 1 ft. of the random location provided for the placement subplot. For Type D and Type F mixtures, 4-in. diameter cores are allowed. Mark the cores for identification, measure and record the untrimmed core height, and provide the information to the Engineer. The Engineer will witness the coring operation and measurement of the core thickness. Visually inspect each core and verify that the current paving layer is bonded to the underlying layer. Take corrective action if an adequate bond does not exist between the current and underlying layer to ensure that an adequate bond will be achieved during subsequent placement operations.

Trim the cores immediately after obtaining the cores from the roadway in accordance with [Tex-251-F](#) if the core heights meet the minimum untrimmed value listed in Table 13. Trim the cores on site in the presence of the Engineer. Use a permanent marker or paint pen to record the lot and subplot numbers on each core as well as the designation as Core A or B. The Engineer may require additional information to be marked on the core and may choose to sign or initial the core. The Engineer will take custody of the cores immediately after witnessing the trimming of the cores and will retain custody of the cores until the Department’s testing is completed. Before turning the trimmed cores over to the Engineer, the Contractor may wrap the trimmed cores or secure them in a manner that will reduce the risk of possible damage occurring during transport by the Engineer. After testing, the Engineer will return the cores to the Contractor.

The Engineer may have the cores transported back to the Department’s laboratory at the HMA plant via the Contractor’s haul truck or other designated vehicle. In such cases where the cores will be out of the Engineer’s possession during transport, the Engineer will use Department-provided security bags and the Roadway Core Custody protocol located at <http://www.txdot.gov/business/specifications.htm> to provide a secure means and process that protects the integrity of the cores during transport.

Decide whether to include the pair of cores in the air void determination for that subplot if the core height before trimming is less than the minimum untrimmed value shown in Table 13. Trim the cores as described above before delivering to the Engineer if electing to have the cores included in the air void determination. Deliver untrimmed cores to the Engineer and inform the Engineer of the decision to not have the cores included in air void determination if electing to not have the cores included in air void determination. The placement pay factor for the subplot will be 1.000 if cores will not be included in air void determination.

Instead of the Contractor trimming the cores on site immediately after coring, the Engineer and the Contractor may mutually agree to have the trimming operations performed at an alternate location such as a field laboratory or other similar location. In such cases, the Engineer will take possession of the cores

immediately after they are obtained from the roadway and will retain custody of the cores until testing is completed. Either the Department or Contractor representative may perform trimming of the cores. The Engineer will witness all trimming operations in cases where the Contractor representative performs the trimming operation.

Dry the core holes and tack the sides and bottom immediately after obtaining the cores. Fill the hole with the same type of mixture and properly compact the mixture. Repair core holes with other methods when approved.

4.9.3.3. **Placement Testing.** Perform placement tests in accordance with Table 16. After the Engineer returns the cores, the Contractor may test the cores to verify the Engineer's test results for in-place air voids. The allowable differences between the Contractor's and Engineer's test results are listed in Table 11.

4.9.3.3.1. **In-Place Air Voids.** The Engineer will measure in-place air voids in accordance with [Tex-207-F](#) and [Tex-227-F](#). Before drying to a constant weight, cores may be pre-dried using a CoreDry or similar vacuum device to remove excess moisture. The Engineer will average the values obtained for all sublots in the production lot to determine the theoretical maximum specific gravity. The Engineer will use the average air void content for in-place air voids.

The Engineer will use the vacuum method to seal the core if required by [Tex-207-F](#). The Engineer will use the test results from the unsealed core to determine the placement payment adjustment factor if the sealed core yields a higher specific gravity than the unsealed core. After determining the in-place air void content, the Engineer will return the cores and provide test results to the Contractor.

4.9.3.3.2. **Segregation (Density Profile).** Test for segregation using density profiles in accordance with [Tex-207-F](#), Part V when using a thermal camera instead of the thermal imaging system. Density profiles are not required and are not applicable when using a thermal imaging system. Density profiles are not applicable in areas described in Section 3076.4.9.3.1.4., "Miscellaneous Areas."

Perform a minimum of one density profile per subplot. Perform additional density profiles when any of the following conditions occur, unless otherwise approved:

- the paver stops due to lack of material being delivered to the paving operations and the temperature of the uncompacted mat before the initial break down rolling is less than the temperatures shown in Table 17;
- areas that are identified by either the Contractor or the Engineer with thermal segregation,;
- any visibly segregated areas that exist.

Table 17
Minimum Uncompacted Mat Temperature Requiring a Segregation Profile

High-Temperature Binder Grade ¹	Minimum Temperature of the Uncompacted Mat Allowed Before Initial Break Down Rolling ^{2,3,4}
PG 64	<250°F
PG 70	<260°F
PG 76	<270°F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. Segregation profiles are required in areas with moderate and severe thermal segregation as described in Section 3076.4.7.3.1.3.
3. Minimum uncompacted mat temperature requiring a segregation profile may be reduced 10°F if using a chemical WMA additive as a compaction aid.
4. When using WMA, the minimum uncompacted mat temperature requiring a segregation profile is 215°F.

Provide the Engineer with the density profile of every subplot in the lot within one working day of the completion of each lot. Report the results of each density profile in accordance with Section 3076.4.2., "Reporting and Responsibilities."

The density profile is considered failing if it exceeds the tolerances in Table 18. No production or placement payment adjustments greater than 1.000 will be paid for any subplot that contains a failing density profile. When a hand-held thermal camera is used instead of a thermal imaging system, the Engineer will measure the density profile at least once per project. The Engineer's density profile results will be used when available. The Engineer may require the Contractor to remove and replace the area in question if the area fails the density profile and has surface irregularities as defined in Section 3076.4.9.3.3.5., "Irregularities." The subplot in question may receive a production and placement payment adjustment greater than 1.000, if applicable, when the defective material is successfully removed and replaced.

Investigate density profile failures and take corrective actions during production and placement to eliminate the segregation. Suspend production if 2 consecutive density profiles fail unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

Table 18
Segregation (Density Profile) Acceptance Criteria

Mixture Type	Maximum Allowable Density Range (Highest to Lowest)	Maximum Allowable Density Range (Average to Lowest)
Type B	8.0 pcf	5.0 pcf
Type C, Type D & Type F	6.0 pcf	3.0 pcf

4.9.3.3.3. Longitudinal Joint Density.

4.9.3.3.3.1. **Informational Tests.** Perform joint density evaluations while establishing the rolling pattern and verify that the joint density is no more than 3.0 pcf below the density taken at or near the center of the mat. Adjust the rolling pattern, if needed, to achieve the desired joint density. Perform additional joint density evaluations, at least once per subplot, unless otherwise directed.

4.9.3.3.3.2. **Record Tests.** Perform a joint density evaluation for each subplot at each pavement edge that is or will become a longitudinal joint. Joint density evaluations are not applicable in areas described in Section 3076.4.9.3.1.4., "Miscellaneous Areas." Determine the joint density in accordance with [Tex-207-F](#), Part VII. Record the joint density information and submit results on Department forms to the Engineer. The evaluation is considered failing if the joint density is more than 3.0 pcf below the density taken at the core random sample location and the correlated joint density is less than 90.0%. The Engineer will make independent joint density verification at least once per project and may make independent joint density verifications at the random sample locations. The Engineer's joint density test results will be used when available.

Provide the Engineer with the joint density of every subplot in the lot within one working day of the completion of each lot. Report the results of each joint density in accordance with Section 3076.4.2., "Reporting and Responsibilities."

Investigate joint density failures and take corrective actions during production and placement to improve the joint density. Suspend production if the evaluations on two consecutive sublots fail unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

4.9.3.3.4. **Recovered Asphalt Dynamic Shear Rheometer (DSR).** The Engineer may take production samples or cores from suspect areas of the project to determine recovered asphalt properties. Asphalt binders with an aging ratio greater than 3.5 do not meet the requirements for recovered asphalt properties and may be deemed defective when tested and evaluated by the Materials and Tests Division. The aging ratio is the DSR value of the extracted binder divided by the DSR value of the original unaged binder. Obtain DSR values in accordance with AASHTO T 315 at the specified high temperature performance grade of the asphalt. The Engineer may require removal and replacement of the defective material at the Contractor's expense. The asphalt binder will be recovered for testing from production samples or cores in accordance with [Tex-211-F](#).

4.9.3.3.5. **Irregularities.** Identify and correct irregularities including segregation, rutting, raveling, flushing, fat spots, mat slippage, irregular color, irregular texture, roller marks, tears, gouges, streaks, uncoated aggregate particles, or broken aggregate particles. The Engineer may also identify irregularities, and in such cases, the Engineer will promptly notify the Contractor. If the Engineer determines that the irregularity will adversely affect pavement performance, the Engineer may require the Contractor to remove and replace (at the Contractor's expense) areas of the pavement that contain irregularities. The Engineer may also require the Contractor to remove and replace (at the Contractor's expense) areas where the mixture does not bond to the existing pavement.

If irregularities are detected, the Engineer may require the Contractor to immediately suspend operations or may allow the Contractor to continue operations for no more than one day while the Contractor is taking appropriate corrective action.

4.9.4. **Exempt Production.** The Engineer may deem the mixture as exempt production for the following conditions:

- anticipated daily production is less than 500 tons;
- total production for the project is less than 5,000 tons;
- when mutually agreed between the Engineer and the Contractor; or
- when shown on the plans.

For exempt production, the Contractor is relieved of all production and placement sampling and testing requirements, except for coring operations when required by the Engineer. The production and placement pay factors are 1.000 if the specification requirements listed below are met, all other specification requirements are met, and the Engineer performs acceptance tests for production and placement listed in Table 16 when 100 tons or more per day are produced.

- produce, haul, place, and compact the mixture in compliance with the specification and as directed;
- control mixture production to yield a laboratory-molded density that is within $\pm 1.0\%$ of the target laboratory-molded density as tested by the Engineer;
- compact the mixture in accordance with Section 3076.4.8., "Compaction;" and
- when a thermal imaging system is not used, the Engineer may perform segregation (density profiles) and thermal profiles in accordance with the specification.

4.9.5. **Ride Quality.** Measure ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

5. MEASUREMENT

- 5.1. **Dense Graded Hot-Mix Asphalt.** Hot mix will be measured by the ton of composite hot-mix, which includes asphalt, aggregate, and additives. Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment."
- 5.2. **Tack Coat.** Tack coat will be measured at the applied temperature by strapping the tank before and after road application and determining the net volume in gallons from the calibrated distributor. The Engineer will witness all strapping operations for volume determination. All tack, including emulsions, will be measured by the gallon applied.

The Engineer may allow the use of a metering device to determine asphalt volume used and application rate if the device is accurate within 1.5% of the strapped volume.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under Section 3076.5.1, "Measurement," will be paid for at the unit bid price for "Dense Graded Hot-Mix Asphalt" of the mixture type, SAC, and binder specified. These prices are full compensation for surface preparation, materials, placement, equipment, labor, tools, and incidentals.

The work performed and materials furnished in accordance with this Item and measured as provided under Article 3076.5.2, "Measurement," will be paid for at the unit bid price for "Tack Coat" of the tack coat provided. These prices are full compensation for materials, placement, equipment, labor, tools, and incidentals. Payment adjustments will be applied as determined in this Item; however, a payment adjustment factor of 1.000 will be assigned for all placement sublots for "level ups" only when "level up" is listed as part of the item bid description code. A payment adjustment factor of 1.000 will be assigned to all production and placement sublots when "exempt" is listed as part of the item bid description code, and all testing requirements are met.

Payment for each subplot, including applicable payment adjustments greater than 1.000, will only be paid for sublots when the Contractor supplies the Engineer with the required documentation for production and placement QC/QA, thermal profiles, segregation density profiles, and longitudinal joint densities in accordance with Section 3076.4.2., "Reporting and Responsibilities." When a thermal imaging system is used, documentation is not required for thermal profiles or segregation density profiles on individual sublots; however, the thermal imaging system automated reports described in [Tex-244-F](#) are required.

Trial batches will not be paid for unless they are included in pavement work approved by the Department.

Payment adjustment for ride quality will be determined in accordance with Item 585, "Ride Quality for Pavement Surfaces."

- 6.1. **Production Payment Adjustment Factors.** The production payment adjustment factor is based on the laboratory-molded density using the Engineer's test results. The bulk specific gravities of the samples from each subplot will be divided by the Engineer's maximum theoretical specific gravity for the subplot. The individual sample densities for the subplot will be averaged to determine the production payment adjustment factor in accordance with Table 19 for each subplot, using the deviation from the target laboratory-molded density defined in Table 9. The production payment adjustment factor for completed lots will be the average of the payment adjustment factors for the four sublots sampled within that lot.

Table 19
Production Payment Adjustment Factors for Laboratory-Molded Density¹

Absolute Deviation from Target Laboratory-Molded Density	Production Payment Adjustment Factor (Target Laboratory-Molded Density)
0.0	1.050
0.1	1.050
0.2	1.050
0.3	1.044
0.4	1.038
0.5	1.031
0.6	1.025
0.7	1.019
0.8	1.013
0.9	1.006
1.0	1.000
1.1	0.965
1.2	0.930
1.3	0.895
1.4	0.860
1.5	0.825
1.6	0.790
1.7	0.755
1.8	0.720
> 1.8	Remove and replace

1. If the Engineer's laboratory-molded density on any subplot is less than 95.0% or greater than 98.0%, take immediate corrective action to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractor's corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

6.1.1. **Payment for Incomplete Production Lots.** Production payment adjustments for incomplete lots, described under Section 3076.4.9.2.1.1., "Incomplete Production Lots," will be calculated using the average production payment factors from all sublots sampled.

A production payment factor of 1.000 will be assigned to any lot when the random sampling plan did not result in collection of any samples within the first subplot.

6.1.2. **Production Sublots Subject to Removal and Replacement.** If after referee testing, the laboratory-molded density for any subplot results in a "remove and replace" condition as listed in Table 19, the Engineer may require removal and replacement or may allow the subplot to be left in place without payment. The Engineer may also accept the subplot in accordance with Section 3076.5.3.1., "Acceptance of Defective or Unauthorized Work." Replacement material meeting the requirements of this Item will be paid for in accordance with this Section.

6.2. **Placement Payment Adjustment Factors.** The placement payment adjustment factor is based on in-place air voids using the Engineer's test results. The bulk specific gravities of the cores from each subplot will be divided by the Engineer's average maximum theoretical specific gravity for the lot. The individual core densities for the subplot will be averaged to determine the placement payment adjustment factor in accordance with Table 20 for each subplot that requires in-place air void measurement. A placement payment adjustment factor of 1.000 will be assigned to the entire subplot when the random sample location falls in an area designated on the plans as not subject to in-place air void determination. A placement payment adjustment factor of 1.000 will be assigned to quantities placed in areas described in Section 3076.4.9.3.1.4., "Miscellaneous Areas." The placement payment adjustment factor for completed lots will be the average of the placement payment adjustment factors for up to four sublots within that lot.

Table 20
Placement Payment Adjustment Factors for In-Place Air Voids

In-Place Air Voids	Placement Pay Adjustment Factor	In-Place Air Voids	Placement Pay Adjustment Factor
< 2.7	Remove and Replace	6.4	1.042
2.7	0.710	6.5	1.040
2.8	0.740	6.6	1.038
2.9	0.770	6.7	1.036
3.0	0.800	6.8	1.034
3.1	0.830	6.9	1.032
3.2	0.860	7.0	1.030
3.3	0.890	7.1	1.028
3.4	0.920	7.2	1.026
3.5	0.950	7.3	1.024
3.6	0.980	7.4	1.022
3.7	0.998	7.5	1.020
3.8	1.002	7.6	1.018
3.9	1.006	7.7	1.016
4.0	1.010	7.8	1.014
4.1	1.014	7.9	1.012
4.2	1.018	8.0	1.010
4.3	1.022	8.1	1.008
4.4	1.026	8.2	1.006
4.5	1.030	8.3	1.004
4.6	1.034	8.4	1.002
4.7	1.038	8.5	1.000
4.8	1.042	8.6	0.998
4.9	1.046	8.7	0.996
5.0	1.050	8.8	0.994
5.1	1.050	8.9	0.992
5.2	1.050	9.0	0.990
5.3	1.050	9.1	0.960
5.4	1.050	9.2	0.930
5.5	1.050	9.3	0.900
5.6	1.050	9.4	0.870
5.7	1.050	9.5	0.840
5.8	1.050	9.6	0.810
5.9	1.050	9.7	0.780
6.0	1.050	9.8	0.750
6.1	1.048	9.9	0.720
6.2	1.046	> 9.9	Remove and Replace
6.3	1.044		

6.2.1.

Payment for Incomplete Placement Lots. Payment adjustments for incomplete placement lots described under Section 3076.4.9.3.1.2., "Incomplete Placement Lots," will be calculated using the average of the placement payment factors from all sublots sampled and sublots where the random location falls in an area designated on the plans as not eligible for in-place air void determination.

If the random sampling plan results in production samples, but not in placement samples, the random core location and placement adjustment factor for the subplot will be determined by applying the placement random number to the length of the subplot placed.

If the random sampling plan results in placement samples, but not in production samples, no placement adjustment factor will apply for that subplot placed.

A placement payment adjustment factor of 1.000 will be assigned to any lot when the random sampling plan did not result in collection of any production samples.

- 6.2.2. **Placement Sublots Subject to Removal and Replacement.** If after referee testing, the placement payment adjustment factor for any subplot results in a “remove and replace” condition as listed in Table 20, the Engineer will choose the location of two cores to be taken within 3 ft. of the original failing core location. The Contractor will obtain the cores in the presence of the Engineer. The Engineer will take immediate possession of the untrimmed cores and submit the untrimmed cores to the Materials and Tests Division, where they will be trimmed if necessary and tested for bulk specific gravity within 10 working days of receipt.

The bulk specific gravity of the cores from each subplot will be divided by the Engineer’s average maximum theoretical specific gravity for the lot. The individual core densities for the subplot will be averaged to determine the new payment adjustment factor of the subplot in question. If the new payment adjustment factor is 0.700 or greater, the new payment adjustment factor will apply to that subplot. If the new payment adjustment factor is less than 0.700, no payment will be made for the subplot. Remove and replace the failing subplot, or the Engineer may allow the subplot to be left in place without payment. The Engineer may also accept the subplot in accordance with Section 3076.5.3.1., “Acceptance of Defective or Unauthorized Work.” Replacement material meeting the requirements of this Item will be paid for in accordance with this Section.

- 6.3. **Total Adjusted Pay Calculation.** Total adjusted pay (TAP) will be based on the applicable payment adjustment factors for production and placement for each lot.

$$TAP = (A+B)/2$$

where:

A = Bid price × production lot quantity × average payment adjustment factor for the production lot

B = Bid price × placement lot quantity × average payment adjustment factor for the placement lot + (bid price × quantity placed in miscellaneous areas × 1.000)

Production lot quantity = Quantity actually placed - quantity left in place without payment

Placement lot quantity = Quantity actually placed - quantity left in place without payment - quantity placed in miscellaneous areas

Special Specification 3079

Permeable Friction Course



1. DESCRIPTION

Construct a hot-mix asphalt (HMA) surface course composed of a compacted permeable mixture of aggregate, asphalt binder, and additives mixed hot in a mixing plant.

2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

Notify the Engineer of all material sources and before changing any material source or formulation. The Engineer will verify that the specification requirements are met when the Contractor makes a source or formulation change, and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time during the project to verify specification compliance in accordance with Item 6, "Control of Materials."

- 2.1. **Aggregate.** Furnish aggregates from sources that conform to the requirements in accordance with Table 1 and as specified in this Section. Aggregate requirements in this Section, including those shown in Table 1, may be modified or eliminated when shown on the plans. Additional aggregate requirements may be specified when shown on the plans. Provide aggregate stockpiles that meet the definitions in this Section for coarse aggregate. Do not use intermediate or fine aggregate in permeable friction course (PFC) mixtures. Supply aggregates that meet the definitions in [Tex-100-E](#) for crushed gravel or crushed stone. The Engineer will designate the plant or the quarry as the sampling location. Provide samples from materials produced for the project. The Engineer will establish the Surface Aggregate Classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests in accordance with Table 1. Document all test results on the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis given in [Tex-200-F](#), Part II.

- 2.1.1. **Coarse Aggregate.** Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve. Aggregates from sources listed in the Department's *Bituminous Rated Source Quality Catalog* (BRSQC) are preapproved for use. Use only the rated values for hot-mix listed in the BRSQC. Rated values for surface treatment (ST) do not apply to coarse aggregate sources used in hot-mix asphalt.

For sources not listed on the Department's BRSQC:

- build an individual stockpile for each material;
- request the Department test the stockpile for specification compliance;
- approved only when tested by the Engineer;
- once approved, do not add material to the stockpile unless otherwise approved; and
- allow 30 calendar days for the Engineer to sample, test, and report results.

Provide coarse aggregate with at least the minimum SAC shown on the plans. SAC requirements only apply to aggregates used on the surface of travel lanes, unless otherwise shown on the plans. SAC requirements apply to aggregates used on surfaces other than travel lanes when shown on the plans. The SAC for sources on the Department's *Aggregate Quality Monitoring Program* (AQMP) ([Tex-499-A](#)) is listed in the BRSQC.

2.1.1.1. **Blending Class A and Class B Aggregates.** To prevent crushing of the Class B aggregate when blending, Class B aggregate may be blended with a Class A aggregate to meet requirements for Class A materials if the Department's BRSQC rated source soundness magnesium (RSSM) rating for the Class B aggregate is less than the Class A aggregate or if the RSSM rating for the Class B aggregate is less than or equal to 10%. Use the rated values for hot mix asphaltic concrete (HMAC) published in the BRSQC. When blending Class A and B aggregates to meet a Class A requirement, ensure that at least 50% by weight, or volume if required, of all the aggregates used in the mixture design retained on the No. 4 sieve comes from the Class A aggregate source, unless otherwise shown on the plans. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. Class B aggregate may be disallowed when shown on the plans.

The Engineer may perform tests at any time during production, when the Contractor blends Class A and B aggregates to meet a Class A requirement, to ensure that at least 50% by weight, or volume if required, of the material retained on the No. 4 sieve comes from the Class A aggregate source. The Engineer will use the Department's mix design template, when electing to verify conformance, to calculate the percent of Class A aggregate retained on the No. 4 sieve by inputting the bin percentages shown from readouts in the control room at the time of production and stockpile gradations measured at the time of production. The Engineer may determine the gradations based on either washed or dry sieve analysis from samples obtained from individual aggregate cold feed bins or aggregate stockpiles. The Engineer may perform spot checks using the gradations supplied by the Contractor on the mixture design report as an input for the template; however, a failing spot check will require confirmation with a stockpile gradation determined by the Engineer.

2.1.1.2. **Micro-Deval Abrasion.** The Engineer will perform a minimum of one Micro-Deval abrasion test in accordance with [Tex-461-A](#) for each coarse aggregate source used in the mixture design that has a Rated Source Soundness Magnesium (RSSM) loss value greater than 10 as listed in the BRSQC, unless otherwise directed. The Engineer will perform testing before the start of production and may perform additional testing at any time during production. The Engineer may obtain the coarse aggregate samples from each coarse aggregate source or may require the Contractor to obtain the samples. The Engineer may waive all Micro-Deval testing based on a satisfactory test history of the same aggregate source.

The Engineer will estimate the magnesium sulfate soundness loss for each coarse aggregate source, when tested, using the following formula:

$$Mg_{est.} = (RSSM)(MD_{act.}/RSMD)$$

where:

$Mg_{est.}$ = magnesium sulfate soundness loss

RSSM = Rated Source Soundness Magnesium

$MD_{act.}$ = actual Micro-Deval percent loss

RSMD = Rated Source Micro-Deval

When the estimated magnesium sulfate soundness loss is greater than the maximum magnesium sulfate soundness loss specified, the coarse aggregate source will not be allowed for use unless otherwise approved. The Engineer will consult the Soils and Aggregates Section of the Materials and Tests Division, and additional testing may be required before granting approval.

Table 1
Coarse Aggregate Quality Requirements

Property	Test Method	Requirement
SAC	Tex-499-A (AQMP)	As shown on the plans
Deleterious material, %, Max	Tex-217-F , Part I	1.0
Decantation, %, Max	Tex-217-F , Part II	1.5
Micro-Deval abrasion, %	Tex-461-A	Note ¹
Los Angeles abrasion, %, Max	Tex-410-A	30
Magnesium sulfate soundness, 5 cycles, %, Max	Tex-411-A	20
Crushed face count, ² %, Min	Tex-460-A , Part I	95
Flat and elongated particles @ 5:1, %, Max	Tex-280-F	10

1. Used to estimate the magnesium sulfate soundness loss in accordance with Section 3079.2.1.1.2., "Micro-Deval Abrasion."

2. Only applies to crushed gravel.

- 2.2. **Baghouse Fines.** Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.
- 2.3. **Asphalt Binder.** Furnish the type and grade of binder specified on the plans that meets the requirements of Item 300, "Asphalts, Oils, and Emulsions."
- 2.3.1. **Performance-Graded (PG) Binder.** Provide an asphalt binder with a high-temperature grade of PG 76 and low-temperature grade as shown on the plans in accordance with Section 300.2.10., "Performance-Graded Binders," when PG binder is specified.
- 2.3.2. **Asphalt-Rubber (A-R) Binder.** Provide A-R binder that meets the Type I or Type II requirements of Section 300.2.9., "Asphalt-Rubber Binders," when A-R is specified unless otherwise shown on the plans. Use at least 15.0% by weight of Crumb Rubber Modifier (CRM) that meets the Grade B or Grade C requirements of Section 300.2.7., "Crumb Rubber Modifier," unless otherwise shown on the plans. Provide the Engineer the A-R binder blend design with the mix design (JMF1) submittal. Provide the Engineer with documentation such as the bill of lading showing the quantity of CRM used in the project unless otherwise directed.
- 2.4. **Tack Coat.** Furnish CSS-1H, SS-1H, EBL, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions." Specialized tack coat materials listed on the Department's Tracking Resistant Asphalt Interlayer (TRAIL) MPL may be allowed or required when shown on the plans. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.
- 2.5. **Additives.** Provide the Engineer with documentation such as the bill of lading showing the quantity of additives used in the project unless otherwise directed.
- 2.5.1. **Fibers.** Provide cellulose or mineral fibers when PG binder is specified. Do not use fibers when A-R binder is specified. Submit written certification to the Engineer that the fibers proposed for use meet the requirements of DMS-9204, "Fiber Additives for Bituminous Mixtures." Fibers may be pre-blended into the binder at the asphalt supply terminal unless otherwise shown on the plans.
- 2.5.2. **Lime Mineral Filler.** Add lime as mineral filler at a rate of 1.0% by weight of the total dry aggregate in accordance with Item 301, "Asphalt Antistripping Agents," unless otherwise shown on the plans or waived by the Engineer based on Hamburg Wheel test results. Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime into the drum.
- 2.5.3. **Lime and Liquid Antistripping Agent.** When lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime into the drum. When the plans require lime to be added as an antistripping agent, lime added as mineral filler will count towards the total quantity of lime specified.
- 2.5.4. **Compaction Aid.** Compaction aid is defined as a Department-approved chemical warm mix additive denoted as "chemical additive" on the Department's materials producer list (MPL) that is used to facilitate mixing and compaction of HMA.
- Compaction aid is allowed for use on all projects. Compaction aid is required when shown on the plans or as required in Section 3079.4.7.1., "Weather Conditions."
- Warm mix foaming processes, denoted as "foaming process" on the Department-approved MPL, may be used to facilitate mixing and compaction of HMA; however warm mix foaming processes are not defined as a Compaction aid.
- 2.6. **Recycled Materials.** Recycled materials are not allowed for use.

3. EQUIPMENT

Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement." When A-R binder is specified, equip the hot-mix plant with an in-line viscosity-measuring device located between the blending unit and the mixing drum. Provide a means to calibrate the asphalt mass flow meter on-site when a meter is used.

4. CONSTRUCTION

Produce, haul, place, and compact the specified paving mixture. In addition to tests required by the specification, Contractors may perform other QC tests as deemed necessary. At any time during the project, the Engineer may perform production and placement tests as deemed necessary in accordance with Item 5, "Control of the Work." Schedule and participate in a mandatory pre-paving meeting with the Engineer on or before the first day of paving unless otherwise shown on the plans.

- 4.1. **Certification.** Personnel certified by the Department-approved hot-mix asphalt certification program must conduct all mixture designs, sampling, and testing in accordance with Table 2. Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning production and when personnel changes are made. Provide a mixture design developed and signed by a Level 2 certified specialist. Provide Level 1A certified specialists at the plant during production operations. Provide Level 1B certified specialists to conduct placement tests. Provide Level AGG101 certified specialists for aggregate testing.

Table 2
Test Methods, Test Responsibility, and Minimum Certification Levels

Test Description	Test Method	Contractor	Engineer	Level ¹
1. Aggregate Testing				
Sampling	Tex-221-F	✓	✓	1A/AGG101
Dry sieve	Tex-200-F, Part I	✓	✓	1A/AGG101
Washed sieve	Tex-200-F, Part II	✓	✓	1A/AGG101
Deleterious material	Tex-217-F, Parts I & III	✓	✓	AGG101
Decantation	Tex-217-F, Part II	✓	✓	AGG101
Los Angeles abrasion	Tex-410-A		✓	Department
Magnesium sulfate soundness	Tex-411-A		✓	Department
Micro-Deval abrasion	Tex-461-A		✓	AGG101
Crushed face count	Tex-460-A	✓	✓	AGG101
Flat and elongated particles	Tex-280-F	✓	✓	AGG101
2. Asphalt Binder & Tack Coat Sampling				
Asphalt binder sampling	Tex-500-C, Part II	✓	✓	1A/1B
Tack coat sampling	Tex-500-C, Part III	✓	✓	1A/1B
3. Mix Design & Verification				
Design and JMF changes	Tex-204-F	✓	✓	2
Mixing	Tex-205-F	✓	✓	2
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F, Parts I, VI, & VIII	✓	✓	1A
Rice gravity	Tex-227-F, Part II	✓	✓	1A
Ignition oven correction factors ²	Tex-236-F, Part II	✓	✓	2
Drain-down	Tex-235-F	✓	✓	1A
Hamburg Wheel test	Tex-242-F	✓	✓	1A
Boil test ⁴	Tex-530-C	✓	✓	1A
Cantabro loss	Tex-245-F	✓	✓	1A
4. Production Testing				
Control charts	Tex-233-F	✓	✓	1A
Mixture sampling	Tex-222-F	✓	✓	1A/1B
Gradation & asphalt binder content ²	Tex-236-F, Part I	✓	✓	1A
Moisture content	Tex-212-F, Part II	✓	✓	1A/AGG101
Micro-Deval abrasion	Tex-461-A		✓	AGG101
Drain-down	Tex-235-F	✓	✓	1A
Boil test ⁴	Tex-530-C	✓	✓	1A
Abson recovery	Tex-211-F		✓	Department
5. Placement Testing				
Control charts	Tex-233-F	✓	✓	1A
Ride quality measurement	Tex-1001-S	✓	✓	Note 3
Thermal profile	Tex-244-F	✓	✓	1B
Water flow test	Tex-246-F	✓	✓	1B
Shear bond strength test	Tex-249-F		✓	Department

- Level 1A, 1B, AGG101, and 2 are certification levels provided by the Hot Mix Asphalt Center certification program.
- Refer to Section 3079.4.9.2.3., "Production Testing," for exceptions to using an ignition oven.
- Profiler and operator are required to be certified at the Texas A&M Transportation Institute facility when Surface Test Type B is specified.
- When shown on the plans.

- 4.2. **Reporting and Responsibilities.** Use Department-provided templates to record and calculate all test data, including mixture design, production and placement tests, control charts, and thermal profiles. Obtain the current version of the templates at <https://www.txdot.gov/inside-tdot/forms-publications/consultants-contractors/forms/site-manager.html> or from the Engineer. The Engineer and the Contractor will provide any available test results to the other party when requested. The maximum allowable time for the Contractor and Engineer to exchange test data is given in Table 3. The Engineer and the Contractor will immediately report to the other party any test result that requires suspension of production or placement or that fails to meet the specification requirements. Record and electronically submit all test results and pertinent information on Department-provided templates.

Subsequent sublots placed after test results are available to the Contractor, which require suspension of operations, may be considered unauthorized work. Unauthorized work will be accepted or rejected at the discretion of the Engineer in accordance with Article 5.3., "Conformity with Plans, Specifications, and Special Provisions."

Table 3
Reporting Schedule

Description	Reported By	Reported To	To Be Reported Within
Production Quality Control			
Gradation ¹	Contractor	Engineer	1 working day of completion of the subplot
Asphalt binder content ¹			
Laboratory-molded density ¹			
Moisture content ²			
Drain-down ¹			
Boil test ⁴			
Production Quality Assurance			
Gradation ²	Engineer	Contractor	1 working day of completion of the subplot
Asphalt binder content ²			
Laboratory-molded density ²			
Hamburg Wheel test ³			
Boil test ⁴			
Drain-down ²			
Binder tests ³			
Placement Quality Control			
Thermal profile ¹	Contractor	Engineer	1 working day of completion of the lot
Water flow ¹			
Placement Quality Assurance			
Thermal profile ²	Engineer	Contractor	1 working day of completion of the lot
Aging ratio ³			
Water flow ²			

1. These tests are required on every subplot.
2. To be performed at the frequency in accordance with Table 9 or as shown on the plans.
3. To be reported as soon as the results become available.
4. When shown on the plans

Use the procedures described in [Tex-233-F](#) to plot the results of all production and placement testing, when directed. Update the control charts as soon as test results for each subplot become available. Make the control charts readily accessible at the field laboratory. The Engineer may suspend production for failure to update control charts.

- 4.3. **Quality Control Plan (QCP).** Develop and follow the QCP in detail. Obtain approval for changes to the QCP made during the project. The Engineer may suspend operations if the Contractor fails to comply with the QCP.

Submit a written QCP before the mandatory pre-paving meeting when directed. Receive approval of the QCP before pre-paving meeting. Include the following items in the QCP:

- 4.3.1. **Project Personnel.** For project personnel, include:
- a list of individuals responsible for QC with authority to take corrective action;
 - current contact information for each individual listed; and

- current copies of certification documents for individuals performing specified QC functions.

4.3.2. **Material Delivery and Storage.** For material delivery and storage, include:

- the sequence of material processing, delivery, and minimum quantities to assure continuous plant operations;
- aggregate stockpiling procedures to avoid contamination and segregation;
- frequency, type, and timing of aggregate stockpile testing to assure conformance of material requirements before mixture production; and
- procedure for monitoring the quality and variability of asphalt binder.

4.3.3. **Production.** For production, include:

- loader operation procedures to avoid contamination in cold bins;
- procedures for calibrating and controlling cold feeds;
- procedures to eliminate debris or oversized material;
- procedures for adding and verifying rates of each applicable mixture component (e.g., aggregate, asphalt binder, lime, liquid antistriper, compaction aid, foaming process, fibers);
- procedures for reporting job control test results; and
- procedures to avoid segregation and drain-down in the silo.

4.3.4. **Loading and Transporting.** For loading and transporting, include:

- type and application method for release agents; and
- truck loading procedures to avoid segregation.

4.3.5. **Placement and Compaction.** For placement and compaction, include:

- proposed agenda for mandatory pre-paving meeting, including date and location;
- proposed paving plan (e.g., production rate, paving widths, joint offsets, and lift thicknesses);
- type and application method for release agents in the paver and on rollers, shovels, lutes, and other utensils;
- procedures for the transfer of mixture into the paver, while avoiding physical and thermal segregation and preventing material spillage;
- process to balance production, delivery, paving, and compaction to achieve continuous placement operations and good ride quality;
- paver operations (e.g., speed, operation of wings, height of mixture in auger chamber) to avoid physical and thermal segregation and other surface irregularities; and
- procedures to construct quality longitudinal and transverse joints.

4.4. **Mixture Design.**

4.4.1. **Design Requirements.** Use the PFC design procedure provided in [Tex-204-E](#), unless otherwise shown on the plans. Design the mixture to meet the requirements in accordance with Tables 1, 4, 5, and 6. Use a Superpave Gyrotory Compactor (SGC) at 50 gyrations as the design number of gyrations (Ndesign).

The Engineer will provide the mixture design when shown on the plans. The Contractor may submit a new mixture design at any time during the project. The Engineer will verify and approve all mixture designs (JMF1) before the Contractor can begin production.

Provide the Engineer with a mixture design report using the Department-provided template. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- results of all applicable tests;
- the mixing and molding temperatures;
- the signature of the Level 2 person or persons that performed the design;

- the date the mixture design was performed; and
- a unique identification number for the mixture design.

Table 4
Master Gradation Limits (% Passing by Weight or Volume)

Sieve Size	PG 76 Mixtures		A-R Mixtures		Test Procedure
	Fine (PFC-F)	Coarse (PFC-C)	Fine (PFCR-F)	Coarse (PFCR-C)	
3/4"	–	100.0 ¹	100.0 ¹	100.0 ¹	Tex-200-F
1/2"	100.0 ¹	80.0–100.0	95.0–100.0	80.0–100.0	
3/8"	95.0–100.0	35.0–60.0	50.0–80.0	35.0–60.0	
#4	20.0–55.0	1.0–20.0	0.0–8.0	0.0–20.0	
#8	1.0–10.0	1.0–10.0	0.0–4.0	0.0–10.0	
#200	1.0–4.0	1.0–4.0	0.0–4.0	0.0–4.0	

1. Defined as maximum sieve size. No tolerance allowed.

Table 5
Mixture Design Properties

Mix Property	PG 76 Mixtures		A-R Mixtures		Test Procedure
	Fine (PFC-F) Requirements	Coarse (PFC-C) Requirements	Fine (PFCR-F) Requirements	Coarse (PFCR-C) Requirements	
Design gyrations (N _{design})	50	50	50	50	Tex-241-F
Lab-molded density, %	78.0 Max	82.0 Max	82.0 Max	82.0 Max	Tex-207-F
Asphalt Binder Content, %	6.0–7.0	6.0–7.0	8.0–10.0	7.0–9.0	--
Hamburg Wheel test, ¹ passes at 12.5 mm rut depth	10,000 Min ²	Note 3	Note 3	Note 3	Tex-242-F
Drain-down, %	0.10 Max	0.10 Max	0.10 Max	0.10 Max	Tex-235-F
Fiber content, % by wt. of total PG 76 mixture	0.20–0.50	0.20–0.50	–	–	Calculated
Lime content, % by wt. of total aggregate	1.0 ⁴	1.0 ⁴	–	–	Calculated
CRM content, % by wt. of A-R binder	–	–	15.0 Min	15.0 Min	Calculated
Boil test ⁵	–	–	–	–	Tex-530-C
Cantabro loss, %	20.0 Max	20.0 Max	20.0 Max	20.0 Max	Tex-245-F

1. Mold test specimens to N_{design} at the optimum asphalt binder content.
2. May be decreased when shown on the plans.
3. No specification value is required unless otherwise shown on the plans.
4. Unless otherwise shown on the plans or waived by the Engineer based on Hamburg Wheel results.
5. When shown on the plans. Used to establish baseline for comparison to production results.

4.4.2. **Job-Mix Formula Approval.** The job-mix formula (JMF) is the combined aggregate gradation, N_{design} level, and target asphalt percentage used to establish target values for hot-mix production. JMF1 is the original laboratory mixture design used to produce the trial batch. When a compaction aid or foaming process is used, JMF1 may be designed and submitted to the Engineer without including the compaction aid or foaming process. When a compaction aid or foaming process is used, document the compaction aid or foaming process used and recommended rate on the JMF1 submittal. The Engineer and the Contractor will verify JMF1 based on plant-produced mixture from the trial batch unless otherwise approved. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF1. The Department may require the Contractor to reimburse the Department for verification tests if more than two trial batches per design are required.

4.4.2.1. **Contractor's Responsibilities.**

- 4.4.2.1.1. **Providing Gyrotory Compactor.** Furnish an SGC calibrated in accordance with [Tex-241-F](#) for molding production samples. Locate the SGC at the Engineer's field laboratory or make the SGC available to the Engineer for use in molding production samples.
- 4.4.2.1.2. **Gyrotory Compactor Correlation Factors.** Use [Tex-206-F](#), Part II, to perform a gyrotory compactor correlation when the Engineer uses a different SGC. Apply the correlation factor to all subsequent production test results.
- 4.4.2.1.3. **Submitting JMF1.** Furnish a mix design report (JMF1) with representative samples of all component materials and request approval to produce the trial batch. Provide an additional 25 lb. of the design mixture if opting to have the Department perform the Hamburg Wheel test on the laboratory mixture when required in accordance with Table 5, and request that the Department perform the test.
- 4.4.2.1.4. **Supplying Aggregates.** Provide approximately 40 lb. of each aggregate stockpile unless otherwise directed.
- 4.4.2.1.5. **Supplying Asphalt.** Provide at least 1 gal. of the asphalt material and enough quantities of any additives proposed for use.
- 4.4.2.1.6. **Ignition Oven Correction Factors.** Determine the aggregate and asphalt correction factors from the ignition oven in accordance with [Tex-236-F](#), Part II. Provide correction factors that are not more than 12 mo. old. Note that the asphalt content correction factor takes into account the percent fibers in the mixture so that the fibers are excluded from the binder content determination. Provide the Engineer with split samples of the mixtures before the trial batch production, including all additives (except water), and blank samples used to determine the correction factors for the ignition oven used for quality assurance (QA) testing during production. Correction factors established from a previously approved mixture design may be used for the current mixture design if the mixture design and ignition oven are the same as previously used and the correction factors are not more than 12 mo. old, unless otherwise directed.
- 4.4.2.1.7. **Boil Test.** When shown on the plans, perform the test and retain the tested sample from [Tex-530-C](#) until completion of the project or as directed. Use this sample for comparison purposes during production. Add lime or liquid antistripping agent, as directed, if signs of stripping exist.
- 4.4.2.1.8. **Trial Batch Production.** Provide a plant-produced trial batch upon receiving conditional approval of JMF1 and authorization to produce a trial batch including the compaction aid or foaming process, if applicable, for verification testing of JMF1 and development of JMF2. Produce a trial batch mixture that meets the requirements in accordance with Table 6. The Engineer may accept test results from recent production of the same mixture instead of a new trial batch.
- 4.4.2.1.9. **Trial Batch Production Equipment.** Use only equipment and materials proposed for use on the project to produce the trial batch. Provide documentation to verify the calibration or accuracy of the asphalt mass flow meter to measure the binder content. Verify that asphalt mass flow meter meets the requirements of 0.4% accuracy, when required, in accordance with Item 520, "Weighing and Measuring Equipment." The Engineer may require that the accuracy of the mass flow meter be verified based on quantities used.
- 4.4.2.1.10. **Trial Batch Quantity.** Produce enough quantity of the trial batch to ensure that the mixture meets the specification requirements.
- 4.4.2.1.11. **Number of Trial Batches.** Produce trial batches as necessary to obtain a mixture that meets the specification requirements.
- 4.4.2.1.12. **Trial Batch Sampling.** Obtain a representative sample of the trial batch and split it into three equal portions in accordance with [Tex-222-F](#). Label these portions as "Contractor," "Engineer," and "Referee." Deliver samples to the appropriate laboratory as directed.
- 4.4.2.1.13. **Trial Batch Testing.** Test the trial batch to ensure the mixture produced using the proposed JMF1 meets the mixture requirements in accordance with Table 6. Ensure the trial batch mixture is also in compliance with the requirements in accordance with Table 5. Use a Department-approved laboratory listed on the MPL to perform

the Hamburg Wheel test on the trial batch mixture or request that the Department perform the Hamburg Wheel test. Provide an additional 25 lb. of the trial batch mixture if opting to have the Department perform the Hamburg Wheel test, if applicable, and request that the Department perform the test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the trial batch. Provide the Engineer with a copy of the trial batch test results.

- 4.4.2.1.14. **Development of JMF2.** Evaluate the trial batch test results, determine the target mixture proportions, and submit as JMF2 after the Engineer grants full approval of JMF1 based on results from the trial batch. The mixture produced using JMF2 must meet the requirements in accordance with Tables 4 and 5. Verify that JMF2 meets the operational tolerances in accordance with Table 6.
- 4.4.2.1.15. **Mixture Production.** Use JMF2 to produce Lot 1 after receiving approval for JMF2.
- 4.4.2.1.16. **Development of JMF3.** Evaluate the test results from Lot 1, determine the optimum mixture proportions, and submit as JMF3 for use in Lot 2.
- 4.4.2.1.17. **JMF Adjustments.** If JMF adjustments are necessary to achieve the specified requirements, make the adjustments before beginning a new lot. The adjusted JMF must:
- be provided to the Engineer in writing before the start of a new lot;
 - be numbered in sequence to the previous JMF;
 - meet the master gradation limits in accordance with Table 4; and
 - be within the operational tolerances of JMF2 in accordance with Table 6.
- 4.4.2.1.18. **Requesting Referee Testing.** Use referee testing, if needed, in accordance with Section 3079.4.9.1., "Referee Testing," to resolve testing differences with the Engineer.

Table 6
Operational Tolerances

Test Description	Test Method	Allowable Difference between JMF2 and JMF1 Target ¹	Allowable Difference from Current JMF and JMF2 ²	Allowable Difference between Contractor and Engineer ³
Individual % retained for sieve sized larger than #200	Tex-200-F	Must be Within Master Grading Limits in accordance with Table 4	±3.0 ⁴	±5.0 ⁴
% passing the #200 sieve				±2.0 ⁴
Laboratory-molded density, %	Tex-207-F , Part VIII	±1.0	±1.0	±1.0
Asphalt binder content, %	Tex-236-F , Part I ⁵	±0.3 ^{6,7}	±0.3 ^{4,6,7}	±0.3 ^{6,7}
Drain-down, %	Tex-235-F	Note 8	Note 8	N/A
Boil test	Tex-530-C	Note 9	Note 9	N/A

1. JMF1 is the approved laboratory mixture design used for producing the trial batch. JMF2 is the approved mixture design developed from the trial batch used to produce Lot 1.
2. Current JMF is JMF3 or higher. JMF3 is the approved mixture design used to produce Lot 2.
3. Contractor may request referee testing only when values exceed these tolerances.
4. Only applies to mixture produced for Lot 1 and higher. Aggregate gradation is not allowed to be outside the limits shown in Table 4.
5. Ensure the binder content determination excludes fibers.
6. May be obtained from asphalt mass flow meter readouts as determined by the Engineer.
7. Binder content is not allowed to be outside the limits in accordance with Table 5.
8. Verify that Table 5 requirements are met.
9. When shown on the plans.

4.4.2.2. **Engineer's Responsibilities.**

- 4.4.2.2.1. **Superpave Gyrotory Compactor.** The Engineer will use a Department SGC calibrated in accordance with [Tex-241-F](#) to mold samples for laboratory mixture design verification. For molding trial batch and production specimens, the Engineer will use the Contractor-provided SGC at the

field laboratory or provide and use a Department SGC at an alternate location.

4.4.2.2.2. **Conditional Approval of JMF1 and Authorizing Trial Batch.** The Engineer will review and verify conformance of the following information within two working days of receipt:

- the Contractor's mix design report (JMF1);
- the Contractor-provided Hamburg Wheel test results;
- all required materials including aggregates, asphalt, and additives; and
- the mixture specifications.

The Engineer will grant the Contractor conditional approval of JMF1 if the information provided on the paper copy of JMF1 indicates that the Contractor's mixture design meets the specifications. When the Contractor does not provide Hamburg Wheel test with laboratory mixture design, 10 working days are allowed for conditional approval of JMF1. The Engineer will base full approval of JMF1 on the test results on mixture from the trial batch.

Unless waived, the Engineer will determine the Micro-Deval abrasion loss in accordance with Section 3079.2.1.1.2., "Micro-Deval Abrasion." If the Engineer's test results are pending after two working days, conditional approval of JMF1 will still be granted within two working days of receiving JMF1. When the Engineer's test results become available, they will be used for specification compliance.

The Contractor is authorized to produce a trial batch after the Engineer grants conditional approval of JMF1.

4.4.2.2.3. **Hamburg Wheel Testing.** At the Contractor's request, the Department will perform the Hamburg Wheel test on the laboratory mixture in accordance with [Tex-242-F](#) to verify compliance with the Hamburg Wheel test requirement in accordance with Table 5. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the laboratory mixture design.

4.4.2.2.4. **Ignition Oven Correction Factors.** The Engineer will use the split samples provided by the Contractor to determine the aggregate and asphalt correction factors for the ignition oven used for QA testing during production in accordance with [Tex-236-F](#), Part II. Provide correction factors that are not more than 12 mo. old. The Engineer will verify that the asphalt content correction factor takes into account the percent fibers in the mixture so that the fibers are excluded from the binder content determination.

4.4.2.2.5. **Testing the Trial Batch.** Within one full working day, the Engineer will sample and test the trial batch to ensure that the mixture meets the requirements in accordance with Table 6. If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the trial batch mixture, the Engineer will mold samples in accordance with [Tex-242-F](#) to verify compliance with the Hamburg Wheel test requirement in accordance with Table 5.

The Engineer will have the option to perform [Tex-530-C](#) on the trial batch when shown on the plans. These results may be retained and used for comparison purposes during production.

4.4.2.2.6. **Full Approval of JMF1.** The Engineer will grant full approval of JMF1 and authorize the Contractor to proceed with developing JMF2 if the Engineer's results for the trial batch meet the requirements in accordance with Table 5.

The Engineer will notify the Contractor that an additional trial batch is required if the trial batch does not meet these requirements.

4.4.2.2.7. **Approval of JMF2.** The Engineer will approve JMF2 within one working day if the mixture meets the requirements in accordance with Tables 4, 5, and 6.

- 4.4.2.2.8. **Approval of Lot 1 Production.** The Engineer will authorize the Contractor to proceed with Lot 1 production (using JMF2).
- 4.4.2.2.9. **Approval of JMF3 and Subsequent JMF Changes.** JMF3 and subsequent JMF changes are approved if they meet the master grading limits in accordance with Table 4, the asphalt binder content in accordance with Table 5, and are within the operational tolerances of JMF2 in accordance with Table 6.
- 4.4.2.2.10. **Binder Content Adjustments.** For JMF2 and above, the Engineer may require the Contractor to adjust the target binder content by no more than 0.3% from the current JMF.
- 4.5. **Production Operations.** Perform a new trial batch when the plant or plant location is changed. Take corrective action and receive approval to proceed after any production suspension for noncompliance to the specification.
- 4.5.1. **Storage and Heating of Materials.** Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions," or outside the manufacturer's recommended values. Provide the Engineer with daily records of asphalt binder and hot-mix asphalt discharge temperatures (in legible and discernible increments) in accordance with Item 320, "Equipment for Asphalt Concrete Pavement," unless otherwise directed. Do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr. unless otherwise approved.
- 4.5.2. **Mixing and Discharge of Materials.** Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed the maximum production temperatures in accordance with Table 7. The Department will not pay for or allow placement of any mixture produced above the maximum production temperatures in accordance with Table 7.

Table 7
Maximum Production Temperature

High-Temperature Binder Grade ¹	Maximum Production Temperature
PG 76	345°F
A-R Binder	345°F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.

Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant. Determine the moisture content, if requested, by oven-drying in accordance with [Tex-212-F](#), Part II, and verify that the mixture contains no more than 0.2% of moisture by weight. Obtain the sample immediately after discharging the mixture into the truck and perform the test promptly.

- 4.6. **Hauling Operations.** Clean all truck beds before use to ensure that mixture is not contaminated. Use a release agent, when necessary, shown on the Department's MPL to coat the inside bed of the truck. Do not use diesel or any release agent not shown on the Department's MPL.

Use equipment for hauling as defined in Section 3079.4.7.3.3., "Hauling Equipment." Use other hauling equipment only when allowed.

- 4.7. **Placement Operations.** Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer approximately every hour or as directed. Use a hand-held thermal camera or infrared thermometer, when a thermal imaging system is not used, to measure and record the internal temperature of the mixture as discharged from the truck or Material Transfer Device (MTD) before or as the mix enters the paver and an approximate station number or GPS coordinates on each ticket. Calculate the daily yield and cumulative yield for the specified lift and provide to the Engineer at the end of paving operations for each day unless otherwise directed. The Engineer may suspend production if the Contractor fails to produce and provide haul tickets and yield calculations by the end of paving operations for each day.

Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from

pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of hot-mix by at least 6 in. Place mixture so that longitudinal joints on the surface course coincide within 6-in. of lane lines and are not placed in the wheel path, or as directed. Ensure that all finished surfaces will drain properly.

4.7.1. **Weather Conditions.**

- 4.7.1.1. **When Using a Thermal Imaging System.** The Contractor may pave any time the roadway is dry and the roadway surface temperature is at least 60°F unless otherwise approved or as shown on the plans; however, the Engineer may restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hr. of paving. Place mixtures when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. Provide output data from the thermal imaging system to demonstrate to the Engineer that no recurring severe thermal segregation exists in accordance with Section 3079.4.7.3.1.2., "Thermal Imaging System."

Produce mixture with a target discharge temperature higher than 300°F and with a compaction aid to facilitate compaction when the air temperature is 70°F and falling.

- 4.7.1.1.1. **When Not Using a Thermal Imaging System.** When using a thermal camera instead of the thermal imaging system, place mixture when the roadway surface temperature is at or above 70°F unless otherwise approved or as shown on the plans. Measure the roadway surface temperature with a hand-held thermal camera or infrared thermometer. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. The Engineer may restrict the Contractor from paving if the air temperature is 60°F and falling.

Produce mixture with a target discharge temperature higher than 300°F and with a compaction aid to facilitate compaction when the air temperature is 70°F and falling.

4.7.2. **Tack Coat.**

- 4.7.2.1. **Application.** Clean the surface before placing the tack coat. The Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area. Apply a uniform tack coat at the specified rate unless otherwise directed. Apply the tack coat in a uniform manner to avoid streaks and other irregular patterns. Apply adequate overlap of the tack coat in the longitudinal direction during the placement of the mat to ensure bond of adjacent PFC mats, unless otherwise directed. Unless otherwise directed, avoid tacking the vertical faces of adjacent PFC mats in the longitudinal direction to avoid restricting lateral drainage. Apply tack coat to all transverse joints. Allow adequate time for emulsion to break completely before placing any material. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

- 4.7.2.2. **Sampling.** The Engineer will obtain at least one sample of the tack coat binder per project in accordance with [Tex-500-C](#), Part III, and test it to verify compliance with Item 300, "Asphalts, Oils, and Emulsions." The Engineer will notify the Contractor when the sampling will occur and will witness the collection of the sample from the asphalt distributor immediately before use. Label the can with the corresponding lot and subplot numbers, producer, producer facility, grade, district, date sampled, and project information including highway and CSJ. For emulsions, the Engineer may test as often as necessary to ensure the residual of the emulsion is greater than or equal to the specification requirement in Item 300, "Asphalts, Oils, and Emulsions."

- 4.7.3. **Lay-Down Operations.** Use the placement temperature in accordance with Table 8 to establish the minimum placement temperature of the mixture delivered to the paving operation.

Table 8
Minimum Mixture Placement Temperature

High-Temperature Binder Grade ¹	Minimum Placement Temperature (Before Entering Paving Operation) ^{2,3}
PG 76	280°F
A-R Binder	280°F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. The mixture temperature must be measured using a hand-held thermal camera or infrared thermometer nearest to the point of entry of the paving operation.
3. Minimum placement temperatures may be reduced 10°F if using a compaction aid.

4.7.3.1. **Thermal Profile.** Use a hand-held thermal camera or a thermal imaging system to obtain a continuous thermal profile in accordance with [Tex-244-F](#). Thermal profiles are not applicable in areas described in Section 3079.4.9.3.2., "Miscellaneous Areas."

4.7.3.1.1. **Thermal Segregation.**

4.7.3.1.1.1. **Moderate.** Any areas that have a temperature differential greater than 25°F, but not exceeding 50°F.

4.7.3.1.1.2. **Severe.** Any areas that have a temperature differential greater than 50°F.

4.7.3.1.2. **Thermal Imaging System.** Review the output results when a thermal imaging system is used, and provide the report described in [Tex-244-F](#) to the Engineer daily. Modify the paving process as necessary to eliminate any recurring (moderate or severe) thermal segregation identified by the thermal imaging system.-

The Engineer may suspend subsequent paving operations if the Contractor cannot successfully modify the paving process to eliminate recurring severe or moderate thermal segregation.

Provide the Engineer with electronic copies of all daily data files that can be used with the thermal imaging system software to generate temperature profile plots daily or as requested by the Engineer.

4.7.3.1.2.1. **Thermal Camera.** When using a thermal camera instead of the thermal imaging system, take immediate corrective action to eliminate recurring moderate thermal segregation when a hand-held thermal camera is used. Provide the Engineer with the thermal profile of every subplot within one working day of the completion of each lot. When requested by the Engineer, provide the electronic files generated using the thermal camera. Report the results of each thermal profile in accordance with Section 3079.4.2., "Reporting and Responsibilities." The Engineer will use a hand-held thermal camera to obtain a thermal profile at least once per project. Suspend operations and take immediate corrective action to eliminate severe thermal segregation unless otherwise directed. Resume operations when the Engineer determines that subsequent production will meet the requirements of this Section.

4.7.3.2. **Windrow Operations.** Operate windrow pickup equipment so that when hot-mix is placed in windrows, substantially all the mixture deposited on the roadbed is picked up and loaded into the paver.

4.7.3.3. **Hauling Equipment.** Use belly dumps, live bottom, or end dump trucks to haul and transfer mixture; however, with exception of paving miscellaneous areas, end dump trucks are only allowed when used in conjunction with an MTD with remixing capability or when a thermal imaging system is used unless otherwise allowed.

4.7.3.4. **Screed Heaters.** Turn off screed heaters to prevent overheating of the mat if the paver stops for more than 5 min. The Engineer may evaluate the suspect area in accordance with Section 3079.4.9.3.3., "Recovered Asphalt Dynamic Shear Rheometer (DSR)," if the screed heater remains on for more than 5 min. while the paver is stopped.

4.8. **Compaction.** Roll the freshly placed PFC with as many steel-wheeled rollers as necessary, operated in static mode, to seat the mixture without excessive breakage of the aggregate and to provide a smooth surface and uniform texture. Do not use pneumatic rollers. Moisten the roller drums thoroughly with a soap and water solution to prevent adhesion. Use only water or an approved release agent on rollers, tamps, and

other compaction equipment unless otherwise directed.

Use [Tex-246-F](#) to test and verify that the compacted mixture has adequate permeability. Measure the water flow once per subplot at locations directed by the Engineer. The water flow rate must be less than 20 sec. Investigate the cause of the water flow rate test failures and take corrective actions during production and placement to ensure the water flow rate is less than 20 sec. Suspend production if two consecutive water flow rate tests fail unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

Complete all compaction operations before the pavement temperature drops below 180°F unless otherwise allowed. The Engineer may allow compaction with a light finish roller operated in static mode for pavement temperatures below 180°F.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic unless otherwise directed. Sprinkle the finished mat with water or limewater, when directed, to expedite opening the roadway to traffic.

- 4.9. **Acceptance Plan.** Sample and test the hot-mix on a lot and subplot basis.
- 4.9.3. **Referee Testing.** The Materials and Tests Division is the referee laboratory. The Contractor may request referee testing if the differences between Contractor and Engineer test results exceed the operational tolerances in accordance with Table 6 and the differences cannot be resolved. The Contractor may also request referee testing if the Engineer's test results require suspension of production and the Contractor's test results are within specification limits. Make the request within five working days after receiving test results and cores from the Engineer. Referee tests will be performed only on the subplot in question and only for the particular tests in question. Allow 10 working days from the time the referee laboratory receives the samples for test results to be reported. The Department may require the Contractor to reimburse the Department for referee tests if more than three referee tests per project are required and the Engineer's test results are closer to the referee test results than the Contractor's test results.
- 4.9.4. **Production Acceptance.**
- 4.9.4.1. **Production Lot.** A production lot consists of four equal sublots. The default quantity for Lot 1 is 1,000 ton; however, when requested by the Contractor, the Engineer may increase the quantity for Lot 1 to no more than 2,000 ton. The Engineer will select subsequent lot sizes based on the anticipated daily production such that approximately three to four sublots are produced each day. The lot size will be between 1,000 ton and 4,000 ton. The Engineer may change the lot size before the Contractor begins any lot.
- 4.9.4.1.1. **Incomplete Production Lots.** If a lot is begun but cannot be completed, such as on the last day of production or in other circumstances deemed appropriate, the Engineer may close the lot. Close all lots within five working days unless otherwise allowed.
- 4.9.4.2. **Production Sampling.**
- 4.9.4.2.1. **Mixture Sampling.** Obtain hot-mix samples from trucks at the plant in accordance with [Tex-222-F](#). The sampler will split each sample into three equal portions in accordance with [Tex-200-F](#) and label these portions as "Contractor," "Engineer," and "Referee." The Engineer will perform or witness the sample splitting and take immediate possession of the samples labeled "Engineer" and "Referee." The Engineer will maintain the custody of the samples labeled "Engineer" and "Referee" until the Department's testing is completed.
- 4.9.4.2.1.1. **Random Sample.** At the beginning of the project, the Engineer will select random numbers for all production sublots. Determine sample locations in accordance with [Tex-225-F](#). Take one sample for each subplot at the randomly selected location. The Engineer will perform or witness the sampling of production sublots.
- 4.9.4.2.1.2. **Blind Sample.** For one subplot per lot, the Engineer will obtain and test a "blind" sample instead of the random sample collected by the Contractor. Test either the "blind" or the random sample; however, referee testing (if applicable) will be based on a comparison of results from the "blind" sample. The location of the Engineer's "blind" sample will not be disclosed to the Contractor. The Engineer's "blind" sample may be randomly selected in accordance with [Tex-225-F](#) for any subplot or selected at the discretion of the Engineer. The

Engineer will use the Contractor's split sample for sublots not sampled by the Engineer.

- 4.9.4.2.2. **Informational Shear Bond Strength Testing.** Select one random subplot from Lot 2 or higher for shear bond strength testing. Obtain full depth cores in accordance with [Tex-249-F](#). Label the cores with the Control Section Job (CSJ), producer of the tack coat, mix type, shot rate, lot, and subplot number and provide to the Engineer. The Engineer will ship the cores to the Materials and Tests Division or district laboratory for shear bond strength testing. Results from these tests will not be used for specification compliance.
- 4.9.4.2.3. **Informational Hamburg and Overlay Testing.** Select one random subplot from Lot 2 or higher for Hamburg and Overlay testing during the first week of production. Obtain and provide the Engineer with approximately 90 lb. of mixture, sampled in accordance with [Tex-222-F](#), in sealed containers, boxes, or bags labeled with the Control-Section-Job (CSJ), mixture type, lot, and subplot number. The Engineer will ship the mixture to the Materials and Tests Division for Hamburg and Overlay testing. Results from these tests will not be used for specification compliance.
- 4.9.4.2.4. **Asphalt Binder Sampling.** Obtain a 1 qt. (1 gal. for A-R binder) sample of the asphalt binder witness by the Engineer for each lot of mixture produced. The Contractor will notify the Engineer when the sampling will occur. Obtain the sample at approximately the same time the mixture random sample is obtained. Sample from a port located immediately upstream from the mixing drum or pug mill and upstream from the introduction of any additives in accordance with [Tex-500-C](#), Part II. Label the can with the corresponding lot and subplot numbers, producer, producer facility, grade, district, date sampled, and project information including highway and CSJ. The Engineer will retain these samples for one year. The Engineer may also obtain independent samples. If obtaining an independent asphalt binder sample and upon request of the Contractor, the Engineer will split a sample of the asphalt binder with the Contractor

At least once per project, the Engineer will collect split samples of each binder grade and source used. The Engineer will submit one split sample to the Materials and Tests Division to verify compliance with Item 300, "Asphalts, Oils, and Emulsions" and will retain the other split sample for one year.

- 4.9.4.3. **Production Testing.** The Contractor and Engineer must perform production tests in accordance with Table 9. The Contractor has the option to verify the Engineer's test results on split samples provided by the Engineer. Determine compliance with operational tolerances in accordance with Table 6 for all sublots.

At any time during production, the Engineer may require the Contractor to verify the following based on quantities used:

- lime content (within $\pm 0.1\%$ of JMF), when PG binder is specified;
- fiber content (within $\pm 0.03\%$ of JMF), when PG binder is specified; and
- CRM content (within $\pm 1.5\%$ of JMF), when A-R binder is specified.

Maintain the in-line measuring device when A-R binder is specified to verify the A-R binder viscosity between 2,500 and 4,000 centipoise at 350°F unless otherwise approved. Record A-R binder viscosity at least once per hour and provide the Engineer with a daily summary unless otherwise directed.

If the aggregate mineralogy is such that [Tex-236-F](#), Part I does not yield reliable results, the Engineer may allow alternate methods for determining the asphalt content and aggregate gradation. The Engineer will require the Contractor to provide evidence that results from [Tex-236-F](#), Part I are not reliable before permitting an alternate method unless otherwise allowed. Use the applicable test procedure as directed if an alternate test method is allowed.

Table 9
Production and Placement Testing Frequency

Description	Test Method	Minimum Contractor Testing Frequency	Minimum Engineer Testing Frequency
Individual % retained for sieve sized larger than #200	Tex-200-F	1 per subplot	1 per 12 sublots
% passing the #200 sieve			
Laboratory-molded density, %	Tex-207-F , Part VIII	1 per subplot	1 per lot
Asphalt binder content ¹ , %	Tex-236-F , Part I ²	1 per subplot	1 per lot
Drain-down, %	Tex-235-F	1 per subplot	1 per 12 sublots
Boil test ³	Tex-530-C	1 per project	1 per project
Moisture content	Tex-212-F , Part II	When directed	1 per project
Cantabro loss, %	Tex-245-F	1 per project (sample only)	1 per project
Overlay test	Tex-248-F	1 per project (sample only)	1 per project ^{4,9}
Hamburg Wheel test	Tex-242-F	1 per project (sample only)	1 per project ^{4,9}
Water flow test	Tex-246-F	1 per subplot	1 per project
Asphalt binder sampling	Tex-500-C , Part II	1 per lot (sample only) ⁵	1 per project
Tack coat sampling and testing	Tex-500-C , Part III	N/A	1 per project
Thermal profile	Tex-244-F	1 per subplot, ^{6,7,8}	1 per project ⁷

1. May be obtained from t mass flow meter readouts as determined by the Engineer.
2. Ensure the binder content determination excludes fibers.
3. When shown on the plans.
4. Testing performed by the Materials and Tests Division on sample obtained from Lot 2 or higher.
5. Obtain samples witness by the Engineer. The Engineer will retain these samples for one year.
6. To be performed in the presence of the Engineer when using the thermal camera, unless otherwise approved.
7. Not required when a thermal imaging system is used.
8. When using the thermal imaging system, the test report must include the temperature measurements taken in accordance with Tex-244-F.
9. Testing performed by the Materials and Tests Division for informational purposes only.

4.9.4.4. **Operational Tolerances.** Control the production process within the operational tolerances in accordance with Table 6. Suspend production and placement operations when production or placement test results exceed the tolerances in accordance with Table 6 unless otherwise allowed. When production is suspended, the Engineer will allow production to resume when test results or other information indicates the next mixture produced will be within the operational tolerances.

4.9.4.5. **Individual Loads of Hot-Mix.** The Engineer can reject individual truckloads of hot-mix. When a load of hot-mix is rejected for reasons other than temperature, contamination, or excessive uncoated particles, the Contractor may request that the rejected load be tested. Make this request within 4 hr. of rejection. The Engineer will sample and test the mixture. If test results are within the operational tolerances in accordance with Table 6, payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load.

4.9.5. **Placement Acceptance.**

4.9.5.1. **Placement Lot.** A placement lot consists of four placement sublots. A placement subplot consists of the area placed during a production subplot.

4.9.5.2. **Miscellaneous Areas.** Miscellaneous areas include areas that typically involve significant handwork or discontinuous paving operations such as driveways, mailbox turnouts, crossovers, gores, spot level-up

areas, and other similar areas. The specified layer thickness is based on the rate of 90 lb. per square yard for each inch of pavement unless another rate is shown on the plans. Miscellaneous areas are not subject to thermal profiles testing.

4.9.5.3. **Recovered Asphalt Dynamic Shear Rheometer (DSR).** The Engineer may take production samples or cores from suspect areas of the project to determine recovered asphalt properties. Asphalt binders with an aging ratio greater than 3.5 do not meet the requirements for recovered asphalt properties and may be deemed defective when tested and evaluated by the Materials and Tests Division. The aging ratio is the DSR value of the extracted binder divided by the DSR value of the original unaged binder. Obtain DSR values in accordance with AASHTO T 315 at the specified high temperature performance grade of the asphalt. The Engineer may require removal and replacement of the defective material at the Contractor's expense. The asphalt binder will be recovered for testing from production samples or cores in accordance with [Tex-211-F](#).

4.9.5.4. **Irregularities.** Identify and correct irregularities, including segregation, rutting, raveling, flushing, fat spots, mat slippage, irregular color, irregular texture, roller marks, tears, gouges, streaks, uncoated aggregate particles, or broken aggregate particles. The Engineer may also identify irregularities, and in such cases, the Engineer will promptly notify the Contractor. If the Engineer determines that the irregularity will adversely affect pavement performance, the Engineer may require the Contractor to remove and replace (at the Contractor's expense) areas of the pavement that contain irregularities. The Engineer may also require the Contractor to remove and replace (at the Contractor's expense) areas where the mixture does not bond to the existing pavement.

If irregularities are detected, the Engineer may require the Contractor to immediately suspend operations or may allow the Contractor to continue operations for no more than one day while the Contractor is taking appropriate corrective action.

4.9.6. **Exempt Production.** When the anticipated daily production is less than 100 ton, all QC and QA sampling and testing are waived. The Engineer may deem the mixture as exempt production for the following conditions:

- anticipated daily production is more than 100 ton but less than 250 ton;
- total production for the project is less than 2,500 ton;
- when mutually agreed between the Engineer and the Contractor; or
- when shown on the plans.

For exempt production, the Contractor is relieved of all production and placement sampling and testing requirements. All other specification requirements apply, and the Engineer will perform acceptance tests for production and placement in accordance with Table 9.

For exempt production:

- produce, haul, place, and compact the mixture as directed by the Engineer; and
- control mixture production to yield a laboratory-molded density that is within $\pm 1.0\%$ of the target density as tested by the Engineer.

4.9.7. **Ride Quality.** Measure ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

5. MEASUREMENT

5.1. **PFC Hot-Mix Asphalt.** Permeable friction course (PFC) hot-mix will be measured by the ton of composite mixture which includes asphalt, aggregate, and additives. Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment."

5.2. **Tack Coat.** Tack coat will be measured at the applied temperature by strapping the tank before and after road application and determining the net volume in gallons from the calibrated distributor. The Engineer will witness all strapping operations for volume determination. All tack, including emulsions, will be measured by the gallon applied.

The Engineer may allow the use of a metering device to determine asphalt volume used and application rate if the device is accurate to within 1.5% of the strapped volume.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under Section 3079.5.1., "PFC Hot-Mix Asphalt," will be paid for at the unit bid price for "Permeable friction course Hot Mix Asphalt" of the mixture type, SAC, and binder specified. These prices are full compensation for surface preparation, materials, placement, equipment, labor, tools, and incidentals.

The work performed and materials furnished in accordance with this Item and measured as provided under Section 3079.5.2., "Tack Coat," will be paid for at the unit bid price for "Tack Coat" of the tack coat provided. These prices are full compensation for materials, placement, equipment, labor, tools, and incidentals.

Trial batches will not be paid for unless they are included in pavement work approved by the Department.

Payment adjustment for ride quality will be determined in accordance with Item 585, "Ride Quality for Pavement Surfaces."

Special Specification 3081

Thin Overlay Mixtures



1. DESCRIPTION

Construct a thin surface course composed of a compacted mixture of aggregate and asphalt binder mixed hot in a mixing plant. Produce a thin overlay mixture (TOM) with a minimum lift thickness of 1/2 in. for a Type F mixture and 3/4 in. for a Type C mixture.

2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

Notify the Engineer of all material sources and before changing any material source or formulation. The Engineer will verify that the specification requirements are met when the Contractor makes a source or formulation change, and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time during the project to verify specification compliance in accordance with Item 6, "Control of Materials."

2.1. **Aggregate.** Furnish aggregates from sources that conform to the requirements in accordance with Table 1 and as specified in this Section. Aggregate requirements in this Section, including those shown in Table 1, may be modified or eliminated when shown on the plans. Additional aggregate requirements may be specified when shown on the plans. Provide aggregate stockpiles that meet the definitions in this Section for coarse, intermediate, or fine aggregate. Do not use reclaimed asphalt pavement (RAP) or recycled asphalt shingles (RAS). Supply aggregates that meet the definitions in accordance with [Tex-100-E](#) for crushed gravel or crushed stone. The Engineer will designate the plant or the quarry as the sampling location. Provide samples from materials produced for the project. The Engineer will establish the Surface Aggregate Classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests in accordance with Table 1. Document all test results on the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis in accordance with [Tex-200-F](#), Part II.

2.1.1. **Coarse Aggregate.** Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve. Aggregates from sources listed in the Department's *Bituminous Rated Source Quality Catalog* (BRSQC) are preapproved for use. Use only the rated values for hot-mix listed in the BRSQC. Rated values for surface treatment (ST) do not apply to coarse aggregate sources used in hot-mix asphalt.

For sources not listed on the Department's BRSQC:

- build an individual stockpile for each material;
- request the Department test the stockpile for specification compliance;
- approved only when tested by the Engineer;
- once approved, do not add material to the stockpile unless otherwise approved; and
- allow 30 calendar days for the Engineer to sample, test, and report results.

2.1.1.1. **Blending Class A and Class B Aggregates.** Class B aggregate meeting all other requirements in blending Class A and B aggregates to meet a Class A requirement, ensure that at least 50% by weight, or volume if required, of all aggregates used in the mixture design retained on the No. 8 sieve comes from the Class A

aggregate source, unless otherwise shown on the plans. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. Class B aggregate may be disallowed when shown on the plans.

The Engineer may perform tests at any time during production, when the Contractor blends Class A and B aggregates to meet a Class A requirement, to ensure that at least 50% by weight, or volume if required, of the material retained on the No. 8 sieve comes from the Class A aggregate source. The Engineer will use the Department's mix design template, when electing to verify conformance, to calculate the percent of Class A aggregate retained on the No. 8 sieve by inputting the bin percentages shown from readouts in the control room at the time of production and stockpile gradations measured at the time of production. The Engineer may determine the gradations based on either washed or dry sieve analysis from samples obtained from individual aggregate cold feed bins or aggregate stockpiles. The Engineer may perform spot checks using the gradations supplied by the Contractor on the mixture design report as an input for the template; however, a failing spot check will require confirmation with a stockpile gradation determined by the Engineer.

- 2.1.1.2. **Micro-Deval Abrasion.** The Engineer will perform a minimum of one Micro-Deval abrasion test in accordance with [Tex-461-A](#) for each coarse aggregate source used in the mixture design that has a Rated Source Soundness Magnesium (RSSM) loss value greater than 15 as listed in the BRSQC, unless otherwise directed. The Engineer will perform testing before the start of production and may perform additional testing at any time during production. The Engineer may obtain the coarse aggregate samples from each coarse aggregate source or may require the Contractor to obtain the samples. The Engineer may waive all Micro-Deval testing based on a satisfactory test history of the same aggregate source.

The Engineer will estimate the magnesium sulfate soundness loss for each coarse aggregate source, when tested, using the following formula:

$$Mg_{est.} = (RSSM)(MD_{act.}/RSMD)$$

where:

Mg_{est} = magnesium sulfate soundness loss

RSSM = Rated Source Soundness Magnesium

MD_{act} = actual Micro-Deval percent loss

RSMD = Rated Source Micro-Deval

When the estimated magnesium sulfate soundness loss is greater than the maximum magnesium sulfate soundness loss specified, the coarse aggregate source will not be allowed for use unless otherwise approved. The Engineer will consult the Soils and Aggregates Section of the Materials and Tests Division, and additional testing may be required before granting approval.

- 2.1.2. **Intermediate Aggregate.** Aggregates not meeting the definition of coarse or fine aggregate will be defined as intermediate aggregate. Supply intermediate aggregates, when used that are free from organic impurities. The Engineer may test the intermediate aggregate in accordance with [Tex-408-A](#) to verify the material is free from organic impurities. Supply intermediate aggregate from coarse aggregate sources, when used that meet the requirements in accordance with Table 1 unless otherwise approved.

If 10% or more of the stockpile is retained on the No. 4 sieve, verify that it meets the requirements in accordance with Table 1 for crushed face count ([Tex-460-A](#)) and flat and elongated particles ([Tex-280-F](#)).

- 2.1.3. **Fine Aggregate.** Fine aggregates consist of manufactured sands and screenings. Natural sands are not allowed in any mixture. Fine aggregate stockpiles must meet the fine aggregate properties in accordance with Table 1 and the gradation requirements in accordance with Table 2. Supply fine aggregates that are free from organic impurities. The Engineer may test the fine aggregate in accordance with [Tex-408-A](#) to verify the material is free from organic impurities. Use fine aggregate from coarse aggregate sources that meet the requirements in accordance with Table 1 unless otherwise approved.

If 10% or more of the stockpile is retained on the No. 4 sieve, verify that it meets the requirements in accordance with Table 1 for crushed face count ([Tex-460-A](#)) and flat and elongated particles ([Tex-280-F](#)).

Table 1
Aggregate Quality Requirements

Property	Test Method	Requirement
Coarse Aggregate		
SAC	Tex-499-A	A ¹
Deleterious material, %, Max	Tex-217-F , Part I	1.5
Decantation, %, Max	Tex-217-F , Part II	1.5
Micro-Deval abrasion, %	Tex-461-A	Note ^f
Los Angeles abrasion, %, Max	Tex-410-A	30
Magnesium sulfate soundness, 5 cycles, %, Max	Tex-411-A	20
Crushed face count, ³ %, Min	Tex-460-A , Part I	95
Flat and elongated particles @ 5:1, %, Max	Tex-280-F	10
Fine Aggregate		
Linear shrinkage, %, Max	Tex-107-E	3
Sand equivalent, %, Min	Tex-203-F	45

1. Surface Aggregate Classification of "A" is required unless otherwise shown on the plans.
2. Used to estimate the magnesium sulfate soundness loss in accordance with Section 3081.2.1.1.2., "Micro-Deval Abrasion."
3. Only applies to crushed gravel.

Table 2
Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Weight or Volume
3/8"	100
#8	70-100
#200	0-30

- 2.2. **Mineral Filler.** Mineral filler consists of finely divided mineral matter such as agricultural lime, crusher fines, or hydrated lime. Mineral filler is allowed unless otherwise shown on the plans. Fly ash is not permitted unless otherwise shown on the plans. Use no more than 2% hydrated lime unless otherwise shown on the plans. Test all mineral fillers except hydrated lime and fly ash in accordance with [Tex-107-E](#) to ensure specification compliance. The plans may require or disallow specific mineral fillers. Provide mineral filler, when used, that:
- is sufficiently dry, free-flowing, and free from clumps and foreign matter as determined by the Engineer;
 - does not exceed 3% linear shrinkage when tested in accordance with [Tex-107-E](#); and
 - meets the gradation requirements in Table 3, unless otherwise shown on the plans.

Table 3
Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Weight or Volume
#8	100
#200	55-100

- 2.3. **Baghouse Fines.** Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.
- 2.4. **Asphalt Binder.** Furnish performance-graded (PG) asphalt binder with a high temperature grade of PG 76 unless otherwise shown in the plans and a low temperature grade as shown on the plans, in accordance with Section 300.2.10., "Performance-Graded Binders."
- 2.5. **Tack Coat.** Furnish CSS-1H, SS-1H, EBL, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions." Specialized tack coat materials listed on the Department's Tracking Resistant Asphalt Interlayer (TRAIL) MPL may be allowed or required when shown on the plans. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

- 2.6. **Additives.** Provide the Engineer with documentation such as the bill of lading showing the quantity of additives used in the project unless otherwise directed.
- 2.6.1. **Lime and Liquid Antistripping Agent.** When lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Use no more than 1% hydrated lime when using crushed gravel. Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime into the drum.
- 2.6.2. **Compaction Aid.** Compaction Aid is defined as a department-approved chemical warm mix additive denoted as "chemical additive" on the Department's materials producer list (MPL) that is used to facilitate mixing and compaction of HMA.
- Compaction Aid is allowed for use on all projects. Compaction aid is required when shown on the plans or as required in Section 3081.4.7.1., "Weather Conditions."
- Warm mix foaming processes, denoted as "foaming process" on the Department-approved MPL, may be used to facilitate mixing and compaction of HMA; however warm mix foaming processes are not defined as a Compaction Aid.
- 2.7. **Recycled Materials.** Recycled materials are not allowed for use.

3. EQUIPMENT

Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement."

4. CONSTRUCTION

Produce, haul, place, and compact the specified paving mixture. In addition to tests required by the specification, Contractors may perform other QC tests as deemed necessary. At any time during the project, the Engineer may perform production and placement tests as deemed necessary in accordance with Item 5, "Control of the Work." Schedule and participate in a mandatory pre-paving meeting with the Engineer on or before the first day of paving unless otherwise shown on the plans.

- 4.1. **Certification.** Personnel certified by the Department-approved hot-mix asphalt certification program must conduct all mixture designs, sampling, and testing in accordance with Table 4. Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning production and when personnel changes are made. Provide a mixture design developed and signed by a Level 2 certified specialist. Provide Level 1A certified specialists at the plant during production operations. Provide Level 1B certified specialists to conduct placement tests. Provide AGG101 certified specialists for aggregate testing.

Table 4
Test Methods, Test Responsibility, and Minimum Certification Levels

Test Description	Test Method	Contractor	Engineer	Level ¹
1. Aggregate Testing				
Sampling	Tex-221-F	✓	✓	1A/AGG101
Dry sieve	Tex-200-F , Part I	✓	✓	1A/AGG101
Washed sieve	Tex-200-F , Part II	✓	✓	1A/AGG101
Deleterious material	Tex-217-F , Part I	✓	✓	AGG101
Decantation	Tex-217-F , Part II	✓	✓	AGG101
Los Angeles abrasion	Tex-410-A		✓	Department
Magnesium sulfate soundness	Tex-411-A		✓	Department
Micro-Deval abrasion	Tex-461-A		✓	AGG101
Crushed face count	Tex-460-A	✓	✓	AGG101
Flat and elongated particles	Tex-280-F	✓	✓	AGG101
Sand equivalent	Tex-203-F	✓	✓	AGG101
Organic impurities	Tex-408-A	✓	✓	AGG101
Methylene blue test	Tex-252-F		✓	Department
2. Asphalt Binder & Tack Coat Sampling				
Asphalt binder sampling	Tex-500-C , Part II	✓	✓	1A/1B
Tack coat sampling	Tex-500-C , Part III	✓	✓	1A/1B
3. Mix Design & Verification				
Design and JMF changes	Tex-204-F	✓	✓	2
Mixing	Tex-205-F	✓	✓	2
Molding (TGC)	Tex-206-F	✓	✓	1A
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F , Parts I & VI	✓	✓	1A
Rice gravity	Tex-227-F , Part II	✓	✓	1A
Drain-down	Tex-235-F	✓	✓	1A
Ignition oven correction factors ²	Tex-236-F , Part II	✓	✓	2
Indirect tensile strength	Tex-226-F	✓	✓	1A
Overlay test	Tex-248-F		✓	Department
Hamburg Wheel test	Tex-242-F	✓	✓	1A
Boil test ⁴	Tex-530-C	✓	✓	1A
4. Production Testing				
Selecting production random numbers	Tex-225-F , Part I		✓	1A
Mixture sampling	Tex-222-F	✓	✓	1A/1B
Molding (TGC)	Tex-206-F	✓	✓	1A
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F , Parts I & VI	✓	✓	1A
Rice gravity	Tex-227-F , Part II	✓	✓	1A
Gradation & asphalt binder content ²	Tex-236-F , Part I	✓	✓	1A
Drain-down	Tex-235-F	✓	✓	1A
Control charts	Tex-233-F	✓	✓	1A
Moisture content	Tex-212-F , Part II	✓	✓	1A/AGG101
Hamburg Wheel test	Tex-242-F	✓	✓	1A
Overlay test	Tex-248-F	✓	✓	Department
Micro-Deval abrasion	Tex-461-A		✓	AGG101
Boil test ⁴	Tex-530-C	✓	✓	1A
Abson recovery	Tex-211-F		✓	Department
5. Placement Testing				
Establish rolling pattern	Tex-207-F , Part IV	✓		1B
In-place density (nuclear method)	Tex-207-F , Part III	✓		1B
Control charts	Tex-233-F	✓	✓	1A
Ride quality measurement	Tex-1001-S	✓	✓	Note 3
Thermal profile	Tex-244-F	✓	✓	1B
Water flow test	Tex-246-F	✓	✓	1B

- Level 1A, 1B, AGG101, and 2 are certification levels provided by the Hot Mix Asphalt Center certification program.
- Refer to Section 3081.4.9.2.3., "Production Testing," for exceptions to using an ignition oven.
- Profiler and operator are required to be certified at the Texas A&M Transportation Institute facility when Surface Test Type B is specified.
- When shown on the plans.

4.2.

Reporting and Responsibilities. Use Department-provided templates to record and calculate all test data, including mixture design, production and placement QC/QA, control charts, and thermal profiles. Obtain the current version of the templates at <https://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/forms/site-manager.html> or from the Engineer. The Engineer and the Contractor will provide any available test results to the other party when requested. The maximum allowable time for the Contractor and Engineer to exchange test data is as given in Table 5 unless otherwise approved. The Engineer and the Contractor will immediately report to the other party any test result that requires suspension of production or placement or that fails to meet the specification requirements. Record and electronically submit all test results and pertinent information on Department-provided templates.

Subsequent sublots placed after test results are available to the Contractor, which require suspension of operations, may be considered unauthorized work. Unauthorized work will be accepted or rejected at the discretion of the Engineer in accordance with Section 5.3., "Conformity with Plans, Specifications, and Special Provisions."

Table 5
Reporting Schedule

Description	Reported By	Reported To	To Be Reported Within
Production Quality Control			
Gradation ¹	Contractor	Engineer	1 working day of completion of the subplot
Asphalt binder content ¹			
Laboratory-molded density ²			
Moisture content ³			
Boil test ⁵			
Production Quality Assurance			
Gradation ³	Engineer	Contractor	1 working day of completion of the subplot
Asphalt binder content ³			
Laboratory-molded density ¹			
Hamburg Wheel test ⁴			
Overlay test ⁴			
Boil test ⁵			
Binder tests ⁴			
Placement Quality Control			
Thermal profile ¹	Contractor	Engineer	1 working day of completion of the lot
Water flow ¹			
Placement Quality Assurance			
Thermal profile ³	Engineer	Contractor	1 working day of completion of the lot
Aging ratio ⁴			
Water flow			

1. These tests are required on every subplot.
2. Optional test. When performed on split samples, report the results as soon as they become available.
3. To be performed at the frequency specified and in accordance with Table 13 or as shown on the plans.
4. To be reported as soon as the results become available.
5. When shown on the plans.

Use the procedures described in [Tex-233-E](#) to plot the results of all quality control (QC) and quality assurance (QA) testing. Update the control charts as soon as test results for each subplot become available. Make the control charts readily accessible at the field laboratory. The Engineer may suspend production for failure to update control charts.

4.3.

Quality Control Plan (QCP). Develop and follow the QCP in detail. Obtain approval for changes to the QCP made during the project. The Engineer may suspend operations if the Contractor fails to comply with the QCP.

Submit a written QCP before the mandatory pre-paving meeting. Receive approval of the QCP before pre-paving meeting. Include the following items in the QCP:

- 4.3.1. **Project Personnel.** For project personnel, include:
- a list of individuals responsible for QC with authority to take corrective action;
 - current contact information for each individual listed; and
 - current copies of certification documents for individuals performing specified QC functions.
- 4.3.2. **Material Delivery and Storage.** For material delivery and storage, include:
- the sequence of material processing, delivery, and minimum quantities to assure continuous plant operations;
 - aggregate stockpiling procedures to avoid contamination and segregation;
 - frequency, type, and timing of aggregate stockpile testing to assure conformance of material requirements before mixture production; and
 - procedure for monitoring the quality and variability of asphalt binder.
- 4.3.3. **Production.** For production, include:
- loader operation procedures to avoid contamination in cold bins;
 - procedures for calibrating and controlling cold feeds;
 - procedures to eliminate debris or oversized material;
 - procedures for adding and verifying rates of each applicable mixture component (e.g., aggregate, asphalt binder, lime, liquid antistripping, compaction aid, foaming process);
 - procedures for reporting job control test results; and
 - procedures to avoid segregation and drain-down in the silo.
- 4.3.4. **Loading and Transporting.** For loading and transporting, include:
- type and application method for release agents; and
 - truck loading procedures to avoid segregation.
- 4.3.5. **Placement and Compaction.** For placement and compaction, include:
- proposed agenda for mandatory pre-paving meeting, including date and location;
 - proposed paving plan (e.g., production rate, paving widths, joint offsets, and lift thicknesses);
 - type and application method for release agents in the paver and on rollers, shovels, lutes, and other utensils;
 - procedures for the transfer of mixture into the paver, while avoiding physical and thermal segregation and preventing material spillage;
 - process to balance production, delivery, paving, and compaction to achieve continuous placement operations and good ride quality;
 - paver operations (e.g., speed, operation of wings, height of mixture in auger chamber) to avoid physical and thermal segregation and other surface irregularities; and
 - procedures to construct quality longitudinal and transverse joints.
- 4.4. **Mixture Design.**
- 4.4.1. **Design Requirements.** The Contractor may design the mixture using a Texas Gyrotory Compactor (TGC) or a Superpave Gyrotory Compactor (SGC) unless otherwise shown on the plans. Use the typical weight design example given in [Tex-204-F](#), Part I, when using a TGC. Use the Superpave mixture design procedure provided in [Tex-204-F](#), Part IV, when using a SGC. Design the mixture to meet the requirements in accordance with Tables 1, 2, 3, 6, and 7.
- 4.4.1.1. **Target Laboratory-Molded Density When the TGC Is Used.** Design the mixture at a 97.5% target laboratory-molded density or in accordance with Table 7.

4.4.1.2.

Design Number of Gyration (Ndesign) When the SGC Is Used. Design the mixture at 50 gyrations (Ndesign). Use a target laboratory-molded density of 96.0% to design the mixture; however, adjustments can be made to the Ndesign value as noted in Table 7. The Ndesign level may be reduced to no less than 35 gyrations at the Contractor's discretion.

Use an approved laboratory from the Department's MPL to perform the Hamburg Wheel test, and the Department will perform the Overlay test and provide results with the mixture design, or provide the laboratory mixture and request that the Department perform the Hamburg Wheel test and Overlay test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test and Overlay test results on the laboratory mixture design.

The Engineer will provide the mixture design when shown on the plans. The Contractor may submit a new mixture design at any time during the project. The Engineer will verify and approve all mixture designs (JMF 1) before the Contractor can begin production.

Provide the Engineer with a mixture design report using the Department-provided template. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- the target laboratory-molded density (or Ndesign level when using the SGC);
- results of all applicable tests;
- the mixing and molding temperatures;
- the signature of the Level 2 person or persons that performed the design;
- the date the mixture design was performed; and
- a unique identification number for the mixture design.

Table 6
Master Gradation Limits (% Passing by Weight or Volume) and Volumetric Requirements

Sieve Size	Coarse (TOM-C)	Fine (TOM-F)
1/2"	100.0 ¹	100.0 ¹
3/8"	95.0–100.0	98.0–100.0
#4	40.0–60.0	70.0–95.0
#8	17.0–27.0	40.0–65.0
#16	5.0–27.0	20.0–45.0
#30	5.0–27.0	10.0–35.0
#50	5.0–27.0	10.0–20.0
#200	5.0–9.0	2.0–12.0
Asphalt Binder Content,² % Min		
-	6.0	6.5
Design VMA,³ % Min		
-	16.0	16.5
Production (Plant-Produced) VMA,³ % Min		
-	15.5	16.0

1. Defined as maximum sieve size. No tolerance allowed.
2. Unless otherwise shown on the plans or approved by the Engineer.
3. Voids in Mineral Aggregates (VMA).

Table 7
Mixture Design Properties

Mixture Property	Test Method	Requirement
Target laboratory-molded density, % (TGC)	Tex-207-F	97.5 ¹
Design gyrations (Ndesign for SGC)	Tex-241-F	50 ²
Hamburg Wheel test, passes at 12.5 mm rut depth for PG 76 mixtures	Tex-242-F	20,000 Min
Overlay test, Critical Fracture Energy, lb.-in/sq. in	Tex-248-F	1.5 Min
Overlay test, Crack Progression Rate	Tex-248-F	0.40 Max
Drain-down, %	Tex-235-F	0.20 Max

1. Unless otherwise shown on the plans or approved by the Engineer. Laboratory-molded density requirement using the TGC may be waived when approved by the Engineer.

2. May be adjusted within the range of 35–100 gyrations when shown on the plans or specification or when mutually agreed between the Engineer and Contractor. Laboratory-molded density requirement using the SGC may be waived when approved by the Engineer.

- 4.4.1 **Job-Mix Formula Approval.** The job-mix formula (JMF) is the combined aggregate gradation, target laboratory-molded density (or Ndesign level), and target asphalt percentage used to establish target values for hot-mix production. JMF1 is the original laboratory mixture design used to produce the trial batch. When a compaction aid or foaming process is used, JMF1 may be designed and submitted to the Engineer without including the compaction aid or foaming process. When a compaction aid or foaming process is used, document the compaction aid or foaming process used and recommended rate on the JMF1 submittal. The Engineer and the Contractor will verify JMF1 based on plant-produced mixture from the trial batch unless otherwise approved. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF1. The Department may require the Contractor to reimburse the Department for verification tests if more than two trial batches per design are required.
- 4.4.2.1. **Contractor's Responsibilities.**
- 4.4.2.1.1. **Providing Gyrotory Compactor.** Use a TGC calibrated in accordance with [Tex-914-K](#) when electing or required to design the mixture in accordance with [Tex-204-E](#), Part I, for molding production samples. Furnish an SGC calibrated in accordance with [Tex-241-F](#) when electing or required to design the mixture in accordance with [Tex-204-F](#), Part IV, for molding production samples. Locate the SGC if used, at the Engineer's field laboratory or make the SGC available to the Engineer for use in molding production samples.
- 4.4.2.1.2. **Gyrotory Compactor Correlation Factors.** Use [Tex-206-F](#), Part II, to perform a gyrotory compactor correlation when the Engineer uses a different gyrotory compactor. Apply the correlation factor to all subsequent production test results.
- 4.4.2.1.3. **Submitting JMF1.** Furnish a mix design report (JMF1) with representative samples of all component materials and request approval to produce the trial batch. Provide approximately 25 lb. of the design mixture if opting to have the Department perform the Hamburg Wheel test on the laboratory mixture, and request that the Department perform the test. Provide approximately 60 lb. of the design mixture to perform the Overlay test.
- 4.4.2.1.4. **Supplying Aggregates.** Provide approximately 40 lb. of each aggregate stockpile unless otherwise directed.
- 4.4.2.1.5. **Supplying Asphalt.** Provide at least 1 gal. of the asphalt material and enough quantities of any additives proposed for use.
- 4.4.2.1.6. **Ignition Oven Correction Factors.** Determine the aggregate and asphalt correction factors from the ignition oven in accordance with [Tex-236-F](#), Part II. Provide correction factors that are not more than 12 mo. old. Provide the Engineer with split samples of the mixtures before the trial batch production, including all additives (except water), and blank samples used to determine the correction factors for the ignition oven used for QA testing during production. Correction factors established from a previously approved mixture design may be used for the current mixture design if the mixture design and ignition oven are the same as previously used and the correction factors are not more than 12 mo. old, unless otherwise directed.
- 4.4.2.1.7. **Boil Test.** When shown on the plans, perform the test and retain the tested sample from [Tex-530-C](#) until completion of the project or as directed. Use this sample for comparison purposes during production.
- 4.4.2.1.8. **Trial Batch Production.** Provide a plant-produced trial batch upon receiving conditional approval of JMF1 and authorization to produce a trial batch, including the compaction aid or foaming process, if applicable, for verification testing of JMF1 and development of JMF2. Produce a trial batch mixture that meets the requirements in accordance with Table 8. The Engineer may accept test results from recent production of the same mixture instead of a new trial batch.

- 4.4.2.1.9. **Trial Batch Production Equipment.** Use only equipment and materials proposed for use on the project to produce the trial batch.
- 4.4.2.1.10. **Trial Batch Quantity.** Produce enough quantity of the trial batch to ensure that the mixture meets the specification requirements.
- 4.4.2.1.11. **Number of Trial Batches.** Produce trial batches as necessary to obtain a mixture that meets the specification requirements.
- 4.4.2.1.12. **Trial Batch Sampling.** Obtain a representative sample of the trial batch and split it into three equal portions in accordance with [Tex-222-F](#). Label these portions as “Contractor,” “Engineer,” and “Referee.” Deliver samples to the appropriate laboratory as directed.
- 4.4.2.1.13. **Trial Batch Testing.** Test the trial batch to ensure the mixture produced using the proposed JMF1 meets the mixture requirements in accordance with Table 8. Ensure the trial batch mixture is also in compliance with the requirements in accordance with Tables 6 and 7. Use a Department-approved laboratory listed on the MPL to perform the Hamburg Wheel test on the trial batch mixture or request that the Department perform the Hamburg Wheel test. Provide approximately 25 lb. of the trial batch mixture if opting to have the Department perform the Hamburg Wheel test, and request that the Department perform the test. Obtain and provide approximately 60 lb. of trial batch mixture in sealed containers, boxes, or bags labeled with the CSJ, mixture type, lot, and subplot number in accordance with [Tex-222-F](#) for the Overlay test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test and Overlay test results on the trial batch. Provide the Engineer with a copy of the trial batch test results.
- 4.4.2.1.14. **Development of JMF2.** Evaluate the trial batch test results after the Engineer grants full approval of JMF 1 based on results from the trial batch, determine the optimum mixture proportions, and submit as JMF 2. Adjust the asphalt binder content or gradation to achieve the specified target laboratory-molded density. The mixture produced using JMF2 must meet the requirements in accordance with Tables 6 and 7. Verify that JMF2 meets the operation tolerances of JMF 1 in accordance with Table 8.
- 4.4.2.1.15. **Mixture Production.** Use JMF2 to produce Lot 1 after receiving approval for JMF2 and a passing result from the Department’s or a Department-approved laboratory’s Hamburg Wheel test and the Department’s Overlay test on the trial batch. If desired, proceed to Lot 1 production, once JMF2 is approved, at the Contractor’s risk without receiving the results from either the Department’s Hamburg Wheel test or Overlay test on the trial batch.
- Notify the Engineer if electing to proceed without Hamburg Wheel test and Overlay test results from the trial batch. Note that the Engineer may require up to the entire subplot of any mixture failing the Hamburg Wheel test or Overlay test to be removed and replaced at the Contractor’s expense.
- 4.4.2.1.16. **Development of JMF3.** Evaluate the test results from Lot 1, determine the optimum mixture proportions, and submit as JMF3 for use in Lot 2.
- 4.4.2.1.17. **JMF Adjustments.** If JMF adjustments are necessary to achieve the specified requirements, make the adjustments before beginning a new lot. The adjusted JMF must:
- be provided to the Engineer in writing before the start of a new lot;
 - be numbered in sequence to the previous JMF;
 - meet the master gradation limits in accordance with Table 6; and
 - be within the operational tolerances of JMF2 in accordance with Table 8.
- 4.4.2.1.18. **Requesting Referee Testing.** Use referee testing, if needed, in accordance with Section 3081.4.9.1., “Referee Testing,” to resolve testing differences with the Engineer.

Table 8
Operational Tolerances

Description	Test Method	Allowable Difference between JMF2 and JMF1 Target ¹	Allowable Difference from Current JMF and JMF2 ²	Allowable Difference between Contractor and Engineer ³
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	Must be Within Master Grading Limits in accordance with Table 6	±3.0 ^{4,5}	±5.0
Individual % retained for sieves smaller than #8 and larger than #200			±3.0 ^{4,5}	±3.0
% passing the #200 sieve			±2.0 ^{4,5}	±1.6
Asphalt binder content, % ⁶	Tex-236-F	±0.3	±0.3 ⁵	±0.3
Laboratory-molded density, %	Tex-207-F	±1.0	±1.0	±1.0
Laboratory-molded bulk specific gravity		N/A	N/A	±0.020
VMA, % Min	Tex-204-F	Note 7	Note 7	N/A
Theoretical Max specific (Rice) gravity	Tex-227-F	N/A	N/A	±0.020
Drain-down, %	Tex-235-F	Note 8	Note 8	N/A

1. JMF1 is the approved laboratory mixture design used for producing the trial batch. JMF2 is the approved mixture design developed from the trial batch used to produce Lot 1.
2. Current JMF is JMF3 or higher. JMF3 is the approved mix design used to produce Lot 2.
3. Contractor may request referee testing only when values exceed these tolerances.
4. When within these tolerances, mixture production gradations may fall outside the master grading limits; however, the % passing the #200 will be considered out of tolerance when outside the master grading limits.
5. Only applies to mixture produced for Lot 1 and higher.
6. Binder content is not allowed to be outside the limits in accordance with Table 6. May be obtained from asphalt meter readouts as determined by the Engineer.
7. Verify that Table 6 requirements are met.
8. Verify that Table 7 requirements are met.

4.4.2.2. **Engineer's Responsibilities.**

4.4.2.2.1. **Gyrotory Compactor.** For mixtures designed in accordance with [Tex-204-F](#), Part I, the Engineer will use a Department TGC, calibrated in accordance with [Tex-914-K](#), to mold samples for trial batch and production testing.

For mixtures designed in accordance with [Tex-204-F](#), Part IV, the Engineer will use a Department SGC, calibrated in accordance with [Tex-241-F](#), to mold samples for laboratory mixture design verification. For molding trial batch and production specimens, the Engineer will use the Contractor-provided SGC at the field laboratory or provide and use a Department SGC at an alternate location.

4.4.2.2.2. **Conditional Approval of JMF1 and Authorizing Trial Batch.** The Engineer will review and verify conformance of the following information within two working days of receipt

- the Contractor's mix design report (JMF1);
- the Department-provided Overlay test results;
- the Contractor-provided Hamburg Wheel test results;
- all required materials including aggregates, asphalt, and additives; and
- the mixture specifications.

The Engineer will grant the Contractor conditional approval of JMF1 if the information provided on the paper copy of JMF1 indicates that the Contractor's mixture design meets the specifications. When the Contractor does not provide Hamburg Wheel test and department provided Overlay test results with laboratory mixture design, 10 working days are allowed for conditional approval of JMF1. The Engineer will base full approval of JMF1 on test results on mixture from the trial batch.

Unless waived, the Engineer will determine the Micro-Deval abrasion loss in accordance with

Section 3081.2.1.1., "Micro-Deval Abrasion." If the Engineer's test results are pending after two working days, conditional approval of JMF1 will still be granted within two working days of receiving JMF1. When the Engineer's test results become available, they will be used for specification compliance.

The Contractor is authorized to produce a trial batch after the Engineer grants conditional approval of JMF1.

- 4.4.2.2.3. **Hamburg Wheel and Overlay Testing of JMF1.** If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the laboratory mixture, the Engineer will mold samples in accordance with [Tex-242-F](#) to verify compliance with the Hamburg Wheel test requirement in Table 7. The Engineer will perform the Overlay test and mold samples in accordance with [Tex-248-F](#) to verify compliance with the Overlay test requirements in Table 7. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel and Overlay test results on the laboratory mixture design.
- 4.4.2.2.4. **Ignition Oven Correction Factors.** The Engineer will use the split samples provided by the Contractor to determine the aggregate and asphalt correction factors for the ignition oven used for QA testing during production in accordance with [Tex-236-F](#), Part II. Provide correction factors that are not more than 12 mo. old.
- 4.4.2.2.5. **Testing the Trial Batch.** Within one full working day, the Engineer will sample and test the trial batch to ensure that the mixture meets the requirements in accordance with Table 8. The Engineer will mold samples in accordance with [Tex-242-F](#) if the Contractor requests the option to have the Department perform the Hamburg Wheel test on the trial batch mixture to verify compliance with Hamburg Wheel test requirements in Table 7. The Engineer will mold samples for the Overlay test in accordance with [Tex-248-F](#) to verify compliance with the Overlay test requirement in Table 7.
- The Engineer will have the option to perform [Tex-530-C](#) on the trial batch when shown on the plans. These results may be retained and used for comparison purposes during production.
- 4.4.2.2.6. **Full Approval of JMF1.** The Engineer will grant full approval of JMF1 and authorize the Contractor to proceed with developing JMF2 if the Engineer's results for the trial batch meet the requirements in accordance with Tables 6 and 7. The Engineer will notify the Contractor that an additional trial batch is required if the trial batch does not meet these requirements.
- 4.4.2.2.7. **Approval of JMF2.** The Engineer will approve JMF2 within one working day if the mixture meets the requirements in accordance with Table 6, 7, and 8.
- 4.4.2.2.8. **Approval of Lot 1 Production.** The Engineer will authorize the Contractor to proceed with Lot 1 production (using JMF2) as soon as a passing result is achieved from the Department's or a Department-approved laboratory's Hamburg Wheel test and the Department's Overlay test on the trial batch. The Contractor may proceed at its own risk with Lot 1 production without the results from the Hamburg Wheel test or Overlay test on the trial batch.
- If the Department's or Department-approved laboratory's sample from the trial batch fails the Hamburg Wheel test or Overlay test, the Engineer will suspend production until further Hamburg Wheel tests or Overlay tests meet the specified values. The Engineer may require up to the entire subplot of any mixture failing the Hamburg Wheel test or Overlay test to be removed and replaced at the Contractor's expense.
- 4.4.2.2.9. **Approval of JMF3 and Subsequent JMF Changes.** JMF3 and subsequent JMF changes are approved if they meet the master grading limits and asphalt binder content shown in Table 6 and are within the operational tolerances of JMF2 shown in accordance with Table 8.
- 4.5. **Production Operations.** Perform a new trial batch when the plant or plant location is changed. Take corrective action and receive approval to proceed after any production suspension for noncompliance to the specification.

4.5.1. **Storage and Heating of Materials.** Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions," or outside the manufacturer's recommended values. Provide the Engineer with daily records of asphalt binder and hot-mix asphalt discharge temperatures (in legible and discernible increments) in accordance with Item 320, "Equipment for Asphalt Concrete Pavement," unless otherwise directed. Do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr. unless otherwise approved.

4.5.2. **Mixing and Discharge of Materials.** Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed the maximum production temperatures in accordance with Table 9. The Department will not pay for or allow placement of any mixture produced above the maximum production temperatures listed in Table 9.

Table 9
Maximum Production Temperature

High-Temperature Binder Grade ¹	Max Production Temperature
PG 76	345°F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.

Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant. Determine the moisture content, if requested, by oven-drying in accordance with [Tex-212-F](#), Part II, and verify that the mixture contains no more than 0.2% of moisture by weight. Obtain the sample immediately after discharging the mixture into the truck and perform the test promptly.

4.6. **Hauling Operations.** Clean all truck beds before use to ensure that mixture is not contaminated. Use a release agent shown on the Department's MPL to coat the inside bed of the truck when necessary. Do not use diesel or any release agent not shown on the Department's MPL.

Use equipment for hauling as defined in Section 3081.4.7.3.3., "Hauling Equipment." Use other hauling equipment only when allowed.

4.7. **Placement Operations.** Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer approximately every hour, or as directed. Use a hand-held thermal camera or infrared thermometer, when a thermal imaging system is not used, to measure and record the internal temperature of the mixture as discharged from the truck or Material Transfer Device (MTD) before or as the mix enters the paver and an approximate station number or GPS coordinates on each ticket. Calculate the daily yield and cumulative yield for the specified lift and provide to the Engineer at the end of paving operations for each day unless otherwise directed. The Engineer may suspend production if the Contractor fails to produce and provide haul tickets and yield calculations by the end of paving operations for each day.

Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Place mixture so that longitudinal joints on the surface course coincide within 6-in. of lane lines and are not placed in the wheel path, or as directed, and offset longitudinal joints of successive courses of hot-mix by at least 6-in. Ensure that all finished surfaces will drain properly. Place the mixture at the rate or thickness shown on the plans. The Engineer will use the guidelines in Table 10 to determine the compacted lift thickness. The thickness determined is based on the rate of 110–115 lb. per square inch. for each inch of pavement unless otherwise shown on the plans.

**Table 10
Compacted Lift Thickness**

Mixture Type	Compacted Lift Thickness ¹	
	Min (in.)	Max (in.)
TOM-C	0.75	1.25
TOM-F	0.5	1.00

1. Compacted target lift thickness will be specified on the plans.

4.7.1. **Weather Conditions.**

4.7.1.1. **When Using a Thermal Imaging System.** The Contractor may pave any time the roadway is dry and the roadway surface temperature is at least 60°F unless otherwise approved or as shown on the plans; however, the Engineer may restrict the Contractor from paving surface mixtures if the ambient temperature is likely to drop below 32°F within 12 hr. of paving. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. Provide output data from the thermal imaging system to demonstrate to the Engineer that no recurring severe thermal segregation exists in accordance with Section 3081.4.7.3.1.2., "Thermal Imaging System."

Produce mixture with a target discharge temperature higher than 300°F and with a compaction aid to facilitate compaction when the air temperature is 70°F and falling

4.7.1.2. **When Not Using a Thermal Imaging System.** When using a thermal camera instead the thermal imaging system, place mixture when the roadway surface temperature is at or above 70°F unless otherwise approved or as shown on the plans. Measure the roadway surface temperature with a hand-held thermal camera or infrared thermometer. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. The Engineer may restrict the Contractor from paving if the air temperature is 70°F and falling.

Produce mixture with a target discharge temperature higher than 300°F and with a compaction aid to facilitate compaction when the air temperature is 70°F and falling.

4.7.2. **Tack Coat.**

4.7.2.1. **Application.** Clean the surface before placing the tack coat. The Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area, unless otherwise specified on the plans. Apply a uniform tack coat at the specified rate unless otherwise directed. Apply the tack coat in a uniform manner to avoid streaks and other irregular patterns. Apply the tack coat to all surfaces that will come in contact with the subsequent HMA placement unless otherwise directed. Apply adequate overlap of the tack coat in the longitudinal direction during placement of the mat to ensure bond of adjacent mats, unless otherwise directed. Allow adequate time for emulsion to break completely before placing any material. Prevent splattering of tack coat when placed adjacent to curb, gutter, and structures. The Engineer may suspend paving operations until there is adequate coverage. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

4.7.2.2. **Sampling.** The Engineer will obtain at least one sample of the tack coat binder per project in accordance with [Tex-500-C](#), Part III, and test it to verify compliance with Item 300, "Asphalts, Oils, and Emulsions." The Engineer will notify the Contractor when the sampling will occur and will witness the collection of the sample from the asphalt distributor immediately before use. Label the can with the corresponding lot and subplot numbers, producer, producer facility, grade, district, date sampled, and project information including highway and CSJ. For emulsions, the Engineer may test as often as necessary to ensure the residual of the emulsion is greater than or equal to the specification requirement in Item 300, "Asphalts, Oils, and Emulsions."

4.7.3. **Lay-Down Operations.** Use the placement temperatures in accordance with Table 11 to establish the minimum placement temperature of mixture delivered to the paving operation.

Table 11
Minimum Mixture Placement Temperature

High-Temperature Binder Grade ¹	Min Placement Temperature (Before Entering Paving Operation) ^{2,3}
PG 76	280°F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. The mixture temperature must be measured using a hand-held thermal camera or infrared thermometer nearest to the point of entry of the paving operation.
3. Minimum placement temperatures may be reduced 10°F if using a compaction aid.

4.7.3.1. **Thermal Profile.** Use a hand-held thermal camera or a thermal imaging system to obtain a continuous thermal profile in accordance with [Tex-244-F](#).

4.7.3.1.1. **Thermal Segregation.**

4.7.3.1.1.1. **Moderate.** Any areas that have a temperature differential greater than 25°F, but not exceeding 50°F.

4.7.3.1.1.2. **Severe.** Any areas that have a temperature differential greater than 50°F.

4.7.3.1.2. **Thermal Imaging System.** Review the output results when a thermal imaging system is used, and provide the report described in accordance with [Tex-244-F](#) to the Engineer daily. Modify the paving process as necessary to eliminate any recurring (moderate or severe) thermal segregation identified by the thermal imaging system.

The Engineer may suspend subsequent paving operations if the Contractor cannot successfully modify the paving process to eliminate recurring severe or moderate thermal segregation.

Provide the Engineer with electronic copies of all daily data files that can be used with the thermal imaging system software to generate temperature profile plots daily or as requested by the Engineer.

4.7.3.1.3. **Thermal Camera.** When using a thermal camera instead of the thermal imaging system, take immediate corrective action to eliminate recurring moderate thermal segregation when a hand-held thermal camera is used. Evaluate areas with moderate thermal segregation by performing water flow testing in accordance with [Tex-246-F](#) and verify the water flow is greater than 120 sec. Provide the Engineer with the thermal profile of every subplot within one working day of the completion of each lot. When requested by the Engineer, provide the electronic files generated using the thermal camera. Report the results of each thermal profile in accordance with Section 3081.4.2., "Reporting and Responsibilities." The Engineer will use a hand-held thermal camera to obtain a thermal profile at least once per project, unless the thermal imaging system is used. Suspend operations and take immediate corrective action to eliminate severe thermal segregation unless otherwise directed. Resume operations when the Engineer determines that subsequent production will meet the requirements of this Section. Evaluate areas with severe thermal segregation by performing water flow testing in accordance with [Tex-246-F](#) and verify the water flow is greater than 120 sec. Remove and replace the material in any areas that have both severe thermal segregation and a failing result for water flow test unless otherwise directed.

4.7.3.2. **Windrow Operations.** Operate windrow pickup equipment so that when hot-mix is placed in windrows, substantially all the mixture deposited on the roadbed is picked up and loaded into the paver.

4.7.3.3. **Hauling Equipment.** Use belly dumps, live bottom, or end dump trucks to haul and transfer mixture. End dump trucks are only allowed when used in conjunction with an MTD with remixing capability unless otherwise allowed.

4.7.3.4. **Screed Heaters.** Turn off screed heaters to prevent overheating of the mat if the paver stops for more than 5 min. The Engineer may evaluate the suspect area in accordance with Section 3081.4.9.3.1.1., "Recovered Asphalt Dynamic Shear Rheometer (DSR)," if the screed heater remains on for more than 5 min. while the paver is stopped.

4.8.

Compaction. Roll the freshly placed mixture with as many steel-wheeled rollers as necessary to ensure adequate compaction without excessive breakage of the aggregate and to provide a smooth surface and uniform texture. Operate each roller in static mode for TOM-F mixtures only. Do not use pneumatic-tire rollers. Use the control strip method given in accordance with [Tex-207-F](#), Part IV, to establish the rolling pattern. Thoroughly moisten the roller drums with a soap and water solution to prevent adhesion. Use only water or an approved release agent on rollers, tamps, and other compaction equipment unless otherwise directed.

Use tamps to thoroughly compact the edges of the pavement along curbs, headers, and similar structures and in locations that will not allow thorough compaction with rollers. The Engineer may require rolling with a trench roller on widened areas, in trenches, and in other limited areas.

Use [Tex-246-F](#) to measure water flow to verify the mixture is adequately compacted. Measure the water flow once per subplot at locations directed by the Engineer. Take additional water flow measurements when the minimum temperature of the uncompacted mat is below the temperature requirements in accordance with Table 12.

Table 12
Minimum Uncompacted Mat Temperature Requiring Additional Water Flow Measurements

High-Temperature Binder Grade ¹	Min Temperature of the Uncompacted Mat Allowed Before Initial Break Down Rolling ^{2,3}
PG 76	<270°F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. The surface of the uncompacted mat must be measured using a hand-held thermometer or infrared thermometer.
3. Minimum uncompacted mat temperature requiring a water flow measurement may be reduced 10°F if using a compaction aid.

Use [Tex-246-F](#) to measure water flow to verify the mixture is adequately compacted at confined longitudinal joints as directed by the Engineer.

The water flow rate should be greater than 120 sec. Investigate the cause of the water flow rate test failures and take corrective actions during production and placement to ensure the water flow rate is greater than 120 sec. Suspend production if two consecutive water flow rate tests fail unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

Complete all compaction operations before the pavement temperature drops below 180°F unless otherwise allowed. The Engineer may allow compaction with a light finish roller operated in static mode for pavement temperatures below 180°F when approved.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic unless otherwise directed. Sprinkle the finished mat with water or limewater, when directed, to expedite opening the roadway to traffic.

4.9.

Acceptance Plan. Sample and test the hot-mix asphalt on a lot and subplot basis.

4.9.1.

Referee Testing. The Materials and Tests Division is the referee laboratory. The Contractor may request referee testing if the differences between Contractor and Engineer test results exceed the maximum allowable difference in accordance with Table 8 and the differences cannot be resolved. The Contractor may also request referee testing if the Engineer's test results require suspension of production and the Contractor's test results are within specification limits. Make the request within five working days after receiving test results from the Engineer. Referee tests will be performed only on the subplot in question and only for the particular tests in question. Allow 10 working days from the time the referee laboratory receives the samples for test results to be reported. The Department may require the Contractor to reimburse the Department for referee tests if more than three referee tests per project are required and the Engineer's test results are closer to the referee test results than the Contractor's test results.

The Materials and Tests Division will determine the laboratory-molded density based on the molded specific gravity and the maximum theoretical specific gravity of the referee sample.

4.9.2. **Production Acceptance.**

4.9.2.1. **Production Lot.** A production lot consists of four equal sublots. The default quantity for Lot 1 is 500 ton; however, when requested by the Contractor, the Engineer may increase the quantity for Lot 1 to no more than 2,000 ton. The Engineer will select subsequent lot sizes based on the anticipated daily production such that approximately three to four sublots are produced each day. The lot size will be between 500 ton and 2,000 ton. The Engineer may change the lot size before the Contractor begins any lot.

4.9.2.1.1. **Incomplete Production Lots.** If a lot is begun but cannot be completed, such as on the last day of production or in other circumstances deemed appropriate, the Engineer may close the lot. Close all lots within five working days unless otherwise allowed.

4.9.2.2. **Production Sampling.**

4.9.2.2.1. **Mixture Sampling.** Obtain hot-mix samples from trucks at the plant in accordance with [Tex-222-F](#). The sampler will split each sample into three equal portions in accordance with [Tex-200-F](#) and label these portions as “Contractor,” “Engineer,” and “Referee.” The Engineer will perform or witness the sample splitting and take immediate possession of the samples labeled “Engineer” and “Referee.” The Engineer will maintain the custody of the samples labeled “Engineer” and “Referee” until the Department’s testing is completed.

4.9.2.2.1.1. **Random Sample.** At the beginning of the project, the Engineer will select random numbers for all production sublots. Determine sample locations in accordance with [Tex-225-F](#). Take one sample for each subplot at the randomly selected location. The Engineer will perform or witness the sampling of production sublots.

4.9.2.2.1.2. **Blind Sample.** For one subplot per lot, the Engineer will obtain and test a “blind” sample instead of the random sample collected by the Contractor. Test either the “blind” or the random sample; however, referee testing (if applicable) will be based on a comparison of results from the “blind” sample. The location of the Engineer’s “blind” sample will not be disclosed to the Contractor. The Engineer’s “blind” sample may be randomly selected in accordance with [Tex-225-F](#) for any subplot or selected at the discretion of the Engineer. The Engineer will use the Contractor’s split sample for sublots not sampled by the Engineer.

4.9.2.2.2. **Informational Methylene Blue Testing.** During the project and at random, obtain and provide the Engineer with approximately 50 lb. of each fine aggregate and approximately 20 lb. of all mineral fillers used to produce the mixture. Label the samples with the Control Section Job (CSJ), mixture type, and approximate lot and subplot number corresponding to when the sample was taken. The Engineer will ship the samples to the Materials and Tests Division for Methylene Blue testing in accordance with [Tex-252-F](#). Results from these tests will not be used for specification compliance.

4.9.2.2.3. **Asphalt Binder Sampling.** Obtain a 1-qt. sample of the asphalt binder witnessed by the Engineer for each lot of mixture produced. The Contractor will notify the Engineer when the sampling will occur. Obtain the sample at approximately the same time the mixture random sample is obtained. Sample from a port located immediately upstream from the mixing drum or pug mill and upstream from the introduction of any additives in accordance with [Tex-500-C](#), Part II. Label the can with the corresponding lot and subplot numbers, producer, producer facility location, grade, district, date sampled, and project information including highway and CSJ. The Engineer will retain these samples for one year. The Engineer may also obtain independent samples. If obtaining an independent asphalt binder sample and upon request of the Contractor, the Engineer will split a sample of the asphalt binder with the Contractor.

At least once per project, the Engineer will collect split samples of each binder grade and source used. The Engineer will submit one split sample to the Materials and Tests Division to verify compliance with Item 300, “Asphalts, Oils, and Emulsions,” and will retain the other split sample for 1 yr.

4.9.2.3. **Production Testing.** The Contractor and Engineer must perform production tests in accordance with Table 13. The Contractor has the option to verify the Engineer’s test results on split samples provided by the Engineer. Determine compliance with operational tolerances listed in accordance with Table 8 for all sublots. Take immediate corrective action if the Engineer’s laboratory-molded density on any subplot is less than 95.0% or greater than 98.0% when using the SGC or less than 96.5% or greater than 98.5% when using the TGC, to bring

the mixture within these tolerances. The Engineer may suspend operations if the Contractor's corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

The Engineer may allow alternate methods for determining the asphalt binder content and aggregate gradation if the aggregate mineralogy is such that [Tex-236-F](#), Part I does not yield reliable results. Provide evidence that results from [Tex-236-F](#), Part I are not reliable before requesting permission to use an alternate method unless otherwise directed. Use the applicable test procedure as directed if an alternate test method is allowed.

Table 13
Production and Placement Testing Frequency

Description	Test Method	Min Contractor Testing	Min Engineer Testing
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	1 per subplot	1 per 12 sublots ¹
Individual % retained for sieves smaller than #8 and larger than #200			
% passing the #200 sieve			
Laboratory-molded density	Tex-207-F	N/A	1 per subplot ¹
Laboratory-molded bulk specific gravity			
VMA			
Moisture content	Tex-212-F , Part II	When directed	
Theoretical maximum specific (Rice) gravity	Tex-227-F , Part II	N/A	1 per subplot ¹
Asphalt binder content ²	Tex-236-F , Part I	1 per subplot	1 per lot ¹
Overlay test ³	Tex-248-F	N/A	1 per project
Hamburg Wheel test	Tex-242-F	N/A	1 per project
Thermal profile	Tex-244-F	1 per subplot ^{4,5,6}	1 per project ⁵
Asphalt binder sampling and testing	Tex-500-C , Part II	1 per lot (sample only) ⁷	1 per project
Tack coat sampling and testing	Tex-500-C , Part III	N/A	1 per project
Boil test ⁸	Tex-530-C	1 per subplot ⁹	1 per project
Water flow	Tex-246-F		
Methylene blue test ¹⁰	Tex-252-F	1 per project (sample only)	1 per project

1. For production defined in Section 3081.4.9.4., "Exempt Production," the Engineer will test one per day if 100 ton or more are produced. For Exempt Production, no testing is required with less than 100 ton are produced.
2. May be obtained from asphalt flow meter readout as determined by the Engineer.
3. Testing performed by the Materials and Tests Division on sample obtained from Lot 2 or higher.
4. To be performed in the presence of the Engineer when a thermal camera is used, unless otherwise approved.
5. Not required when a thermal imaging system is used.
6. When using the thermal imaging system, the test report must include the temperature measurements taken in accordance with [Tex-244-F](#).
7. Obtain samples witnessed by the Engineer. The Engineer will retain these samples for 1 yr.
8. When shown on the plans.
9. To be performed in the presence of the Engineer, unless otherwise directed.
10. Testing performed by the Materials and Tests Division for informational purposes only.

4.9.2.4. **Operational Tolerances.** Control the production process within the operational tolerances in accordance with Table 8. When production is suspended, the Engineer will allow production to resume when test results or other information indicates the next mixture produced will be within the operational tolerances.

4.9.2.4.1. **Gradation.** Suspend operation and take corrective action if any aggregate is retained on the maximum sieve size in accordance with Table 6. A subplot is defined as out of tolerance if either the Engineer's or the Contractor's test results are out of operational tolerance. Suspend production when test results for gradation exceed the operational tolerances in accordance with Table 8 for three consecutive sublots on the same sieve or four consecutive sublots on any sieve unless otherwise directed. The consecutive sublots may be from more than one lot.

4.9.2.4.2. **Asphalt Binder Content.** A subplot is defined as out of operational tolerance if either the Engineer's or the Contractor's test results exceed the values in accordance with Table 8. Suspend production when two or

more sublots within a lot are out of operational tolerance or below the minimum asphalt binder content specified in accordance with Table 6 unless otherwise directed. Suspend production and shipment of mixture if the Engineer's or Contractor's asphalt binder content deviates from the current JMF by more than 0.5% for any subplot or is less than the minimum asphalt content allowed in accordance with Table 6.

- 4.9.2.4.3. **Voids in Mineral Aggregates (VMA).** The Engineer will determine the VMA for every subplot. For sublots when the Engineer does not determine asphalt binder content, the Engineer will use the asphalt binder content results from QC testing performed by the Contractor to determine VMA.

Take immediate corrective action if the VMA value for any subplot is less than the minimum VMA requirement for production in accordance with Table 6. Suspend production and shipment of the mixture if the Engineer's VMA results on two consecutive sublots are below the minimum VMA requirement for production in accordance with Table 6.

Suspend production and shipment of the mixture if the Engineer's VMA result is more than 0.5% below the minimum VMA requirement for production in accordance with Table 6. In addition to suspending production, the Engineer may require removal and replacement or may allow the subplot to be left in place without payment.

- 4.9.2.4.4. **Hamburg Wheel.** The Engineer may perform a Hamburg Wheel on plant produced mixture at any time during production. In addition to testing production samples, the Engineer may obtain cores and perform the Hamburg Wheel test on any area of the roadway where rutting is observed. Suspend production until further Hamburg Wheel meet the specified values when the production or core samples fail to meet the Hamburg Wheel criteria in accordance with Table 7. Core samples, if taken, will be obtained from the center of the finished mat or other areas excluding the vehicle wheel paths. The Engineer may require up to the entire subplot of any mixture failing the Hamburg Wheel to be removed and replaced at the Contractor's expense.

If the Department's or Department-approved laboratory's Hamburg Wheel test results in a "remove and replace" condition, the Contractor may request that the Department confirm the results by re-testing the failing material. The Materials and Tests Division will perform the Hamburg Wheel and determine the final disposition of the material in question based on the Department's test results.

- 4.9.2.5. **Individual Loads of Hot-Mix.** The Engineer can reject individual truckloads of hot-mix. When a load of hot-mix is rejected for reasons other than temperature, contamination, or excessive uncoated particles, the Contractor may request that the rejected load be tested. Make this request within 4 hr. of rejection. The Engineer will sample and test the mixture. If test results are within the operational tolerances in accordance with Table 8, payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load.

- 4.9.3. **Placement Acceptance.**

- 4.9.3.1. **Placement Lot.** A placement lot consists of four placement sublots. A placement subplot consists of the area placed during a production subplot.

- 4.9.3.1.1. **Recovered Asphalt Dynamic Shear Rheometer (DSR).** The Engineer may take production samples or cores from suspect areas of the project to determine recovered asphalt properties. Asphalt binders with an aging ratio greater than 3.5 do not meet the requirements for recovered asphalt properties and may be deemed defective when tested and evaluated by the Materials and Tests Division. The aging ratio is the DSR value of the extracted binder divided by the DSR value of the original unaged binder. Obtain DSR values in accordance with AASHTO T 315 at the specified high temperature performance grade of the asphalt. The Engineer may require removal and replacement of the defective material at the Contractor's expense. The asphalt binder will be recovered for testing from production samples or cores in accordance with [Tex-211-F](#).

- 4.9.3.1.2. **Irregularities.** Identify and correct irregularities including segregation, rutting, raveling, flushing, fat spots, mat slippage, irregular color, irregular texture, roller marks, tears, gouges, streaks, uncoated aggregate particles, or broken aggregate particles. The Engineer may also identify irregularities, and in such cases, the Engineer will promptly notify the Contractor. The Engineer may require the Contractor to remove and replace (at the

Contractor's expense) areas of the pavement that contain irregularities if the Engineer determines that the irregularity will adversely affect pavement performance. The Engineer may also require the Contractor to remove and replace (at the Contractor's expense) areas where the mixture does not bond to the existing pavement.

The Engineer may require the Contractor to immediately suspend operations if irregularities are detected or may allow the Contractor to continue operations for no more than one day while the Contractor is taking appropriate corrective action.

4.9.4. **Exempt Production.** When the anticipated daily production is less than 100 ton, all QC and QA sampling and testing are waived. The Engineer may deem the mixture as exempt production for the following conditions:

- anticipated daily production is more than 100 ton but less than 250 ton;
- total production for the project is less than 2,500 ton;
- when mutually agreed between the Engineer and the Contractor; or
- when shown on the plans.

For exempt production, the Contractor is relieved of all production and placement sampling and testing requirements. All other specification requirements apply, and the Engineer will perform acceptance tests for production and placement in accordance with Table 13.

For exempt production:

- produce, haul, place, and compact the mixture as directed by the Engineer; and
- control mixture production to yield a laboratory-molded density that is within $\pm 1.0\%$ of the target density as tested by the Engineer.

4.9.5. **Ride Quality.** Measure ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

5. MEASUREMENT

5.1. **TOM Hot-Mix Asphalt.** TOM hot-mix will be measured by the ton of composite mixture, which includes asphalt, aggregate, and additives. Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment."

5.2. **Tack Coat.** Tack coat will be measured at the applied temperature by strapping the tank before and after road application and determining the net volume in gallons from the calibrated distributor. The Engineer will witness all strapping operations for volume determination. All tack, including emulsions, will be measured by the gallon applied.

The Engineer may allow the use of a metering device to determine asphalt volume used and application rate if the device is accurate within 1.5% of the strapped volume.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under Section 3081.5.1., "TOM Hot-Mix Asphalt," will be paid for at the unit bid price for "Thin Overlay Mixture" of the mixture type, SAC, and binder specified. These prices are full compensation for surface preparation, removing pavement marking and markers, materials, placement, equipment, labor, tools, and incidentals.

The work performed and materials furnished in accordance with this Item and measured as provided under Section 3081.5.2., "Tack Coat," will be paid for at the unit bid price for "Tack Coat" of the tack coat provided. These prices are full compensation for materials, placement, equipment, labor, tools, and incidentals.

Trial batches will not be paid for unless they are included in pavement work approved by the Department.

Payment adjustment for ride quality will be determined in accordance with Item 585, "Ride Quality for Pavement Surfaces."

Special Specification 3082

Thin Bonded Friction Courses



1. DESCRIPTION

Construct a hot-mix asphalt (HMA) surface course composed of a warm spray-applied polymer modified emulsion membrane followed immediately with a compacted permeable mixture of aggregate, asphalt binder, and additives mixed hot in a mixing plant.

2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

Notify the Engineer of all material sources and before changing any material source or formulation. The Engineer will verify that the specification requirements are met when the Contractor makes a source or formulation change, and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time during the project to verify specification compliance in accordance with Item 6, "Control of Materials."

- 2.1. **Aggregate.** Furnish aggregates from sources that conform to the requirements shown in Table 1 and as specified in this Section. Aggregate requirements in this Section, including those shown in Table 1, may be modified or eliminated when shown on the plans. Additional aggregate requirements may be specified when shown on the plans. Provide aggregate stockpiles that meet the definitions in this Section for coarse or fine aggregate. Do not use intermediate or fine aggregate in PFC mixtures. Supply aggregates that meet the definitions in [Tex-100-E](#) for crushed gravel or crushed stone. The Engineer will designate the plant or the quarry as the sampling location. Provide samples from materials produced for the project. The Engineer will establish the Surface Aggregate Classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests listed in accordance with Table 1. Document all test results on the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis given in [Tex-200-F](#), Part II.

- 2.1.1. **Coarse Aggregate.** Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve. Aggregates from sources listed in the Department's *Bituminous Rated Source Quality Catalog* (BRSQC) are preapproved for use. Use only the rated values for hot-mix listed in the BRSQC. Rated values for surface treatment (ST) do not apply to coarse aggregate sources used in hot-mix asphalt.

For sources not listed on the Department's BRSQC:

- build an individual stockpile for each material;
- request the Department test the stockpile for specification compliance;
- approved only when tested by the Engineer;
- once approved, do not add material to the stockpile unless otherwise approved; and
- allow 30 calendar days for the Engineer to sample, test, and report results.

Provide coarse aggregate with at least the minimum SAC shown on the plans. SAC requirements only apply to aggregates used on the surface of travel lanes, unless otherwise shown on the plans. SAC requirements apply to aggregates used on surfaces other than travel lanes when shown on the plans. The SAC for sources on the Department's *Aggregate Quality Monitoring Program* (AQMP) ([Tex-499-A](#)) is listed in the BRSQC.

- 2.1.1.1. **Blending Class A and Class B Aggregates.** To prevent crushing of the Class B aggregate when blending, Class B aggregate may be blended with a Class A aggregate to meet requirements for Class A materials if the Department's BRSQC rated source soundness magnesium (RSSM) rating for the Class B aggregate is less than the Class A aggregate or if the RSSM rating for the Class B aggregate is less than or equal to 10%. Use the rated values for hot mix asphaltic concrete (HMAC) published in the BRSQC. When blending Class A and B aggregates to meet a Class A requirement, ensure that at least 50% by weight, or volume if required, of all the aggregates used in the mixture design retained on the No. 4 sieve comes from the Class A aggregate source, unless otherwise shown on the plans. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. Class B aggregate may be disallowed when shown on the plans.

The Engineer may perform tests at any time during production, when the Contractor blends Class A and B aggregates to meet a Class A requirement, to ensure that at least 50% by weight, or volume if required, of the material retained on the No. 4 sieve comes from the Class A aggregate source. The Engineer will use the Department's mix design template, when electing to verify conformance, to calculate the percent of Class A aggregate retained on the No. 4 sieve by inputting the bin percentages shown from readouts in the control room at the time of production and stockpile gradations measured at the time of production. The Engineer may determine the gradations based on either washed or dry sieve analysis from samples obtained from individual aggregate cold feed bins or aggregate stockpiles. The Engineer may perform spot checks using the gradations supplied by the Contractor on the mixture design report as an input for the template; however, a failing spot check will require confirmation with a stockpile gradation determined by the Engineer.

- 2.1.1.2. **Micro-Deval Abrasion.** The Engineer will perform a minimum of one Micro-Deval abrasion test in accordance with [Tex-461-A](#) for each coarse aggregate source used in the mixture design that has a Rated Source Soundness Magnesium (RSSM) loss value greater than 15 as listed in the BRSQC, unless otherwise directed. The Engineer will perform testing before the start of production and may perform additional testing at any time during production. The Engineer may obtain the coarse aggregate samples from each coarse aggregate source or may require the Contractor to obtain the samples. The Engineer may waive all Micro-Deval testing based on a satisfactory test history of the same aggregate source.

The Engineer will estimate the magnesium sulfate soundness loss for each coarse aggregate source, when tested, using the following formula:

$$Mg_{est.} = (RSSM)(MD_{act.}/RSMD)$$

where:

$Mg_{est.}$ = magnesium sulfate soundness loss

$RSSM$ = Rated Source Soundness Magnesium

$MD_{act.}$ = actual Micro-Deval percent loss

$RSMD$ = Rated Source Micro-Deval

When the estimated magnesium sulfate soundness loss is greater than the maximum magnesium sulfate soundness loss specified, the coarse aggregate source will not be allowed for use unless otherwise approved. The Engineer will consult the Soils and Aggregates Section of the Materials and Tests Division, and additional testing may be required before granting approval.

- 2.1.2. **Fine Aggregate.** Fine aggregates consist of manufactured sands and screenings. Fine aggregate stockpiles must meet the fine aggregate properties in accordance with Table 1 and the gradation requirements in accordance with Table 2. Supply fine aggregates that are free from organic impurities. The Engineer may test the fine aggregate in accordance with [Tex-408-A](#) to verify the material is free from organic impurities. Do not use field sand or other uncrushed fine aggregate. Use fine aggregate from coarse aggregate sources that meet the requirements shown in accordance with Table 1 unless otherwise approved.

Table 1
Coarse Aggregate Quality Requirements

Property	Test Method	Requirement
SAC	Tex-499-A (AQMP)	As shown on the plans
Deleterious material, %, Max	Tex-217-E, Part I	1.0
Decantation, %, Max	Tex-217-E, Part II	1.5
Micro-Deval abrasion, %	Tex-461-A	Note ¹
Los Angeles abrasion, %, Max	Tex-410-A	30
Magnesium sulfate soundness, 5 cycles, %, Max	Tex-411-A	20
Crushed face count ² , %, Min	Tex-460-A, Part I	95
Flat and elongated particles @ 5:1, %, Max	Tex-280-F	10
Fine Aggregate Properties		
Sand Equivalent, %, Min	Tex-203-F	45
Methylene Blue, mg/g, Max	Tex-252-F	10.0

- Used to estimate the magnesium sulfate soundness loss in accordance with section 3082.2.1.1.2., "Micro-Deval Abrasion."
- Only applies to crushed gravel.

Table 2
Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Weight or Volume
3/8"	100
#8	70–100
#200	0–30

- 2.2. **Mineral Filler.** Mineral filler consists of finely divided mineral matter such as agricultural lime, crusher fines, or hydrated lime. Fly ash is not allowed unless otherwise shown on the plans. Mineral filler is allowed unless otherwise shown on the plans. Use no more than 2% hydrated lime, unless otherwise shown on the plans. Test all mineral fillers except hydrated lime and fly ash in accordance with [Tex-252-F](#) to ensure specification compliance. The plans may require or disallow specific mineral fillers. Provide mineral filler, when used, that:
- is sufficiently dry, free-flowing, and free from clumps and foreign matter as determined by the Engineer;
 - does not exceed 3% linear shrinkage when tested in accordance with [Tex-107-E](#); and
 - meets the gradation requirements in accordance with Table 3, unless otherwise shown on the plans.

Table 3
Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Weight or Volume
#8	100
#200	55–100

- 2.3. **Baghouse Fines.** Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.
- 2.4. **Asphalt Binder.** Furnish the type and grade of binder specified on the plans that meets the requirements of Item 300, "Asphalts, Oils, and Emulsions."
- 2.4.1. **Performance-Graded (PG) Binder.** Provide an asphalt binder with a high-temperature grade of PG 76 and low-temperature grade as shown on the plans in accordance with Section 300.2.10., "Performance-Graded Binders," when PG binder is specified.
- 2.4.2. **Asphalt-Rubber (A-R) Binder.** Provide A-R binder that meets the Type I or Type II requirements of Section 300.2.9., "Asphalt-Rubber Binders," when A-R is specified unless otherwise shown on the plans. Use at least 15.0% by weight of Crumb Rubber Modifier (CRM) that meets the Grade B or Grade C requirements of Section 300.2.7., "Crumb Rubber Modifier," unless otherwise shown on the plans. Provide the Engineer the A-R binder blend design with the mix design (JMF1) submittal. Provide the Engineer with documentation such as the bill of lading showing the quantity of CRM used in the project unless otherwise directed.
- 2.5. **Membrane.** Provide a smooth and homogeneous polymer modified emulsion meeting the requirements in accordance with Table 4.

Table 4
Polymer Modified Emulsion Requirements

Test on Emulsion	Test Method	Min	Max
Viscosity @ 77°F, SSF	T 72	20	100
Storage Stability, ¹ %	T 59		1
Demulsibility (for anionic emulsions), 35 mL of 0.02 N CaCl ₂ , %	T 59	55	
Demulsibility (for cationic emulsions), 35 mL 0.8% Sodium dioctyl sulfosuccinate, %	T 59	55	
Sieve Test, ² %	T 59		0.05
Distillation Test: ³			
Residue by distillation, % by wt.	T 59	63	0.5
Oil portion of distillate, % by vol.			
Test on Residue from Distillation	Test Method	Min	Max
Elastic Recovery @ 50°F, 50 mm/min., %	Tex-539-C	60	
Penetration @ 77°F, 100 g, 5 sec, 0.1 mm	T 49	100	150

1. After standing undisturbed for 24 hr., the surface must be smooth, must not exhibit a white or milky colored substance, and must be a homogeneous color throughout.
2. May be required by the Engineer only when the emulsion cannot be easily applied in the field.
3. The temperature on the lower thermometer should be brought slowly to 350°F ±10°F and maintained at this temperature for 20 min. The total distillation should be complete in 60 ±5 min. from the first application of heat.

2.6. **Additives.** Provide the Engineer with documentation such as the bill of lading showing the quantity of additives used in the project unless otherwise directed.

2.6.1. **Fibers.** Provide cellulose or mineral fibers when PG binder is specified. Do not use fibers when A-R binder is specified. Submit written certification to the Engineer that the fibers proposed for use meet the requirements of DMS-9204, "Fiber Additives for Bituminous Mixtures." Fibers may be pre-blended into the binder at the asphalt supply terminal unless otherwise shown on the plans.

2.6.2. **Lime Mineral Filler.** Add lime as mineral filler at a rate of 1.0% by weight of the total dry aggregate in accordance with Item 301, "Asphalt Antistripping Agents," unless otherwise shown on the plans or waived by the Engineer based on Hamburg Wheel test results. Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime into the drum.

2.6.3. **Lime and Liquid Antistripping Agent.** When lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime into the drum. Lime added as mineral filler will count towards the total quantity of lime specified when the plans require lime to be added as an antistripping agent.

2.6.4. **Compaction Aid.** Compaction Aid is defined as a Department-approved chemical warm mix additive denoted as "chemical additive" on the Department's material producer list (MPL) that is used to facilitate mixing and compaction of HMA.

Compaction aid is allowed for use on all projects. Compaction aid is required when shown on the plans or as required in Section 3082.4.7.1., "Weather Conditions."

Warm mix foaming processes, denoted as "foaming process" on the Department-approved MPL, may be used to facilitate mixing and compaction of HMA; however warm mix processes are not defined as a Compaction Aid.

2.7. **Recycled Materials.** Recycled materials are not allowed for use.

3. EQUIPMENT

Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement." When A-R binder is specified, equip the hot-mix plant with an in-line viscosity-measuring device located between the blending unit and the mixing drum. Provide a means to calibrate the asphalt mass flow meter on-site when a meter is used.

3.1. **Placement Equipment.** Provide a paver that meets all the requirements listed below.

3.1.1. **Paver.** Furnish a paver that will spray the membrane, apply the PFC mixture, and level the surface of the mat in a single pass. Configure the paver so that the mixture is placed no more than 5 sec. after the membrane is applied. Ensure the paver does not support the weight of any portion of hauling equipment other than the connection. Provide loading equipment that does not transmit vibrations or other motions to the paver that adversely affects the finished pavement quality. Equip the paver with an automatic dual longitudinal-grade control system and an automatic transverse-grade control system.

3.1.1.1. **Tractor Unit.** Supply a tractor unit that can push or propel vehicles, dumping directly into the finishing machine to obtain the desired lines and grades to eliminate any hand finishing. Equip the unit with a hitch to maintain contact between the hauling equipment's rear wheels and the finishing machine's pusher rollers while mixture is unloaded.

3.1.1.2. **Membrane Storage Tank and Distribution System.** Equip the paver with an insulated storage tank with a minimum capacity of 900 gal. Provide a metered mechanical pressure sprayer on the paver to apply a uniform membrane at the specified rate. Locate the spray bar on the paver so that the membrane is applied immediately in front of the screed unit. Provide a read-out device on the paver to monitor the membrane application rate.

Furnish a volumetric calibration and strap stick for the tank in accordance with [Tex-922-K](#), Part I, unless otherwise directed. Calibrate the tank within the previous 5 yr. of the date first used on the project. The Engineer may verify calibration accuracy in accordance with [Tex-922-K](#), Part II.

3.1.1.3. **Screed.** Provide a variable width vibratory screed that meets Item 320, "Equipment for Asphalt Concrete Pavement."

3.1.2. **Material Transfer Device (MTD).** Provide the specified type of MTD when shown on the plans. Ensure MTDs provide a continuous, uniform mixture flow to the asphalt paver.

3.1.3. **Rollers.** Provide steel-wheel rollers meeting the requirements of Item 210, "Rolling," except provide rollers weighing a minimum of 10 ton for each roller required. Operate rollers in static (non-vibrating) mode unless otherwise allowed.

4. CONSTRUCTION

Produce, haul, place, and compact the specified paving mixture. In addition to tests required by the specification, Contractors may perform other QC tests as deemed necessary. At any time during the project, the Engineer may perform production and placement tests as deemed necessary in accordance with Item 5, "Control of the Work." Schedule and participate in a mandatory pre-paving meeting with the Engineer on or before the first day of paving unless otherwise shown on the plans.

4.1. **Certification.** Personnel certified by the Department-approved hot-mix asphalt certification program must conduct all mixture designs, sampling, and testing in accordance with Table 5. Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning production and when personnel changes are made. Provide a mixture design developed and signed by a Level 2 certified specialist. Provide Level 1A certified specialists at the plant during production operations. Provide Level 1B certified specialists to conduct placement tests. Provide AGG101 certified specialists for aggregate testing.

Table 5
Test Methods, Test Responsibility, and Minimum Certification Levels

Test Description	Test Method	Contractor	Engineer	Level ¹
1. Aggregate Testing				
Sampling	Tex-221-F	✓	✓	1A/AGG101
Dry sieve	Tex-200-F , Part I	✓	✓	1A/AGG101
Washed sieve	Tex-200-F , Part II	✓	✓	1A/AGG101
Deleterious material	Tex-217-F , Parts I & III	✓	✓	AGG101
Decantation	Tex-217-F , Part II	✓	✓	AGG101
Los Angeles abrasion	Tex-410-A		✓	Department
Magnesium sulfate soundness	Tex-411-A		✓	Department
Micro-Deval abrasion	Tex-461-A		✓	AGG101
Crushed face count	Tex-460-A	✓	✓	AGG101
Flat and elongated particles	Tex-280-F	✓	✓	AGG101
Methylene blue test	Tex-252-F		✓	Department
2. Asphalt Binder & Tack Coat Sampling				
Asphalt binder sampling	Tex-500-C , Part II	✓	✓	1A/1B
Membrane sampling	Tex-500-C , Part III	✓	✓	1A/1B
3. Mix Design & Verification				
Design and JMF changes	Tex-204-F	✓	✓	2
Mixing	Tex-205-F	✓	✓	2
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F , Parts I, VI, & VIII	✓	✓	1A
Rice gravity	Tex-227-F , Part II	✓	✓	1A
Ignition oven correction factors ²	Tex-236-F , Part II	✓	✓	2
Drain-down	Tex-235-F	✓	✓	1A
Hamburg Wheel test	Tex-242-F	✓	✓	1A
Boil test ⁴	Tex-530-C	✓	✓	1A
Cantabro loss	Tex-245-F	✓	✓	1A
4. Production Testing				
Control charts	Tex-233-F	✓	✓	1A
Mixture sampling	Tex-222-F	✓	✓	1A/1B
Gradation & asphalt binder content ²	Tex-236-F , Part I	✓	✓	1A
Moisture content	Tex-212-F , Part II	✓	✓	1A/AGG101
Micro-Deval abrasion	Tex-461-A		✓	AGG101
Drain-down	Tex-235-F	✓	✓	1A
Boil test ⁴	Tex-530-C	✓	✓	1A
Abson recovery	Tex-211-F		✓	Department
5. Placement Testing				
Control charts	Tex-233-F	✓	✓	1A
Ride quality measurement	Tex-1001-S	✓	✓	Note 3
Thermal profile	Tex-244-F	✓	✓	1B
Water flow test	Tex-246-F	✓	✓	1B

1. Level 1A, 1B, AGG101, and 2 are certification levels provided by the Hot Mix Asphalt Center certification program.
2. Refer to Section 3082.4.5., "Production Operations," for exceptions to using an ignition oven.
3. Profiler and operator are required to be certified at the Texas A&M Transportation Institute facility when Surface Test Type B is specified.
4. When shown on the plans.

4.2.

Reporting and Responsibilities. Use Department-provided templates to record and calculate all test data, including mixture design, production and placement tests, control charts, and thermal profiles. Obtain the current version of the templates at <https://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/forms/site-manager.html> or from the Engineer. The Engineer and the Contractor will provide any available test results to the other party when requested. The Contractor and Engineer must exchange test data within the maximum allowable time in accordance with Table 6 unless otherwise approved. The Engineer and the

Contractor will immediately report to the other party any test result that requires suspension of production or placement or that fails to meet the specification requirements. Record and electronically submit all test results and pertinent information on Department-provided templates.

Subsequent sublots placed after test results are available to the Contractor, which require suspension of operations, may be considered unauthorized work. Unauthorized work will be accepted or rejected at the discretion of the Engineer in accordance with Section 5.3., "Conformity with Plans, Specifications, and Special Provisions."

Table 6
Reporting Schedule

Description	Reported By	Reported To	To Be Reported Within
Production Quality Control			
Gradation ¹	Contractor	Engineer	1 working day of completion of the subplot
Asphalt binder content ¹			
Laboratory-molded density ¹			
Moisture content ²			
Drain-down ¹			
Boil test ⁴			
Production Quality Assurance			
Gradation ²	Engineer	Contractor	1 working day of completion of the subplot
Asphalt binder content ²			
Laboratory-molded density ²			
Hamburg Wheel test ³			
Boil test ⁴			
Drain-down ²			
Binder tests ³			
Placement Quality Control			
Thermal profile ¹	Contractor	Engineer	1 working day of completion of the lot
Water flow ¹			
Membrane application rate ²			
Placement Quality Assurance			
Thermal profile ²	Engineer	Contractor	1 working day of completion of the lot
Aging ratio ³			
Water flow ²			
Membrane application rate ²			

1. These tests are required on every subplot.
2. To be performed at the frequency in accordance with Table 14 or as shown on the plans.
3. To be reported as soon as the results become available.
4. When shown on the plans

Use the procedures described in [Tex-233-F](#), when directed, to plot the results of all production and placement testing. Update the control charts as soon as test results for each subplot become available. Make the control charts readily accessible at the field laboratory. The Engineer may suspend production for failure to update control charts.

- 4.3. **Quality Control Plan (QCP).** Develop and follow the QCP in detail. Obtain approval for changes to the QCP made during the project. The Engineer may suspend operations if the Contractor fails to comply with the QCP.

Submit a written QCP before the mandatory pre-paving meeting, when directed. Receive approval of the QCP before pre-paving meeting. Include the following items in the QCP:

- 4.3.1. **Project Personnel.** For project personnel, include:
- a list of individuals responsible for QC with authority to take corrective action;
 - current contact information for each individual listed; and
 - current copies of certification documents for individuals performing specified QC functions.
- 4.3.2. **Material Delivery and Storage.** For material delivery and storage, include:
- the sequence of material processing, delivery, and minimum quantities to assure continuous plant

operations;

- aggregate stockpiling procedures to avoid contamination and segregation;
- frequency, type, and timing of aggregate stockpile testing to assure conformance of material requirements before mixture production; and
- procedure for monitoring the quality and variability of asphalt binder.

4.3.3. **Production.** For production, include:

- loader operation procedures to avoid contamination in cold bins;
- procedures for calibrating and controlling cold feeds;
- procedures to eliminate debris or oversized material;
- procedures for adding and verifying rates of each applicable mixture component (e.g., aggregate, asphalt binder, lime, liquid antistripping, compaction aid, foaming process, fibers);
- procedures for reporting job control test results; and
- procedures to avoid segregation and drain-down in the silo.

4.3.4. **Loading and Transporting.** For loading and transporting, include:

- type and application method for release agents; and
- truck loading procedures to avoid segregation.

4.3.5. **Placement and Compaction.** For placement and compaction, include:

- proposed agenda for mandatory pre-paving meeting, including date and location;
- proposed paving plan (e.g., production rate, paving widths, joint offsets, and lift thicknesses);
- type and application method for release agents in the paver and on rollers, shovels, lutes, and other utensils;
- procedures for the transfer of mixture into the paver while avoiding physical and thermal segregation and preventing material spillage;
- process to balance production, delivery, paving, and compaction to achieve continuous placement operations and good ride quality;
- paver operations (e.g., speed, operation of wings, height of mixture in auger chamber) to avoid physical and thermal segregation and other surface irregularities; and
- procedures to construct quality longitudinal and transverse joints.

4.4. **Mixture Design.**

4.4.1. **Design Requirements.** Use the design procedure provided in [Tex-204-F](#), unless otherwise shown on the plans. Design the mixture to meet the requirements in accordance with Tables 1, 2, 3, 7, 8, and 9. Use a Superpave Gyration Compactor (SGC) at 50 gyrations as the design number of gyrations (Ndesign).

The Engineer will provide the mixture design when shown on the plans. The Contractor may submit a new mixture design at any time during the project. The Engineer will verify and approve all mixture designs (JMF1) before the Contractor can begin production.

Provide the Engineer with a mixture design report using the Department-provided template. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- the membrane application rate based on design volumetrics;
- results of all applicable tests;
- the mixing and molding temperatures;
- the signature of the Level 2 person or persons that performed the design;
- the date the mixture design was performed; and
- a unique identification number for the mixture design.

Table 7
Master Gradation Limits (% Passing by Weight or Volume)
and Laboratory Mixture Design Properties

Sieve Size	Permeable Friction Course		Thin Bonded Friction Course		
	Fine (PFC-F)	Coarse (PFC-C and PFCR-C)	Type A	Type B	Type C
3/4"	–	100.0 ¹	–	–	100 ¹
1/2"	100.0 ¹	80.0–100.0	–	100 ¹	75–100
3/8"	95.0–100.0	35.0–60.0	100 ¹	75–100	55–80
#4	20.0–55.0	1.0–20.0	35–55	22–36	22–36
#8	1.0–10.0	1.0–10.0	19–30	19–30	19–30
#16	–	–	14–25	14–24	14–24
#50	–	–	7–14	7–14	7–14
#200	1.0–4.0	1.0–4.0	4–6	4–6	4–6

1. Defined as maximum sieve size. No tolerance allowed.

Table 8
Mixture Design Properties

Mixture Property	Test Method	PG 76 Mixtures		A-R Mixtures	Thin Bonded Friction Course		
		Fine (PFC-F)	Coarse (PFC-C)	Coarse (PFCR-C)	Type A	Type B	Type C
Asphalt binder content, %	–	6.0–7.0	6.0–7.0	7.0–9.0	5.0–5.8	4.8–5.6	4.8–5.6
Film thickness, microns	–	–	–	–	9.0 Min	9.0 Min	9.0 Min
Design gyrations (Ndesign)	Tex-241-F	50	50	50	50	50	50
Laboratory-molded density, %	Tex-207-F	78.0 Max	82.0 Max	82.0 Max	92.0 Max	92.0 Max	92.0 Max
Hamburg Wheel test, ¹ passes at 12.5 mm rut depth	Tex-242-F	10,000 Min	Note 2	Note 2	Note 2	Note 2	Note 2
Drain-down, %	Tex-235-F	0.10 Max	0.10 Max	0.10 Max	0.10 Max	0.10 Max	0.10 Max
Fiber content, % by wt. of total PG 76 mixture	Calculated	0.20–0.50	0.20–0.50	–	–	–	–
Lime content, % by wt. of total aggregate	Calculated	1.0 ³	1.0 ³	–	Note 4	Note 4	Note 4
CRM content, % by wt. of A-R binder	Calculated	–	–	15.0 Min	–	–	–
Boil test ⁵	Tex-530-C	–	–	–	–	–	–
Cantabro loss, %	Tex-245-F	20.0 Max	20.0 Max	20.0 Max	20.0 Max	20.0 Max	20.0 Max

1. Mold test specimens to Ndesign at the optimum asphalt binder content.
2. No specification value is required unless otherwise shown on the plans.
3. Unless otherwise shown on the plans or waived by the Engineer based on Hamburg Wheel results.
4. Lime may be required when shown on the plans.
5. When shown on the plans. Used to establish baseline for comparison to production results.

4.4.2. **Job-Mix Formula Approval.** The job-mix formula (JMF) is the combined aggregate gradation, Ndesign level, and target asphalt percentage used to establish target values for hot-mix production. JMF1 is the original laboratory mixture design used to produce the trial batch. When a compaction aid or foaming process is used, JMF1 may be designed and submitted to the Engineer without including the compaction aid or foaming process. When a compaction aid or foaming process is used, document the compaction aid or foaming process used and recommended rate on the JMF1 submittal. The Engineer and the Contractor will verify JMF1 based on plant-produced mixture from the trial batch unless otherwise approved. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF1. The Department may require the Contractor to reimburse the Department for verification tests if more than two trial batches per design are required.

4.4.2.1. **Contractor's Responsibilities.**

4.4.2.1.1. **Providing Superpave Gyratory Compactor.** Furnish an SGC calibrated in accordance with [Tex-241-F](#) for molding production samples. Locate the SGC at the Engineer's field laboratory or make the SGC available to the Engineer for use in molding production samples.

4.4.2.1.2. **Gyratory Compactor Correlation Factors.** Use [Tex-206-F](#), Part II, to perform a gyratory compactor

correlation when the Engineer uses a different SGC. Apply the correlation factor to all subsequent production test results.

- 4.4.2.1.3. **Submitting JMF1.** Furnish a mix design report (JMF1) with representative samples of all component materials and request approval to produce the trial batch. Provide an additional 25 lb. of the design mixture if opting to have the Department perform the Hamburg Wheel test on the laboratory mixture when required in accordance with Table 8, and request that the Department perform the test.
- 4.4.2.1.4. **Supplying Aggregates.** Provide approximately 40 lb. of each aggregate stockpile unless otherwise directed.
- 4.4.2.1.5. **Supplying Asphalt.** Provide at least 1 gal. of the asphalt material and enough quantities of any additives proposed for use.
- 4.4.2.1.6. **Ignition Oven Correction Factors.** Determine the aggregate and asphalt correction factors from the ignition oven in accordance with [Tex-236-F](#), Part II. Provide correction factors that are not more than 12 mo. old. Note that the asphalt content correction factor takes into account the percent fibers in the mixture so that the fibers are excluded from the binder content determination. Provide the Engineer with split samples of the mixtures before the trial batch production, including all additives (except water), and blank samples used to determine the correction factors for the ignition oven used for quality assurance testing during production. Correction factors established from a previously approved mixture design may be used for the current mixture design if the mixture design and ignition oven are the same as previously used and the correction factors are not more than 12 mo. old, unless otherwise directed.
- 4.4.2.1.7. **Boil Test.** When shown on the plans, perform the test and retain the tested sample from [Tex-530-C](#) until completion of the project or as directed. Use this sample for comparison purposes during production. Add lime or liquid antistripping agent as directed if signs of stripping exist.
- 4.4.2.1.8. **Trial Batch Production.** Provide a plant-produced trial batch upon receiving conditional approval of JMF1 and authorization to produce a trial batch, including the compaction aid or foaming process, if applicable, for verification testing of JMF1 and development of JMF2. Produce a trial batch mixture that meets the requirements in accordance with Table 9. The Engineer may accept test results from recent production of the same mixture instead of a new trial batch.
- 4.4.2.1.9. **Trial Batch Production Equipment.** Use only equipment and materials proposed for use on the project to produce the trial batch. Provide documentation to verify the calibration or accuracy of the asphalt mass flow meter to measure the binder content. Verify that asphalt mass flow meter meets the requirements of 0.4 % accuracy, when required, in accordance with Item 520, "Weighing and Measuring Equipment." The Engineer may require that the accuracy of the mass flow meter be verified based on quantities used.
- 4.4.2.1.10. **Trial Batch Quantity.** Produce enough quantity of the trial batch to ensure that the mixture meets the specification requirements.
- 4.4.2.1.11. **Number of Trial Batches.** Produce trial batches as necessary to obtain a mixture that meets the specification requirements.
- 4.4.2.1.12. **Trial Batch Sampling.** Obtain a representative sample of the trial batch and split it into three equal portions in accordance with [Tex-222-F](#). Label these portions as "Contractor," "Engineer," and "Referee." Deliver samples to the appropriate laboratory as directed.
- 4.4.2.1.13. **Trial Batch Testing.** Test the trial batch to ensure the mixture produced using the proposed JMF1 meets the mixture requirements in accordance with Table 9. Ensure the trial batch mixture is also in compliance with the requirements in accordance with Tables 7 and 8. Use a Department-approved laboratory listed on the MPL to perform the Hamburg Wheel test on the trial batch mixture or request that the Department perform the Hamburg Wheel test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the trial batch. Provide the Engineer with a copy of the trial batch test results.
- 4.4.2.1.14. **Development of JMF2.** Evaluate the trial batch test results, determine the target mixture proportions, and

submit as JMF2 after the Engineer grants full approval of JMF1 based on results from the trial batch. Verify that JMF2 meets the mixture requirements in accordance with Table 9.

4.4.2.1.15. **Mixture Production.** After receiving approval for JMF2, use JMF2 to produce Lot 1.

4.4.2.1.16. **Development of JMF3.** Evaluate the test results from Lot 1, determine the optimum mixture proportions, and submit as JMF3 for use in Lot 2.

4.4.2.1.17. **JMF Adjustments.** If JMF adjustments are necessary to achieve the specified requirements, make the adjustments before beginning a new lot. The adjusted JMF must:

- be provided to the Engineer in writing before the start of a new lot;
- be numbered in sequence to the previous JMF;
- meet the master gradation limits in accordance with Table 7
- meet the binder content limits in accordance with Table 8; and
- be within the operational tolerances of JMF2 in accordance with Table 9.

4.4.2.1.18. **Requesting Referee Testing.** Use referee testing, if needed, in accordance with Section 3082.4.9.1., "Referee Testing," to resolve testing differences with the Engineer.

Table 9
Operational Tolerances

Test Description	Test Method	Allowable Difference between JMF2 and JMF1 Target ¹	Allowable Difference from Current JMF and JMF2 ²	Allowable Difference between Contractor and Engineer ³
Individual % retained for sieve sized larger than #200	Tex-200-F	Must be Within Master Grading Limits in accordance with Table 7	±3.0 ⁴	±5.0 ⁴
% passing the #200 sieve			±2.0 ⁴	±3.0 ⁴
Laboratory-molded density, %	Tex-207-F , Part VIII	±1.0	±1.0	±1.0
Asphalt binder content, %	Tex-236-F , Part I ⁵	±0.3 ^{6,7}	±0.3 ^{4,6,7}	±0.3 ^{6,7}
Drain-down, %	Tex-235-F	Note 8	Note 8	N/A
Boil test	Tex-530-C	Note 9	Note 9	N/A
Membrane application rate	Tex-247-F	±0.02	±0.02	N/A

1. JMF1 is the approved laboratory mixture design used for producing the trial batch. JMF2 is the approved mixture design developed from the trial batch used to produce Lot 1.
2. Current JMF is JMF3 or higher. JMF3 is the approved mixture design used to produce Lot 2.
3. Contractor may request referee testing only when values exceed these tolerances.
4. Only applies to mixture produced for Lot 1 and higher. Aggregate gradation is not allowed to be outside the limits in accordance with Table 7.
5. Ensure the binder content determination excludes fibers.
6. May be obtained from asphalt mass flow meter readouts as determined by the Engineer.
7. Binder content is not allowed to be outside the limits shown in Table 8.
8. Verify that Table 8 requirements are met.
9. When shown on the plans.

4.4.2.2. **Engineer's Responsibilities.**

4.4.2.2.1. **Superpave Gyratory Compactor.** The Engineer will use a Department SGC calibrated in accordance with [Tex-241-F](#) to mold samples for laboratory mixture design verification. For molding trial batch and production specimens, the Engineer will use the Contractor-provided SGC at the field laboratory or provide and use a Department SGC at an alternate location.

4.4.2.2.2. **Conditional Approval of JMF1 and Authorizing Trial Batch.** The Engineer will review and verify conformance of the following information within two working days of receipt:

- the Contractor's mix design report (JMF1);
- the Contractor-provided Hamburg Wheel test results, if applicable;
- all required materials including aggregates, asphalt, and additives; and
- the mixture specifications.

The Engineer will grant the Contractor conditional approval of JMF1 if the information provided on the paper copy of JMF1 indicates that the Contractor's mixture design meets the specifications. When the Contractor does not provide Hamburg Wheel test with laboratory mixture design, 10 working days are allowed for conditional approval of JMF1. The Engineer will base full approval of JMF1 on the test results on mixture from the trial batch.

Unless waived, the Engineer will determine the Micro-Deval abrasion loss in accordance with

Section 3082.2.1.1.2., "Micro-Deval Abrasion." If the Engineer's test results are pending after two working days, conditional approval of JMF1 will still be granted within two working days of receiving JMF1. When the Engineer's test results become available, they will be used for specification compliance.

The Contractor is authorized to produce a trial batch after the Engineer grants conditional approval of JMF1.

4.4.2.2.3. **Hamburg Wheel Testing.** At the Contractor's request, the Department will perform the Hamburg Wheel test on the laboratory mixture in accordance with [Tex-242-F](#) to verify compliance with the Hamburg Wheel test requirement in accordance with Table 8. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel results on the laboratory mixture design.

4.4.2.2.4. **Ignition Oven Correction Factors.** The Engineer will use the split samples provided by the Contractor to determine the aggregate and asphalt correction factors for the ignition oven used for quality assurance testing during production in accordance with [Tex-236-F](#), Part II. Provide correction factors that are not more than 12 mo. old. The Engineer will verify that the asphalt content correction factor takes into account the percent fibers in the mixture so that the fibers are excluded from the binder content determination.

4.4.2.2.5. **Testing the Trial Batch.** The Engineer will sample and test the trial batch within one full working day to ensure that the mixture meets the requirements in accordance with Table 9. If the Contractor requests the option to have the Department perform the Hamburg Wheel test on the trial batch mixture, the Engineer will mold samples in accordance with [Tex-242-F](#) to verify compliance with the Hamburg Wheel test requirement in accordance with Table 8.

The Engineer will have the option to perform [Tex-530-C](#) on the trial batch when shown on the plans. These results may be retained and used for comparison purposes during production.

4.4.2.2.6. **Full Approval of JMF1.** The Engineer will grant full approval of JMF1 and authorize the Contractor to proceed with developing JMF2 if the Engineer's results for the trial batch meet the requirements in accordance with Tables 7 and 8.

The Engineer will notify the Contractor that an additional trial batch is required if the trial batch does not meet these requirements.

4.4.2.2.7. **Approval of JMF2.** The Engineer will approve JMF2 within one working day if the mixture meets the requirements in accordance with Tables 7, 8, and 9.

4.4.2.2.8. **Approval of Lot 1 Production.** The Engineer will authorize the Contractor to proceed with Lot 1 production (using JMF2).

4.4.2.2.9. **Approval of JMF3 and Subsequent JMF Changes.** JMF3 and subsequent JMF changes are approved if they meet the master grading and asphalt binder content shown in accordance with Tables 7 and 8 and are within the operational tolerances of JMF2 in accordance with Table 9.

- 4.4.2.2.10. **Binder Content Adjustments.** For JMF2 and above, the Engineer may require the Contractor to adjust the target binder content by no more than 0.3% from the current JMF.
- 4.5. **Production Operations.** Perform a new trial batch when the plant or plant location is changed. Take corrective action and receive approval to proceed after any production suspension for noncompliance to the specification.
- 4.5.1. **Storage and Heating of Materials.** Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions," or outside the manufacturer's recommended values. Provide the Engineer with daily records of asphalt binder and hot-mix asphalt discharge temperatures (in legible and discernible increments) in accordance with Item 320, "Equipment for Asphalt Concrete Pavement," unless otherwise directed. Do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr. unless otherwise approved.
- 4.5.2. **Mixing and Discharge of Materials.** Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed the maximum production temperatures in accordance with Table 10. The Department will not pay for or allow placement of any mixture produced above the maximum production temperatures in accordance with Table 10.

Table 10
Maximum Production Temperature

High-Temperature Binder Grade ¹	Max Production Temperature
PG 76	345°F
A-R Binder	345°F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.

Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant. Determine the moisture content, if requested, by oven-drying in accordance with [Tex-212-F](#), Part II, and verify that the mixture contains no more than 0.2% of moisture by weight. Obtain the sample immediately after discharging the mixture into the truck and perform the test promptly.

- 4.6. **Hauling Operations.** Clean all truck beds before use to ensure that mixture is not contaminated. Use a release agent shown on the Department's MPL to coat the inside bed of the truck when necessary. Do not use diesel or any release agent not shown on the Department's MPL.
- Use equipment for hauling as defined in Section 3082.4.7.3.2., "Hauling Equipment." Use other hauling equipment only when allowed.
- 4.7. **Placement Operations.** Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer approximately every hour, or as directed. Use a hand-held thermal camera or infrared thermometer, when a thermal imaging system is not used, to measure and record the internal temperature of the mixture as discharged from the truck or Material Transfer Device (MTD) before or as the mix enters the paver and an approximate station number or GPS coordinates on each ticket. Calculate the daily yield and cumulative yield for the specified lift and provide to the Engineer at the end of paving operations for each day unless otherwise directed. The Engineer may suspend production if the Contractor fails to produce and provide haul tickets and yield calculations by the end of paving operations for each day.

Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Do not allow any loose mixture onto the prepared surface before application of the membrane. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of hot-mix by at least 6 in. Place mixture so that longitudinal joints on the surface course coincide within 6-in. of lane lines and are not placed in the wheel path, or as directed, and offset longitudinal joints of successive courses of hot-mix by at least 6-in. Ensure that all finished surfaces will drain properly.

4.7.1. **Weather Conditions.**

4.7.1.1. **When Using a Thermal Imaging System.** The Contractor may pave any time the roadway is dry and the roadway surface temperature is at least 60°F unless otherwise approved or as shown on the plans; however, the Engineer may restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hr. of paving. Place mixtures when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. Provide output data from the thermal imaging system to demonstrate to the Engineer that no recurring severe thermal segregation exists in accordance with Section 3082.4.7.3.1.2., "Thermal Imaging System."

Produce mixture with a target discharge temperature higher than 300°F and with a compaction aid to facilitate compaction when the air temperature is 70°F and falling.

4.7.1.2. **When Not Using a Thermal Imaging System.** When using a thermal camera instead of the thermal imaging system, place mixture when the roadway surface temperature is at or above 70°F unless otherwise approved or as shown on the plans. Measure the roadway surface temperature with a hand-held thermal camera or infrared thermometer. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. The Engineer may restrict the Contractor from paving if the air temperature is 60°F and falling.

Produce mixture with a target discharge temperature higher than 300°F and with a compaction aid to facilitate compaction when the air temperature is 70°F and falling.

4.7.2. **Application of Membrane.** Apply the membrane at the rates in accordance with Table 11 unless otherwise directed. Spray the membrane using a metered mechanical pressure spray bar at a temperature of 140°F to 180°F. Monitor the membrane application rate and make adjustments to the rate when directed. Verify that the spray bar is capable of applying the membrane at a uniform rate across the entire paving width. Apply adequate overlap of the tack coat in the longitudinal direction during placement of the mat to ensure bond of adjacent mats, unless otherwise directed. Unless otherwise directed, avoid tacking the vertical faces of adjacent PFC mats in the longitudinal direction to avoid restricting lateral drainage. Apply tack coat to all transverse joints. Do not let the wheels or other parts of the paving machine contact the freshly applied membrane. Do not dilute the membrane at the terminal, in the field, or at any other location before use. Do not allow any loose mixture onto the prepared surface before application of the membrane.

Table 11
Membrane Application Rate Limits, (Gal. per square yard)

Mix Type	Lift Thickness	Membrane Rate
Permeable Friction Course	1-1/2 in.	0.30–0.33
	1-1/4 in.	0.27–0.30
	1 in.	0.25–0.28
	3/4 in.	0.22–0.25
Thin Bonded Friction Course	3/4 in.	0.17–0.27
	5/8 in.	0.16–0.24
	1/2 in.	0.14–0.20

4.7.2.1. **Non-uniform Application of Membrane.** Stop application if it is not uniform due to streaking, ridging, pooling, or flowing off the roadway surface. Verify equipment condition including plugged nozzles on the spray bar, operating procedures, application temperature, and material properties. Determine and correct the cause of non-uniform application.

4.7.2.2. **Test Strips.** The Engineer may perform independent tests to confirm Contractor compliance and may require testing differences or failing results to be resolved before resuming production.

The Engineer may cease operations and require construction of test strips at the Contractor's expense if any of the following occurs:

- non-uniformity of application continues after corrective action;
- in three consecutive shots, application rate differs by more than 0.03 gal. per square yard from the rate

- directed; or
- any shot differs by more than 0.05 gal. per square yard from the rate directed.

The Engineer will approve the test strip location. The Engineer may require additional test strips until the membrane application meets specification requirements.

- 4.7.3. **Lay-Down Operations.** Use the placement temperature in accordance with Table 12 to establish the minimum placement temperature of the mixture delivered to the paving operation.

Table 12
Min Mixture Placement Temperature

High-Temperature Binder Grade ¹	Min Placement Temperature (Before Entering Paving Operation) ^{2,3}
PG 76	280°F
A-R Binder	280°F

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. The mixture temperature must be measured using a hand-held thermal camera or infrared thermometer nearest to the point of entry of the paving operation.
3. Minimum placement temperatures may be reduced 10°F if using a compaction aid.

- 4.7.3.1. **Thermal Profile.** Use a hand-held thermal camera or a thermal imaging system to obtain a continuous thermal profile in accordance with [Tex-244-F](#). Thermal profiles are not applicable in areas described in Section 3082.4.9.8., "Miscellaneous Areas."

- 4.7.3.1.1. **Thermal Segregation.**

- 4.7.3.1.1.1. **Moderate.** Any areas that have a temperature differential greater than 25°F, but not exceeding 50°F.

- 4.7.3.1.1.2. **Severe.** Any areas that have a temperature differential greater than 50°F.

- 4.7.3.1.2. **Thermal Imaging System.** Review the output results when a thermal imaging system is used, and provide the report described in [Tex-244-F](#) to the Engineer daily unless otherwise directed. Modify the paving process as necessary to eliminate any recurring (moderate or severe) thermal segregation identified by the thermal imaging system.

The Engineer may suspend subsequent paving operations if the Contractor cannot successfully modify the paving process to eliminate recurring severe or moderate thermal segregation.

Provide the Engineer with electronic copies of all daily data files that can be used with the thermal imaging system software to generate temperature profile plots daily or as requested by the Engineer.

- 4.7.3.1.3. **Thermal Camera.** When using the thermal camera instead of the thermal imaging system, take immediate corrective action to eliminate recurring moderate thermal segregation when a hand-held thermal camera is used. Provide the Engineer with the thermal profile of every subplot within one working day of the completion of each lot. When requested by the Engineer, provide the electronic files generated using the thermal camera. Report the results of each thermal profile in accordance with Section 3082.4.2., "Reporting and Responsibilities." The Engineer will use a hand-held thermal camera to obtain a thermal profile at least once per project unless the thermal imaging system is used. Suspend operations and take immediate corrective action to eliminate severe thermal segregation unless otherwise directed. Resume operations when the Engineer determines that subsequent production will meet the requirements of this Section.

- 4.7.3.2. **Hauling Equipment.** Use live bottom or end dump trucks to haul and transfer mixture; however, with exception of paving miscellaneous areas, end dump trucks are only allowed when used in conjunction with an MTD with remixing capability or when a thermal imaging system is used unless otherwise allowed.

- 4.7.3.3. **Screed Heaters.** Turn off screed heaters to prevent overheating of the mat if the paver stops for more than 5 min. The Engineer may evaluate the suspect area in accordance with Section 3082.4.9.9., "Recovered

Asphalt Dynamic Shear Rheometer (DSR),” if the screed heater remains on for more than 5 min. while the paver is stopped.

- 4.8. **Compaction.** Roll the freshly placed mixture with as many steel-wheeled rollers as necessary, operated in static mode, to seat the mixture without excessive breakage of the aggregate and to provide a smooth surface and uniform texture. Do not use pneumatic rollers. Use the control strip method given in [Tex-207-F](#), Part IV, to establish the rolling pattern. Moisten the roller drums thoroughly with a soap and water solution to prevent adhesion. Use only water or an approved release agent on rollers, tamps, and other compaction equipment unless otherwise directed.

For PFC mixtures, use [Tex-246-F](#) to test and verify that the compacted mixture has adequate permeability. Measure the water flow once per subplot at locations directed by the Engineer. The water flow rate should be less than 20 sec. Investigate the cause of the water flow rate test failures and take corrective actions during production and placement to ensure the water flow rate is less than 20 sec. Suspend production if two consecutive water flow rate tests fail unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

Complete all compaction operations before the pavement temperature drops below 180°F unless otherwise allowed. The Engineer may allow compaction with a light finish roller operated in static mode for pavement temperatures below 180°F.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic unless otherwise directed. Sprinkle the finished mat with water or limewater, when directed, to expedite opening the roadway to traffic.

- 4.9. **Acceptance Plan.** Sample and test the hot-mix on a lot and subplot basis.
- 4.9.1. **Referee Testing.** The Materials and Tests Division is the referee laboratory. The Contractor may request referee testing if the differences between Contractor and Engineer test results exceed the operational tolerances in accordance with Table 9 and the differences cannot be resolved. The Contractor may also request referee testing if the Engineer’s test results require suspension of production and the Contractor’s test results are within specification limits. Make the request within five working days after receiving test results and cores from the Engineer. Referee tests will be performed only on the subplot in question and only for the particular tests in question. Allow 10 working days from the time the referee laboratory receives the samples for test results to be reported. The Department may require the Contractor to reimburse the Department for referee tests if more than three referee tests per project are required and the Engineer’s test results are closer to the referee test results than the Contractor’s test results.
- 4.9.2. **Production Acceptance.**
- 4.9.2.1. **Production Lot.** A production lot consists of four equal sublots. The default quantity for Lot 1 is 1,000 ton; however, when requested by the Contractor, the Engineer may increase the quantity for Lot 1 to no more than 2,000 ton. The Engineer will select subsequent lot sizes based on the anticipated daily production such that approximately three to four sublots are produced each day. The lot size will be between 1,000 ton and 4,000 ton. The Engineer may change the lot size before the Contractor begins any lot.
- 4.9.2.1.1. **Incomplete Production Lots.** If a lot is begun but cannot be completed, such as on the last day of production or in other circumstances deemed appropriate, the Engineer may close the lot. Close all lots within five working days unless otherwise allowed.
- 4.9.2.2. **Production Sampling.**
- 4.9.2.2.1. **Mixture Sampling.** Obtain hot-mix samples from trucks at the plant in accordance with [Tex-222-F](#). The sampler will split each sample into three equal portions in accordance with [Tex-200-F](#) and label these portions as “Contractor,” “Engineer,” and “Referee.” The Engineer will perform or witness the sample splitting and take immediate possession of the samples labeled “Engineer” and “Referee.” The Engineer will maintain the custody of the samples labeled “Engineer” and “Referee” until the Department’s testing is completed.

- 4.9.2.2.1.1. **Random Sample.** At the beginning of the project, the Engineer will select random numbers for all production sublots. Determine sample locations in accordance with [Tex-225-F](#). Take one sample for each subplot at the randomly selected location. The Engineer will perform or witness the sampling of production sublots.
- 4.9.2.2.1.2. **Blind Sample.** For one subplot per lot, the Engineer will obtain and test a “blind” sample instead of the random sample collected by the Contractor. Test either the “blind” or the random sample; however, referee testing (if applicable) will be based on a comparison of results from the “blind” sample. The location of the Engineer’s “blind” sample will not be disclosed to the Contractor. The Engineer’s “blind” sample may be randomly selected in accordance with [Tex-225-F](#) for any subplot or selected at the discretion of the Engineer. The Engineer will use the Contractor’s split sample for sublots not sampled by the Engineer.
- 4.9.2.2.2. **Informational Hamburg and Overlay Testing.** Select one random subplot from Lot 2 or higher for Hamburg and Overlay testing during the first week of production. Obtain and provide the Engineer with approximately 90 lb. of mixture, sampled in accordance with [Tex-222-F](#), in sealed containers, boxes, or bags labeled with the Control-Section-Job (CSJ), mixture type, lot, and subplot number. The Engineer will ship the mixture to the Materials and Tests Division for Hamburg and Overlay testing. Results from these tests will not be used for specification compliance.
- 4.9.2.2.3. **Asphalt Binder Sampling.** Obtain a 1-qt. (1 gal. for A-R binder) sample of the asphalt binder witness by the Engineer for each lot of mixture produced. The Contractor will notify the Engineer when the sampling will occur. Obtain the sample at approximately the same time the mixture random sample is obtained. Sample from a port located immediately upstream from the mixing drum or pug mill and upstream from the introduction of any additives in accordance with [Tex-500-C](#), Part II. Label the can with the corresponding lot and subplot numbers, producer, producer facility, grade, district, date sampled, and project information including highway and CSJ. The Engineer will retain these samples for one year. The Engineer may also obtain independent samples. If obtaining an independent asphalt binder sample and upon request of the Contractor, the Engineer will split a sample of the asphalt binder with the Contractor.

At least once per project, the Engineer will collect split samples of each binder grade and source used. The Engineer will submit one split sample to the Materials and Tests Division to verify compliance with Item 300, “Asphalts, Oils, and Emulsions” and will retain the other split sample for 1 yr.

- 4.9.2.3. **Membrane Sampling.** The Engineer will obtain a 1-qt. sample of the polymer modified emulsion for each lot of mixture produced in accordance with [Tex-500-C](#), Part III. The Engineer will notify the Contractor when the sampling will occur and will witness the collection of the sample. Obtain the sample at approximately the same time the mixture random sample is obtained. Label the can with the corresponding lot and subplot numbers, producer, producer facility, grade, district, date sampled, and project information including highway and CSJ. The Engineer will retain these samples for two months.

At least once per project, the Engineer will collect split samples of the polymer modified emulsion. The Engineer will submit one split sample to the Materials and Tests Division to verify compliance with Item 300, “Asphalts, Oils, and Emulsions” and will retain the other split sample for two months. The Engineer may test as often as necessary to ensure the residual of the emulsion is greater than or equal to the specification requirement in Item 300, “Asphalts, Oils, and Emulsions.”

- 4.9.2. **Production Testing.** The Contractor and Engineer must perform production tests in accordance with Table 13. The Contractor has the option to verify the Engineer’s test results on split samples provided by the Engineer. Determine compliance with operational tolerances in accordance with Table 9 for all sublots.

At any time during production, the Engineer may require the Contractor to verify the following based on quantities used:

- lime content (within $\pm 0.1\%$ of JMF), when PG binder is specified;
- fiber content (within $\pm 0.03\%$ of JMF), when PG binder is specified; and
- CRM content (within $\pm 1.5\%$ of JMF), when A-R binder is specified.

Maintain the in-line measuring device when A-R binder is specified to verify the A-R binder viscosity between

2,500 and 4,000 centipoise at 350°F unless otherwise approved. Record A-R binder viscosity at least once per hour and provide the Engineer with a daily summary unless otherwise directed.

If the aggregate mineralogy is such that [Tex-236-F](#) Part I does not yield reliable results, the Engineer may allow alternate methods for determining the asphalt content and aggregate gradation. The Engineer will require the Contractor to provide evidence that results from [Tex-236-F](#), Part I are not reliable before permitting an alternate method unless otherwise allowed. Use the applicable test procedure as directed if an alternate test method is allowed.

Table 13
Production and Placement Testing Frequency

Description	Test Method	Min Contractor Testing Frequency	Min Engineer Testing Frequency
Individual % retained for sieve sized larger than #200	Tex-200-F	1 per subplot	1 per 12 sublots
% passing the #200 sieve			
Laboratory-molded density, %	Tex-207-E , Part VIII	1 per subplot	1 per lot
Asphalt binder content ¹ , %	Tex-236-F , Part I ²	1 per subplot	1 per lot
Drain-down, %	Tex-235-F	1 per subplot	1 per 12 sublots
Boil test ³	Tex-530-C	1 per project	1 per project
Membrane application rate	Tex-247-F	1 per lot	1 per 12 sublots
Moisture content	Tex-212-F , Part II	When directed	1 per project
Cantabro loss, %	Tex-245-F	1 per project (sample only)	1 per project
Overlay test	Tex-248-F	1 per project (sample only) ¹⁰	1 per project ⁴
Hamburg Wheel test	Tex-242-F	1 per project (sample only) ¹⁰	1 per project ⁴
Water flow test ⁵	Tex-246-F	1 per subplot	1 per project
Asphalt binder sampling	Tex-500-C , Part II	1 per lot (sample only) ⁶	1 per project
Membrane sampling and testing	Tex-500-C , Part III	N/A	1 per project
Thermal profile	Tex-244-F	1 per subplot ^{7,8,9}	1 per project ⁸

1. May be obtained from asphalt mass flow meter readouts as determined by the Engineer.
2. Ensure the binder content determination excludes fibers.
3. When shown on the plans.
4. When required according to mixture type and requirements in accordance with Table 8.
5. Only required for PFC mixtures.
6. Obtain samples witness by the Engineer. The Engineer will retain these samples for 1 yr.
7. To be performed in the presence of the Engineer when using the thermal camera, unless otherwise approved.
8. Not required when a thermal imaging system is used.
9. When using the thermal imaging system, the test report must include the temperature measurements taken in accordance with [Tex-244-F](#).
10. Testing performed by the Materials and Tests Division for informational purposes only.

4.9.3.

Operational Tolerances. Control the production process within the operational tolerances in accordance with Table 9. Suspend production and placement operations when production or placement test results exceed the tolerances in accordance with Table 9 unless otherwise allowed. The Engineer will allow suspended production to resume when test results or other information indicates the next mixture produced will be within the operational tolerances.

- 4.9.4. **Individual Loads of Hot-Mix.** The Engineer can reject individual truckloads of hot-mix. When a load of hot-mix is rejected for reasons other than temperature, contamination, or excessive uncoated particles, the Contractor may request that the rejected load be tested. Make this request within 4 hr. of rejection. The Engineer will sample and test the mixture. If test results are within the operational tolerances in accordance with Table 9, payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load.
- 4.9.5. **Placement Acceptance.**
- 4.9.6. **Placement Lot.** A placement lot consists of four placement sublots. A placement subplot consists of the area placed during a production subplot.
- 4.9.7. **Miscellaneous Areas.** Miscellaneous areas include areas that typically involve significant handwork or discontinuous paving operations such as driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. The specified layer thickness is based on the rate of 90 lb. per square yard for each inch of pavement unless another rate is shown on the plans. Miscellaneous areas are not subject to thermal profiles testing.
- 4.9.8. **Recovered Asphalt Dynamic Shear Rheometer (DSR).** The Engineer may take production samples or cores from suspect areas of the project to determine recovered asphalt properties. Asphalt binders with an aging ratio greater than 3.5 do not meet the requirements for recovered asphalt properties and may be deemed defective when tested and evaluated by the Materials and Tests Division. The aging ratio is the DSR value of the extracted binder divided by the DSR value of the original unaged binder. Obtain DSR values in accordance with AASHTO T 315 at the specified high temperature performance grade of the asphalt. The Engineer may require removal and replacement of the defective material at the Contractor's expense. The asphalt binder will be recovered for testing from production samples or cores in accordance with [Tex-211-F](#).
- 4.9.9. **Irregularities.** Identify and correct irregularities including segregation, rutting, raveling, flushing, fat spots, mat slippage, irregular color, irregular texture, roller marks, tears, gouges, streaks, uncoated aggregate particles, or broken aggregate particles. The Engineer may also identify irregularities, and in such cases, the Engineer will promptly notify the Contractor. If the Engineer determines that the irregularity will adversely affect pavement performance, the Engineer may require the Contractor to remove and replace (at the Contractor's expense) areas of the pavement that contain irregularities. The Engineer may also require the Contractor to remove and replace (at the Contractor's expense) areas where the mixture does not bond to the existing pavement.
- If irregularities are detected, the Engineer may require the Contractor to immediately suspend operations or may allow the Contractor to continue operations for no more than one day while the Contractor is taking appropriate corrective action.
- 4.9.10. **Exempt Production.** When the anticipated daily production is less than 100 ton, all QC and QA sampling and testing are waived. The Engineer may deem the mixture as exempt production for the following conditions:
- anticipated daily production is more than 100 ton but less than 250 ton;
 - total production for the project is less than 2,500 ton;
 - when mutually agreed between the Engineer and the Contractor; or
 - when shown on the plans.
- For exempt production, the Contractor is relieved of all production and placement sampling and testing requirements. All other specification requirements apply, and the Engineer will perform acceptance tests for production and placement in accordance with Table 13.
- For exempt production:
- produce, haul, place, and compact the mixture as directed by the Engineer; and
 - control mixture production to yield a laboratory-molded density that is within $\pm 1.0\%$ of the target density as tested by the Engineer.

- 4.9.11. **Ride Quality.** Measure ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

5. MEASUREMENT

- 5.1. **PFC Hot-Mix Asphalt.** Permeable friction course (PFC) hot-mix will be measured by the ton of composite mixture, which includes asphalt, aggregate, and additives. Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment."
- 5.2. **TBFC Hot-Mix Asphalt.** Thin bonded friction course (TBFC) hot-mix will be measured by the ton of composite mixture, which includes asphalt, aggregate, and additives. Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment."
- 5.3. **Membrane.** Membrane material will be measured by volume. Membrane material will be measured at the applied temperature by strapping the tank before and after road application and determining the net volume in gallons from the distributor's calibrated strap stick. The Engineer will witness all operations for volume determination. All membrane will be measured by the gallon applied, in the accepted membrane.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under Section 3082.5.1., "PFC Hot-Mix Asphalt," will be paid for at the unit bid price for "Permeable friction course" of the mixture type, SAC, and binder specified. These prices are full compensation for surface preparation, removing pavement marking and markers, materials, placement, equipment, labor, tools, and incidentals.

The work performed and materials furnished in accordance with this Item and measured as provided under Section 3082.5.2., "TBFC Hot-Mix Asphalt," will be paid for at the unit bid price for "Thin bonded friction course" of the mixture type, SAC, and binder specified. These prices are full compensation for surface preparation, removing pavement marking and markers, materials, placement, equipment, labor, tools, and incidentals.

The work performed and materials furnished in accordance with this Item and measured as provided under Section 3082.5.3., "Membrane," will be paid for at the unit bid price for "Membrane" of the membrane material provided. These prices are full compensation for materials, placement, equipment, labor, tools, and incidentals.

Trial batches will not be paid for unless they are included in pavement work approved by the Department.

Payment adjustment for ride quality will be determined in accordance with Item 585, "Ride Quality for Pavement Surfaces."

Special Specification 3096

Asphalts, Oils, and Emulsions



1. DESCRIPTION

Provide asphalt cements, cutback and emulsified asphalts, performance-graded asphalt binders, and other miscellaneous asphalt materials as specified on the plans.

2. MATERIALS

Provide asphalt materials that meet the stated requirements when tested in conformance with the referenced Department, AASHTO, and ASTM test methods. Use asphalt containing recycled materials only if the recycled components meet the requirements of Article 6.9., "Recycled Materials." Provide asphalt materials that the Department has preapproved for use in accordance with [Tex-545-C](#), "Asphalt Binder Quality Program."

Inform the Department of all additives or modifiers included in the asphalt binder as part of the facility quality plan, as required by [Tex-545-C](#), "Asphalt Binder Quality Program," and provide that information to Department personnel. The Department reserves the right to prohibit the use of any asphalt additive or modifier.

Limit the use of polyphosphoric acid to no more than 0.5% by weight of the asphalt binder.

The use of re-refined engine oil bottoms is prohibited.

Acronyms used in this Item are defined in Table 1.

Table 1
Acronyms

Acronym	Definition
Test Procedure Designations	
Tex T or R D	Department AASHTO ASTM
Polymer Modifier Designations	
P	polymer-modified
SBR or L	styrene-butadiene rubber (latex)
SBS	styrene-butadiene-styrene block co-polymer
TR	tire rubber (from ambient temperature grinding of truck and passenger tires)
AC	asphalt cement
AE	asphalt emulsion
AE-P	asphalt emulsion prime
A-R	asphalt-rubber
C	cationic
EAP&T	emulsified asphalt prime and tack
EBL	emulsified bonding layer
FDR	full depth reclamation
H-suffix	harder residue (lower penetration)
HF	high float
HY	high yield
MC	medium-curing
MS	medium-setting
PCE	prime, cure, and erosion control
PG	performance grade
RC	rapid-curing
RS	rapid-setting
S-suffix	stockpile usage
SCM	special cutback material
SS	slow-setting
SY	standard yield
TRAIL	tracking resistant asphalt interlayer

2.1.

Asphalt Cement. Provide asphalt cement that is homogeneous, water-free, and nonfoaming when heated to 347°F, and meets the requirements in Table 2.

Table 2
Asphalt Cement

Property	Test Procedure	Viscosity Grade									
		AC-0.6		AC-1.5		AC-3		AC-5		AC-10	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity 140°F, poise 275°F, poise	T 202	40	80	100	200	250	350	400	600	800	1,200
		0.4	–	0.7	–	1.1	–	1.4	–	1.9	–
Penetration, 77°F, 100g, 5 sec.	T 49	350	–	250	–	210	–	135	–	85	–
Flash point, C.O.C., °F	T 48	425	–	425	–	425	–	425	–	450	–
Solubility in trichloroethylene, %	T 44	99.0	–	99.0	–	99.0	–	99.0	–	99.0	–
Spot test	Tex-509-C	Neg.		Neg.		Neg.		Neg.		Neg.	
Tests on residue from RTFOT:											
Viscosity, 140°F, poise	T 240										
Ductility, ¹ 77°F	T 202	–	180	–	450	–	900	–	1,500	–	3,000
5 cm/min., cm	T 51	100	–	100	–	100	–	100	–	100	–

1. If AC-0.6 or AC-1.5 ductility at 77°F is less than 100 cm, material is acceptable if ductility at 60°F is more than 100 cm.

- 2.2. **Polymer-Modified Asphalt Cement.** Provide polymer-modified asphalt cement that is smooth, homogeneous, and meets the requirements Table 3. Supply samples of the base asphalt cement and polymer additives if requested.

Table 3
Polymer-Modified Asphalt Cement

Property	Test Procedure	Polymer-Modified Viscosity Grade											
		AC-12-5TR		NT-HA ¹		AC-15P		AC-20XP		AC-10-2TR		AC-20-5TR	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Polymer		TR		-		SBS		SBS		TR		TR	
Polymer content, % (solids basis)	Tex-533-C or Tex-553-C	5.0	-	-	-	3.0	-	-	-	2.0	-	5.0	-
Dynamic shear, G*/sinδ, 82°C, 10 rad/s, kPa	T 315			1.0	-								
Dynamic shear, G*/sinδ, 64°C, 10 rad/s, kPa	T 315	-	-	-	-	-	-	1.0	-	-	-	1.0	-
Dynamic shear, G*/sinδ, 58°C, 10 rad/s, kPa	T 315	1.0	-	-	-	-	-	-	-	1.0	-	-	-
Viscosity 140°F, poise	T 202	1,200	-			1,500	-	2,000	-	1,000	-	2,000	-
275°F, poise	T 202			-	4,000	-	8.0	-	-	-	8.0	-	10.0
Penetration, 77°F, 100 g, 5 sec.	T 49	110	150	-	25	100	150	75	115	95	130	75	115
Ductility, 5cm/min., 39.2°F, cm	T 51					-	-	-	-	-	-	-	-
Elastic recovery, 50°F, %	Tex-539-C	55	-			55	-	55	-	30	-	55	-
Softening point, °F	T 53	113	-	170	-	-	-	120	-	110	-	120	-
Polymer separation, 5 hr.	Tex-540-C	None				None		None		None		None	
Flash point, C.O.C., °F	T 48	425	-	425	-	425	-	425	-	425	-	425	-
Tests on residue from RTFOT aging and pressure aging:	T 240 and R 28												
Creep stiffness S, -18°C, MPa	T 313	-	300	-	-	-	300	-	300	-	300	-	300
m-value, -18°C		0.300	-	-	-	0.300	-	0.300	-	0.300	-	0.300	-

1. Non-Tracking Hot Applied Tack Coat - TRAIL product

- 2.3. **Cutback Asphalt.** Provide cutback asphalt that meets the requirements of Tables 4, 5, and 6, for the specified type and grade. Supply samples of the base asphalt cement and polymer additives if requested.

Table 4
Rapid-Curing Cutback Asphalt

Property	Test Procedure	Type-Grade					
		RC-250		RC-800		RC-3000	
		Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	250	400	800	1,600	3,000	6,000
Water, %	D95	–	0.2	–	0.2	–	0.2
Flash point, T.O.C., °F	T 79	80	–	80	–	80	–
Distillation test:	T 78						
Distillate, percentage by volume of total distillate to 680°F							
to 437°F		40	75	35	70	20	55
to 500°F		65	90	55	85	45	75
to 600°F		85	–	80	–	70	–
Residue from distillation, volume %		70	–	75	–	82	–
Tests on distillation residue:							
Viscosity, 140°F, poise	T 202	600	2,400	600	2,400	600	2,400
Ductility, 5 cm/min., 77°F, cm	T 51	100	–	100	–	100	–
Solubility in trichloroethylene, %	T 44	99.0	–	99.0	–	99.0	–
Spot test	Tex-509-C	Neg.		Neg.		Neg.	

Table 5
Medium-Curing Cutback Asphalt

Property	Test Procedure	Type-Grade							
		MC-30		MC-250		MC-800		MC-3000	
		Min	Max	Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	30	60	250	500	800	1,600	3,000	6,000
Water, %	D95	–	0.2	–	0.2	–	0.2	–	0.2
Flash point, T.O.C., °F	T 79	95	–	122	–	140	–	149	–
Distillation test:	T 78								
Distillate, percentage by volume of total distillate to 680°F									
to 437°F		–	35	–	20	–	–	–	–
to 500°F		30	75	5	55	–	40	–	15
to 600°F		75	95	60	90	45	85	15	75
Residue from distillation, volume %		50	–	67	–	75	–	80	–
Tests on distillation residue:									
Viscosity, 140°F, poise	T 202	300	1,200	300	1,200	300	1,200	300	1,200
Ductility, 5 cm/min., 77°F, cm	T 51	100	–	100	–	100	–	100	–
Solubility in trichloroethylene, %	T 44	99.0	–	99.0	–	99.0	–	99.0	–
Spot test	Tex-509-C	Neg.		Neg.		Neg.		Neg.	

Table 6
Special-Use Cutback Asphalt

Property	Test Procedure	Type-Grade					
		MC-2400L		SCM I		SCM II	
		Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	2,400	4,800	500	1,000	1,000	2,000
Water, %	D95	–	0.2	–	0.2	–	0.2
Flash point, T.O.C., °F	T 79	150	–	175	–	175	–
Distillation test:	T 78						
Distillate, percentage by volume of total distillate to 680°F							
to 437°F		–	–	–	–	–	–
to 500°F		–	35	–	0.5	–	0.5
to 600°F		35	80	20	60	15	50
Residue from distillation, volume %		78	–	76	–	82	–
Tests on distillation residue:							
Polymer		SBR		–		–	
Polymer content, % (solids basis)	Tex-533-C	2.0	–	–	–	–	–
Penetration, 100 g, 5 sec., 77°F	T 49	150	300	180	–	180	–
Ductility, 5 cm/min., 39.2°F, cm	T 51	50	–	–	–	–	–
Solubility in trichloroethylene, %	T 44	99.0	–	99.0	–	99.0	–

- 2.4. **Emulsified Asphalt.** Provide emulsified asphalt that is homogeneous, does not separate after thorough mixing, and meets the requirements for the specified type and grade in Tables 7, 8, 9, 10, and 10A-C.

Table 7
Emulsified Asphalt

Property	Test Procedure	Type-Grade									
		Rapid-Setting		Medium-Setting				Slow-Setting			
		HFRS-2		MS-2		AES-300		SS-1		SS-1H	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec. 122°F, sec.	T 72	-	-	-	-	75	400	20	100	20	100
		150	400	100	300	-	-	-	-	-	-
Sieve test, %	T 59	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1
Miscibility	T 59	-		-		-		Pass		Pass	
Cement mixing, %	T 59	-	-	-	-	-	-	-	2.0	-	2.0
Coating ability and water resistance: Dry aggregate/after spray Wet aggregate/after spray	T 59	-		-		Good/Fair Fair/Fair		-		-	
		-	-	-	-	-	-	-	-	-	-
Demulsibility, 35 mL of 0.02 N CaCl ₂ , %	T 59	50	-	-	30	-	-	-	-	-	-
Storage stability, 1 day, %	T 59	-	1	-	1	-	1	-	1	-	1
Freezing test, 3 cycles ¹	T 59	-		Pass		-		Pass		Pass	
Distillation test: Residue by distillation, % by wt. Oil distillate, % by volume of emulsion	T 59	65	-	65	-	65	-	60	-	60	-
		-	0.5	-	0.5	-	5	-	0.5	-	0.5
Tests on residue from distillation: Penetration, 77°F, 100 g, 5 sec. Solubility in trichloroethylene, % Ductility, 77°F, 5 cm/min., cm Floot test, 140°F, sec.	T 49	100	140	120	160	300	-	120	160	70	100
	T 44	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-
	T 51	100	-	100	-	-	-	100	-	80	-
	T 50	1,200	-	-	-	1,200	-	-	-	-	-

1. Applies only when the Engineer designates material for winter use.

Table 8
Cationic Emulsified Asphalt

Property	Test Procedure	Type-Grade											
		Rapid-Setting		Medium-Setting				Slow-Setting					
		CRS-2		CRS-2H		CMS-2		CMS-2S		CSS-1		CSS-1H	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec. 122°F, sec.	T 72	-	-	-	-	-	-	-	-	20	100	20	100
		150	400	150	400	100	300	100	300	-	-	-	-
Sieve test, %	T 59	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1
Cement mixing, %	T 59	-	-	-	-	-	-	-	-	-	2.0	-	2.0
Coating ability and water resistance: Dry aggregate/after spray Wet aggregate/after spray	T 59	-		-		Good/Fair Fair/Fair		Good/Fair Fair/Fair		-		-	
		-	-	-	-	-	-	-	-	-	-	-	-
Demulsibility, 35 mL of 0.8% Sodium dioctyl sulfosuccinate, %	T 59	70	-	70	-	-	-	-	-	-	-	-	-
Storage stability, 1 day, %	T 59	-	1	-	1	-	1	-	1	-	1	-	1
Particle charge	T 59	Positive		Positive		Positive		Positive		Positive		Positive	
Distillation test: Residue by distillation, % by wt. Oil distillate, % by volume of emulsion	T 59	65	-	65	-	65	-	65	-	60	-	60	-
		-	0.5	-	0.5	-	7	-	5	-	0.5	-	0.5
Tests on residue from distillation: Penetration, 77°F, 100 g, 5 sec. Solubility in trichloroethylene, % Ductility, 77°F, 5 cm/min., cm	T 49	120	160	70	110	120	200	300	-	120	160	70	110
	T 44	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-
	T 51	100	-	80	-	100	-	-	-	100	-	80	-

Table 9
Polymer-Modified Emulsified Asphalt

Property	Test Procedure	Type-Grade									
		Rapid-Setting		Medium-Setting				Slow-Setting			
		HFRS-2P		AES-150P		AES-300P		AES-300S		SS-1P	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furoil 77°F, sec. 122°F, sec.	T 72	-	-	75	400	75	400	75	400	30	100
Sieve test, %	T 59	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1
Miscibility	T 59	-	-	-	-	-	-	-	-	-	Pass
Coating ability and water resistance: Dry aggregate/after spray Wet aggregate/after spray	T 59	-	-	Good/Fair Fair/Fair	-	Good/Fair Fair/Fair	-	Good/Fair Fair/Fair	-	-	-
Demulsibility, 35 mL of 0.02 N CaCl ₂ , %	T 59	50	-	-	-	-	-	-	-	-	-
Storage stability, 1 day, %	T 59	-	1	-	1	-	1	-	1	-	1
Breaking index, g	Tex-542-C	-	-	-	-	-	-	-	-	-	-
Distillation test: ¹ Residue by distillation, % by wt. Oil distillate, % by volume of emulsion	T 59	65	-	65	-	65	-	65	-	60	-
		-	0.5	-	3	-	5	-	7	-	0.5
Tests on residue from distillation: Polymer content, wt. % (solids basis)	Tex-533-C	3.0	-	-	-	-	-	-	-	3.0	-
Penetration, 77°F, 100 g, 5 sec.	T 49	90	140	150	300	300	-	300	-	100	140
Solubility in trichloroethylene, %	T 44	97.0	-	97.0	-	97.0	-	97.0	-	97.0	-
Viscosity, 140°F, poise	T 202	1,500	-	-	-	-	-	-	-	1,300	-
Float test, 140°F, sec	T 50	1,200	-	1,200	-	1,200	-	1,200	-	-	-
Ductility, ² 39.2°F, 5 cm/min., cm	T 51	50	-	-	-	-	-	-	-	50	-
Elastic recovery, 250°F, %	Tex-539-C	55	-	-	-	-	-	-	-	-	-
Tests on RTFO curing of distillation residue Elastic recovery, 50°F, %	T 240 Tex-536-C	-	-	50	-	50	-	30	-	-	-

1. Exception to T 59: Bring the temperature on the lower thermometer slowly to 350°F ±10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 min. (±5 min.) from the first application of heat.

2. HFRS-2P must meet one of either the ductility or elastic recovery requirements.

Table 10
Polymer-Modified Cationic Emulsified Asphalt

Property	Test Procedure	Type-Grade											
		Rapid-Setting						Medium-Setting				Slow-Setting	
		CRS-2P		CHFRS-2P		CRS-2TR		CMS-1P ³		CMS-2P ³		CSS 1P	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec. 122°F, sec.	T 72	-	-	-	-	-	-	10	100	-	-	20	100
		150	400	100	400	150	500	-	-	50	400	-	-
Sieve test, %	T 59	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1
Demulsibility, 35 ml of 0.8% sodium dioctyl sulfosuccinate, %	T 59	70	-	60	-	40	-	-	-	-	-	-	-
Storage stability, 1 day, %	T 59	-	1	-	1	-	1	-	1	-	1	-	1
Breaking index, g	Tex-542-C	-	-	-	-	-	-	-	-	-	-	-	-
Particle charge	T 59	Positive		Positive		Positive		Positive		Positive		Positive	
Distillation test ¹ :	T 59												
Residue by distillation, % by weight		65	-	65	-	65	-	30	-	60	-	62	-
Oil distillate, % by volume of emulsion		-	0.5	-	0.5	-	3	-	0.5	-	0.5	-	0.5
Tests on residue from distillation:													
Polymer content, wt. % (solids basis)	Tex-533-C	3.0	-	3.0	-	5.0 ⁷	-	-	-	-	-	3.0	-
Penetration, 77°F, 100 g, 5 sec.	T 49	90	150	80	130	90	150	30	-	30	-	55	90
Viscosity, 140°F, poise	T 202	1,300	-	1,300	-	1,000	-	-	-	-	-	-	-
Solubility in trichloroethylene, %	T 44	97.0	-	95.0	-	98	-	-	-	-	-	97.0	-
Softening point, °F	T 53	-	-	-	-	-	-	-	-	-	-	135	-
Ductility, 77°F, 5 cm/min., cm	T 51	-	-	-	-	40	-	-	-	-	-	70	-
Float test, 140°F, sec.	T 50	-	-	1,800	-	-	-	-	-	-	-	-	-
Ductility, ² 39.2°F, 5 cm/min., cm	T 51	50	-	-	-	-	-	-	-	-	-	-	-
Elastic recovery, ² 50°F, %	Tex-539-C	55	-	55	-	-	-	-	-	-	-	-	-
Tests on residue from evaporative recovery:	R 78, Procedure B												
Nonrecoverable creep compliance of residue, 3.2 kPa, 52°C, kPa ⁻¹	T 350	-	-	-	-	-	-	-	2.0	-	4.0	-	-
Tests on rejuvenating agent:													
Viscosity, 140°F, cSt	T 201	-	-	-	-	-	-	50	175	50	175	-	-
Flash point, C.O.C., °F	T 48	-	-	-	-	-	-	380	-	380	-	-	-
Saturates, % by weight	D 2007	-	-	-	-	-	-	-	30	-	30	-	-
Solubility in n-pentane, % by weight	D 2007	-	-	-	-	-	-	99	-	99	-	-	-
Tests on rejuvenating agent after RTFO	T 240												
Weight Change, %		-	-	-	-	-	-	-	6.5	-	6.5	-	-
Viscosity Ratio		-	-	-	-	-	-	-	3.0	-	3.0	-	-
Tests on latex ⁴ :													
Tensile strength, die C dumbbell, psi	D 412 ⁵	-	-	-	-	-	-	800	-	800	-	-	-
Change in mass after immersion in rejuvenating agent, %	D 471	-	-	-	-	-	-	-	40 ⁶	-	40 ⁶	-	-

- Exception to T 59: Bring the temperature on the lower thermometer slowly to 350°F (±0°F). Maintain at this temperature for 20 min. Complete total distillation in 60 min. (±5 min.) from the first application of heat.
- CRS-2P must meet one of either the ductility or elastic recovery requirements.
- With all precertification samples of CMS-1P or CMS-2P, submit certified test reports showing that the rejuvenating agent and latex meet the stated requirements. Submit samples of these raw materials if requested by the Engineer.
- Preparation of latex specimens: use any substrate and recovery method which produces specimens of uniform dimensions and which delivers enough material to achieve desired residual thickness.
- Cut samples for tensile strength determination using a crosshead speed of 20 in. per minute.
- Specimen must remain intact after exposure and removal of excess rejuvenating agent.
- Modifier type is tire rubber.

Table 10A
Non-Tracking Tack Coat Emulsion¹

Property	Test Procedure	NT-HRE		NT-RRE		NT-SRE	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77° F, sec.	T 72	15	–	15	–	10	100
Storage stability, 1 Day, %	T 59	–	1	–	1	–	1
Settlement, 5-day, %	T 59	–	5	–	5	–	5
Sieve test, %	T 59	–	0.30	–	0.30	–	0.1
Distillation test: ² Residue by distillation, % by wt. Oil distillate, by volume of emulsion	T 59	50 –	– 1.0	58 –	– 1.0	50 –	– 1.0
Test on residue from distillation: Penetration, 77°F, 100 g, 5 sec.	T 49	–	20	15	45	40	90
Solubility in trichloroethylene, %	T 44	97.5	–	97.5	–	97.5	–
Softening point, °F	T 53	150	–	–	–	–	–
Dynamic shear, G*/sin(δ), 82°C, 10 rad/s, kPa	T 315	1.0	–	–	–	–	–

1. Due to the hardness of the residue, these emulsions should be heated to 120-140°F before thoroughly mixing as the emulsion is being prepared for testing.
2. Exception to T 59: Bring the temperature on the lower thermometer slowly to 350°F ± 10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 ± 5 min. from first application of heat.

Table 10B
Spray Applied Underseal Membrane Polymer-Modified Emulsions (EBL)

Property	Test Procedure	Min	Max
Viscosity @ 77°F, SSF	T 72	20	100
Storage Stability ¹ , %	T 59	–	1
Demulsibility ² Anionic emulsions – 35 mL of 0.02 N CaCl ₂ , % Cationic emulsions – 35 mL of 0.8% sodium dioctyl sulfosuccinate, %	T 59	55	–
Sieve Test ³ , %	T 59	–	0.05
Distillation Test ⁴ Residue by distillation, % by wt. Oil portion of distillate, % by vol.	T 59	63	0.5
Test on Residue from Distillation			
Elastic Recovery @ 50°F, 50 mm/min., %	Tex-539-C	60	–
Penetration @ 77°F, 100 g, 5 sec., 0.1 mm	T 49	80	130

1. After standing undisturbed for 24 hr., the surface must be smooth, must not exhibit a white or milky colored substance, and must be a homogeneous color throughout.
2. Material must meet demulsibility test for emulsions.
3. May be required by the Engineer only when the emulsion cannot be easily applied in the field.
4. The temperature on the lower thermometer should be brought slowly to 350°F ± 10°F and maintained at this temperature for 20 min. The total distillation should be completed in 60 ± 5 min. from the first application of heat.

Table 10C
Full-Depth Reclamation Emulsion (FDR EM)

Property	Test Procedure	Standard Yield (SY)		High Yield (HY)	
		Min	Max	Min	Max
Sieve test, %	T 59	–	0.1	–	0.1
Viscosity Saybolt Furol @ 77°F, sec.	T 59	20	100	20	100
Distillation test ¹ : Residue by distillation, % by wt. Oil portion of distillate, % by vol.	T 59	60 –	– 0.5	63 –	– 0.5
Test on residue from distillation: Penetration @ 77°F, dmm	T 49	55	95	120	–
Test on rejuvenating agent:					
BWOA, % ²	***	–	–	2	–
Viscosity @ 140°F, cSt	T 201	–	–	50	175
Flash Point, COC, °F	T 48	–	–	380	–
Solubility in n-pentane, % by wt.	D2007	–	–	99	–

1. The temperature on the lower thermometer should be brought slowly to 350°F ± 10°F and maintained at this temperature for 20 min. The total distillation should be completed in 60 ± 5 min. from the first application of heat.
2. BWOA = By weight of asphalt. Provide a manufacturer's certificate of analysis (COA) with the percent of rejuvenator added.

2.5.

Specialty Emulsions. Provide specialty emulsion that is either asphalt-based or resin-based and meets the requirements of Table 11 or Table 11A.

Table 11
Specialty Emulsions

Property	Test Procedure	Type-Grade					
		Medium-Setting				Slow-Setting	
		AE-P		EAP&T		PCE ¹	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec. 122°F, sec.	T 72	–	–	–	–	10	100
Sieve test, %	T 59	–	0.1	–	0.1	–	0.1
Miscibility ²	T 59	–	–	Pass	–	Pass	–
Demulsibility, 35 mL of 0.10 N CaCl ₂ , %	T 59	–	70	–	–	–	–
Storage stability, 1 day, %	T 59	–	1	–	1	–	–
Particle size, ⁵ % by volume < 2.5 μm	Tex-238-F³	–	–	90	–	90	–
Asphalt emulsion distillation to 500°F followed by Cutback asphalt distillation of residue to 680°F: Residue after both distillations, % by wt. Total oil distillate from both distillations, % by volume of emulsion	T 59 & T 78	40	–	–	–	–	–
		25	40	–	–	–	–
Residue by distillation, % by wt.	T 59	–	–	60	–	–	–
Residue by evaporation, ⁴ % by wt.	T 59	–	–	–	–	60	–
Tests on residue after all distillations:							
Viscosity, 140°F, poise	T 202	–	–	800	–	–	–
Kinematic viscosity, ⁵ 140°F, cSt	T 201	–	–	–	–	100	350
Flash point C.O.C., °F	T 48	–	–	–	–	400	–
Solubility in trichloroethylene, %	T 44	97.5	–	–	–	–	–
Float test, 122°F, sec.	T 50	50	200	–	–	–	–

1. Supply with each shipment of PCE:

- a copy of a lab report from an approved analytical lab, signed by a lab official, indicating the PCE formulation does not meet any characteristics of a Resource Conservation Recovery Act (RCRA) hazardous waste;
- a certification from the producer that the formulation supplied does not differ from the one tested and that no listed RCRA hazardous wastes or Polychlorinated Biphenyls (PCBs) have been mixed with the product; and
- a Safety Data Sheet.

2. Exception to T 59: In dilution, use 350 mL of distilled or deionized water and a 1,000-mL beaker.
3. Use [Tex-238-F](#), beginning at "Particle Size Analysis by Laser Diffraction," with distilled or deionized water as a medium and no dispersant, or use another approved method.
4. Exception to T 59: Leave sample in the oven until foaming ceases, then cool and weigh.
5. PCE must meet either the kinematic viscosity requirement or the particle size requirement.

Table 11A
Hard Residue Surface Sealant

Property	Test Procedure	Min	Max
Viscosity, Krebs unit, 77°F, Krebs units	D 562	45	75
Softening point, °F	Tex-505-C ¹	250	–
Uniformity	D 2939	Pass ²	
Resistance to heat	D 2939	Pass ³	
Resistance to water	D 2939	Pass ⁴	
Wet flow, mm	D 2939	–	0
Resistance to Kerosene (optional) ⁵	D 2939	Pass ⁶	
Ultraviolet exposure, UVA-340, 0.77 W/m ² , 50°C chamber, 8 hr. UV lamp, 5 min. spray, 3 hr. 55 min. condensation, 1,000 hr. total exposure ⁷	G 154	Pass ⁸	
Abrasion loss, 1.6 mm thickness, liquid only, %	ISSA TB-100	–	1.0
Residue by evaporation, % by weight	D 2939	33	–
Tests on residue from evaporation: Penetration, 77°F, 100 g, 5 sec. Flash point, Cleveland open cup, °F	T 49 T 48	15 500	30
Tests on base asphalt before emulsification Solubility in trichloroethylene, %	T 44	98	–

1. Cure the emulsion in the softening point ring in a 200°F ± 5°F oven for 2 hr.
2. Product must be homogenous and show no separation or coagulation that cannot be overcome by moderate stirring.
3. No sagging or slippage of film beyond the initial reference line.
4. No blistering or re-emulsification.
5. Recommended for airport applications or where fuel resistance is desired.
6. No absorption of Kerosene into the clay tile past the sealer film. Note sealer surface condition and loss of adhesion.
7. Other exposure cycles with similar levels of irradiation and conditions may be used with Department approval.
8. No cracking, chipping, surface distortion, or loss of adhesion. No color fading or lightening.

2.6.

Recycling Agent. Recycling agent and emulsified recycling agent must meet the requirements in Table 12. Additionally, recycling agent and residue from emulsified recycling agent, when added in the specified proportions to the recycled asphalt, must meet the properties specified on the plans.

Table 12
Recycling Agent and Emulsified Recycling Agent

Property	Test Procedure	Recycling Agent		Emulsified Recycling Agent (ARA-1)		Polymer Modified Emulsified Recycling Agent (ARA-1P)	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol, 77°F, sec.	T 72	–	–	15	100	15	110
Sieve test, %	T 59	–	–	–	0.1	–	0.1
Miscibility ¹	T 59	–		No coagulation			
Residue by evaporation, ² % by wt.	T 59	–	–	60	–	–	–
Distillation test: Residue by distillation, % by wt. Oil distillate, % by volume of emulsion	T 59					60 –	65 2
Penetration of Distillation Residue at 39.2°F, 100 g, 5 sec.	T 49					110	190
Tests on recycling agent or residue from evaporation: Flash point, C.O.C., °F Kinematic viscosity, 140°F, cSt 275°F, cSt	T 48 T 201	400 75 –	– 200 10.0	400 75 –	– 200 10.0	400	–

1. Exception to T 59: Use 0.02 N CaCl₂ solution in place of water.
2. Exception to T 59: Maintain sample at 300°F until foaming ceases, then cool and weigh.

2.7. **Crumb Rubber Modifier.** Crumb rubber modifier (CRM) consists of automobile and truck tires processed by ambient temperature grinding.

CRM must be:

- free from contaminants including fabric, metal, and mineral and other nonrubber substances;
- free-flowing; and
- nonfoaming when added to hot asphalt binder.

Ensure rubber gradation meets the requirements of the grades in Table 13 when tested in accordance with [Tex-200-F](#), Part I, using a 50-g sample.

Table 13
CRM Gradations

Sieve Size (% Passing)	Grade A		Grade B		Grade C		Grade D	Grade E
	Min	Max	Min	Max	Min	Max		
#8	100	–	–	–	–	–	As shown on the plans	As approved
#10	95	100	100	–	–	–		
#16	–	–	70	100	100	–		
#30	–	–	25	60	90	100		
#40	–	–	–	–	45	100		
#50	0	10	–	–	–	–		
#200	–	–	0	5	–	–		

2.8. **Crack Sealer.** Provide polymer-modified asphalt-emulsion crack sealer meeting the requirements of Table 14. Provide rubber-asphalt crack sealer meeting the requirements of Table 15.

Table 14
Polymer-Modified Asphalt-Emulsion Crack Sealer

Property	Test Procedure	Min	Max
Rotational viscosity, 77°F, cP	D 2196, Method A	10,000	25,000
Sieve test, %	T 59	–	0.1
Storage stability, 1 day, %	T 59	–	1
Evaporation	Tex-543-C		
Residue by evaporation, % by wt.		65	–
Tests on residue from evaporation:			
Penetration, 77°F, 100 g, 5 sec.	T 49	35	75
Softening point, °F	T 53	140	–
Ductility, 39.2°F, 5 cm/min., cm	T 51	100	–

Table 15
Rubber-Asphalt Crack Sealer

Property	Test Procedure	Class A		Class B	
		Min	Max	Min	Max
CRM content, Grade A or B, % by wt.	Tex-544-C	22	26	–	–
CRM content, Grade B, % by wt.	Tex-544-C	–	–	13	17
Virgin rubber content, ¹ % by wt.		–	–	2	–
Flash point, ² C.O.C., °F	T 48	400	–	400	–
Penetration, ³ 77°F, 150 g, 5 sec.	T 49	30	50	30	50
Penetration, ³ 32°F, 200 g, 60 sec.	T 49	12	–	12	–
Softening point, °F	T 53	–	–	170	–
Bond Test, non-immersed, 0.5 in specimen, 50% extension, 20°F ⁴	D5329	–	–	–	Pass

1. Provide certification that the Min % virgin rubber was added.
2. Agitate the sealing compound with a 3/8- to 1/2 in. (9.5- to 12.7 mm) wide, square-end metal spatula to bring the material on the bottom of the cup to the surface (i.e., turn the material over) before passing the test flame over the cup. Start at one side of the thermometer, move around to the other, and then return to the starting point using 8 to 10 rapid circular strokes. Accomplish agitation in 3 to 4 sec. Pass the test flame over the cup immediately after stirring is completed.
3. Exception to T 49: Substitute the cone specified in D 217 for the penetration needle.
4. Allow no crack in the crack sealing materials or break in the bond between the sealer and the mortar blocks over 1/4 in. deep for any specimen after completion of the test.

- 2.9. **Asphalt-Rubber Binders.** Provide asphalt-rubber (A-R) binders that are mixtures of asphalt binder and CRM, which have been reacted at elevated temperatures. Provide A-R binders meeting D6114 and containing a minimum of 15% CRM by weight. Provide Types I or II, containing CRM Grade C, for use in hot-mixed aggregate mixtures. Provide Types II or III, containing CRM Grade B, for use in surface treatment binder. Ensure binder properties meet the requirements of Table 16.

**Table 16
A-R Binders**

Property	Test Procedure	Binder Type					
		Type I		Type II		Type III	
		Min	Max	Min	Max	Min	Max
Apparent viscosity, 347°F, cP	D2196, Method A	1,500	5,000	1,500	5,000	1,500	5,000
Penetration, 77°F, 100 g, 5 sec.	T 49	25	75	25	75	50	100
Penetration, 39.2°F, 200 g, 60 sec.	T 49	10	–	15	–	25	–
Softening point, °F	T 53	135	–	130	–	125	–
Resilience, 77°F, %	D5329	25	–	20	–	10	–
Flash point, C.O.C., °F	T 48	450	–	450	–	450	–
Tests on residue from Thin-Film Oven Test:	T 179						
Retained penetration ratio, 39.2°F, 200 g, 60 sec., % of original	T 49	75	–	75	–	75	–

- 2.10. **Performance-Graded Binders.** Provide PG binders that are smooth and homogeneous, show no separation when tested in accordance with [Tex-540-C](#), and meet the requirements of Table 17.

Separation testing is not required if:

- a modifier is introduced separately at the mix plant either by injection in the asphalt line or mixer,
- the binder is blended on site in continuously agitated tanks, or
- binder acceptance is based on field samples taken from an in-line sampling port at the hot-mix plant after the addition of modifiers.

Table 17
Performance-Graded Binders

Property and Test Method	Performance Grade																	
	PG 58			PG 64				PG 70				PG 76				PG 82		
	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28
Average 7-day max pavement design temperature, °C ¹	58			64				70				76				82		
Min pavement design temperature, °C ¹	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28
Original Binder																		
Flash point, T 48, Min, °C	230																	
Viscosity, T 316 ^{2,3} : Max, 3.0 Pa s, test temperature, °C	135																	
Dynamic shear, T 315 ⁴ : G*/sin(δ), Min, 1.00 kPa, Max, 2.00 kPa ⁷ , Test temperature @ 10 rad/sec., °C	58			64				70				76				82		
Elastic recovery, D6084, 50°F, % Min ⁸	-	-	30	-	-	30	50	-	30	50	60	30	50	60	70	50	60	70
Rolling Thin-Film Oven (Tex-506-C)																		
Mass change, T 240, Max, %	1.0																	
Dynamic shear, T 315: G*/sin(δ), Min, 2.20 kPa, Max, 5.00 kPa ⁷ , Test temperature @ 10 rad/sec., °C	58			64				70				76				82		
MSCR, T350, Recovery, 0.1 kPa, High Temperature, % Min ⁸	-	-	20	-	-	20	30	-	20	30	40	20	30	40	50	30	40	50
Pressure Aging Vessel (PAV) Residue (R 28)																		
PAV aging temperature, °C	100																	
Dynamic shear, T 315: G*/sin(δ), Max, 5,000 kPa Test temperature @ 10 rad/sec., °C	25	22	19	28	25	22	19	28	25	22	19	28	25	22	19	28	25	22
Creep stiffness, T 313 ^{5,6} : S, max, 300 MPa, m-value, Min, 0.300 Test temperature @ 60 sec., °C	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18
Direct tension, T 314 ⁶ : Failure strain, min, 1.0% Test temperature @ 1.0 mm/min., °C	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18

- Pavement temperatures are estimated from air temperatures and using an algorithm contained in a Department-supplied computer program, may be provided by the Department, or by following the procedures outlined in AASHTO MP 2 and PP 28.
- This requirement may be waived at the Department's discretion if the supplier warrants that the asphalt binder can be adequately pumped, mixed, and compacted at temperatures that meet all applicable safety, environmental, and constructability requirements. At test temperatures where the binder is a Newtonian fluid, any suitable standard means of viscosity measurement may be used, including capillary (T 201 or T 202) or rotational viscometry (T 316).
- Viscosity at 135°C is an indicator of mixing and compaction temperatures that can be expected in the lab and field. High values may indicate high mixing and compaction temperatures. Additionally, significant variation can occur from batch to batch. Contractors should be aware that variation could significantly impact their mixing and compaction operations. Contractors are therefore responsible for addressing any constructability issues that may arise.
- For quality control of unmodified asphalt binder production, measurement of the viscosity of the original asphalt binder may be substituted for dynamic shear measurements of G*/sin(δ) at test temperatures where the asphalt is a Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary (T 201 or T 202) or rotational viscometry (T 316).
- Silicone beam molds, as described in AASHTO TP 1-93, are acceptable for use.
- If creep stiffness is below 300 MPa, direct tension test is not required. If creep stiffness is between 300 and 600 MPa, the direct tension failure strain requirement can be used instead of the creep stiffness requirement. The m value requirement must be satisfied in both cases.
- Maximum values for unaged and RTFO aged dynamic shear apply only to materials used as substitute binders, as described in Item 340, "Dense-Graded Hot-Mix Asphalt (Small Quantity)", Item 341, "Dense-Graded Hot-Mix Asphalt, and Item 344, "Superpave Mixtures."
- Elastic Recovery (ASTM D6084) is not required unless MSCR (AASHTO T 350) is less than the minimum % recovery. Elastic Recovery must be used for the acceptance criteria in this instance.

3. EQUIPMENT

Provide all equipment necessary to transport, store, sample, heat, apply, and incorporate asphalts, oils, and emulsions.

4. CONSTRUCTION

Typical Material Use. Use materials shown in Table 18, unless otherwise determined by the Engineer.

Table 18
Typical Material Use

Material Application	Typically Used Materials
Hot-mixed, hot-laid asphalt mixtures	PG binders, A-R binders Types I and II
Surface treatment	AC-5, AC-10, AC-15P, AC-20XP, AC-10-2TR, AC-20-5TR, HFRS-2, MS-2, CRS-2, CRS-2H, CRS-2TR, CMS-2P HFRS-2P, CRS-2P, CHFRS-2P, A-R binders Types II and III
Surface treatment (cool weather)	AC12-5TR, RC-250, RC-800, RC-3000, MC-250, MC-800, MC-3000, MC-2400L, CMS-2P
Precoating	AC-5, AC-10, PG 64-22, SS-1, SS-1H, CSS-1, CSS-1H
Tack coat	PG Binders, SS-1H, CSS-1H, EAP&T, TRAIL, EBL
Fog seal	SS-1, SS-1H, CSS-1, CSS-1H, CMS-1P
Hot-mixed, cold-laid asphalt mixtures	AC-0.6, AC-1.5, AC-3, AES-300, AES-300P, CMS-2, CMS-2S
Patching mix	MC-800, SCM I, SCM II, AES-300S
Recycling	AC-0.6, AC-1.5, AC-3, AES-150P, AES-300P, recycling agent, emulsified recycling agent
Crack sealing	SS-1P, polymer mod AE crack sealant, rubber asphalt crack sealers (Class A, Class B)
Microsurfacing	CSS-1P
Prime	MC-30, AE-P, EAP&T, PCE
Curing membrane	SS-1, SS-1H, CSS-1, CSS-1H, PCE
Erosion control	SS-1, SS-1H, CSS-1, CSS-1H, PCE
FDR -Foaming	PG 64-22, FDR EM-SY, FDR EM-HY

- 4.1. **Storage and Application Temperatures.** Use storage and application temperatures in accordance with Table 19. Store and apply materials at the lowest temperature yielding satisfactory results. Follow the manufacturer's instructions for any agitation requirements in storage. Manufacturer's instructions regarding recommended application and storage temperatures supersede those of Table 19.

Table19
Storage and Application Temperatures

Type-Grade	Application		Storage Max (°F)
	Recommended Range (°F)	Max Allowable (°F)	
AC-0.6, AC-1.5, AC-3	200–300	350	350
AC-5, AC-10	275–350	350	350
AC-15P, AC-20-5TR, AC12-5TR and AC10-2TR	300–375	375	360
RC-250	125–180	200	200
RC-800	170–230	260	260
RC-3000	215–275	285	285
MC-30, AE-P	70–150	175	175
MC-250	125–210	240	240
MC-800, SCM I, SCM II	175–260	275	275
MC-3000, MC-2400L	225–275	290	290
HFRS-2, MS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P, CMS-2, CMS-2S, AES-300, AES-300S, AES-150P, AES-300P, CRS-2TR	120–160	180	180
SS-1, SS-1H, CSS-1, CSS-1H, PCE, EAP&T, SS-1P, RS-1P, CRS-1P, CSS-1P, recycling agent, emulsified recycling agent, polymer mod AE crack sealant	50–130	140	140
PG binders	275–350	350	350
Rubber asphalt crack sealers (Class A, Class B)	350–375	400	–
A-R binders Types I, II, and III	325–425	425	425

5. MEASUREMENT AND PAYMENT

The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly but is subsidiary or is included in payment for other pertinent items.

Special Specification 6001

Portable Changeable Message Sign



1. DESCRIPTION

Furnish, operate, and maintain portable trailer mounted changeable message sign (PCMS) units.

2. MATERIALS

Furnish new or used material in accordance with the requirements of this Item and the details shown on the plans. Provide a self-contained PCMS unit with the following:

- Sign controller
- Changeable Message Sign
- Trailer
- Power source

Paint the exterior surfaces of the power supply housing, supports, trailer, and sign with Federal Orange No. 22246 or Federal Yellow No. 13538 of Federal Standard 595C, except paint the sign face assembly flat black.

2.1. **Sign Controller.** Provide a controller with permanent storage of a minimum of 75 pre-programmed messages. Provide an external input device for random programming and storage of a minimum of 75 additional messages. Provide a controller capable of displaying up to 3 messages sequentially. Provide a controller with adjustable display rates. Enclose sign controller equipment in a lockable enclosure.

2.2. **Changeable Message Sign.** Provide a sign capable of being elevated to at least 7 ft. above the roadway surface from the bottom of the sign. Provide a sign capable of being rotated 360° and secured against movement in any position.

Provide a sign with 3 separate lines of text and 8 characters per line minimum. Provide a minimum 18 in. character height. Provide a 5 × 7 character pixel matrix. Provide a message legibility distance of 600 ft. for nighttime conditions and 800 ft. for normal daylight conditions. Provide for manual and automatic dimming light sources.

The following are descriptions for 3 screen types of PCMS:

- **Character Modular Matrix.** This screen type comprises of character blocks.
- **Continuous Line Matrix.** This screen type uses proportionally spaced fonts for each line of text.
- **Full Matrix.** This screen type uses proportionally spaced fonts, varies the height of characters, and displays simple graphics on the entire sign.

2.3. **Trailer.** Provide a 2 wheel trailer with square top fenders, 4 leveling jacks, and trailer lights. Do not exceed an overall trailer width of 96 in. Shock mount the electronics and sign assembly.

2.4. **Power Source.** Provide a diesel generator, solar powered power source, or both. Provide a backup power source as necessary.

2.5. **Cellular Telephone.** When shown on the plans, provide a cellular telephone connection to communicate with the PCMS unit remotely.

3. CONSTRUCTION

Place or relocate PCMS units as shown on the plans or as directed. The plans will show the number of PCMS units needed, for how many days, and for which construction phases.

Maintain the PCMS units in good working condition. Repair damaged or malfunctioning PCMS units as soon as possible. PCMS units will remain the property of the Contractor.

4. MEASUREMENT

This Item will be measured by each PCMS or by the day used. All PCMS units must be set up on a work area and operational before a calendar day can be considered measurable. When measurement by the day is specified, a day will be measured for each PCMS set up and operational on the worksite.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Portable Changeable Message Sign." This price is full compensation for PCMS units; set up; relocating; removing; replacement parts; batteries (when required); fuel, oil, and oil filters (when required); cellular telephone charges (when required); software; and equipment, materials, tools, labor, and incidentals.

Special Specification 6185

Truck Mounted Attenuator (TMA) and Trailer Attenuator (TA)



1. DESCRIPTION

Furnish, operate, maintain and remove upon completion of work, Truck Mounted Attenuator (TMA) or Trailer Attenuator (TA).

2. MATERIALS

Furnish, operate and maintain new or used TMAs or TAs. Assure used attenuators are in good working condition and are approved for use. A list of approved TMA/TA units can be found in the Department's Compliant Work Zone Traffic Control Devices List. The host vehicle for the TMA and TA must weigh a minimum of 19,000 lbs. Host vehicles may be ballasted to achieve the required weight. Any weight added to the host vehicle must be properly attached or contained within it so that it does not present a hazard and that proper energy dissipation occurs if the attenuator is impacted from behind by a large truck. The weight of a TA will not be considered in the weight of the host vehicle but the weight of a TMA may be included in the weight of the host vehicle. Upon request, provide either a manufacturer's curb weight or a certified scales weight ticket to the Engineer.

3. CONSTRUCTION

Place or relocate TMA/TAs as shown on the plans or as directed. The plans will show the number of TMA/TAs needed, for how many days or hours, and for which construction phases.

Maintain the TMA/TAs in good working condition. Replace damaged TMA/TAs as soon as possible.

4. MEASUREMENT

4.1. **Truck Mounted Attenuator/Trailer Attenuator (Stationary).** This Item will be measured by the each or by the day. TMA/TAs must be set up in a work area and operational before a calendar day can be considered measurable. When measurement by the day is specified, a day will be measured for each TMA/TA set up and operational on the worksite.

4.2. **Truck Mounted Attenuator/Trailer Attenuator (Mobile Operation).** This Item will be measured by the hour. The time begins once the TMA/TA is ready for operation at the predetermined site and stops when notified by the Engineer. A minimum of 4 hr. will be paid each day for each operating TMA/TA used in a mobile operation.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Truck Mounted Attenuators/Trailer Attenuators (Stationary)," or "Truck Mounted Attenuators/Trailer Attenuators (Mobile Operation)." This price is full compensation for furnishing TMA/TA: set up; relocating; removing; operating; fuel; and equipment, materials, tools, labor, and incidentals.

Special Specification 7016

WATER AND SANITARY SEWER SYSTEMS



1. DESCRIPTION

This Item will govern for furnishing new materials and installing water and sanitary sewer systems shown on the plans.

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3. WATER MAINS

3.1. **Description.** Furnish all labor, materials, equipment and incidentals required to install water mains as shown on the plans and as specified.

3.2. **Materials.**

3.2.1. **Polyvinyl Chloride (PVC) Pressure Pipe.** The following specifications cover the requirements for polyvinyl chloride (PVC) pressure plastic pipe materials and installation for potable water use and apply to PVC pipe, sizes 4 inch through 16 inch diameters.

3.2.1.1. **Quality Assurance.** Color-code PVC pipe in blue to provide positive identification and prevent accidental damage to or interruption of the water facilities. Pipe will conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 "Drinking Water System Components - Health Effects" and be certified by and organization accredited by ANSI. Provide compliance affidavit from the manufacturer or vendor. If the pipe does not conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted.

Only pipe manufactured in the United States of America will be accepted.

Pipe must be suitable for use in the conveyance of water for human consumption. Mark each piece of pipe with two seals of the testing agency that certified the pipe material as being suitable for potable water use.

3.2.1.2. **Submittals.** Furnish all necessary shop drawings, certificates, etc. for review and acceptance. A certification from the manufacturer must be furnished attesting compliance with appropriate ASTM Standards and ANSI/NSF Standard 61. Such compliance will be evidenced by an affidavit from the manufacturer or vendor.

If the pipe does not presently conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted. Failure to provide this information may result in rejection of pipeline material. Include documentation on pipe products, fittings, and related materials as may be required by the plans or the Engineer. Review all submittals prior to submission. Submit it in a timely manner so as not to delay the project. Allow sufficient time for Engineer's review and resubmission, if necessary. Include certifications from manufacturer that the product complies with appropriate ASTM standards

3.2.1.3. Standards. Comply with the applicable requirements of the following items listed below. In case of conflict between the requirements of this Specification and those of the listed documents, the requirements of this Section will prevail.

- ANSI/NSF 61 Drinking Water System Components - Health Effects
- ASTM F-477 Specifications for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- ASTM D-1784 Specifications for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds
- ASTM D-2241 Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series)
- ASTM D-2774 Recommended Practice for Underground Installation of Thermoplastic Pressure Piping
- ASTM D-2837 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
- ASTM D-3139 Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- AWWA C-651 Standard for Disinfecting Water Mains
- AWWA C-900 Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-inches, for Water Distribution
- AWWA C-905 Standard for Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14-inch through 36-Inches
- AWWA M-23 Manual: PVC Pipe - Design and Installation
- UNI-BELL-3 Polyvinyl Chloride (PVC) Pressure Pipe (Complying with AWWA Standard C-900)
- UNI-BELL-11 Polyvinyl Chloride (PVC) Water Transmission Pipe Nominal Diameters 14-36 inches
- Texas Commission on Environmental Quality, Chapter 290 - Public Drinking Water

3.2.1.4. Delivery and Storage. Pipe, fittings, and accessories will be inspected upon delivery and during progress of the work. Any material found defective will be rejected and must be promptly removed from the site.

Unload at point of delivery all pipe, fittings, and other accessories, unless otherwise directed, haul to and distribute at the work site. In loading and unloading, lift materials by hoists or roll on skidways to avoid shock or damage. Do not incorporate materials that have been dropped. Do not skid or roll pipe handled on skidways against pipe already on the ground.

Do not store PVC pipe outside exposed to prolonged periods of sunlight. Any discoloration of pipe due to such exposure is an indication of reduced pipe impact strength, and will be sufficient cause for rejection of the pipe. Remove rejected all pipe from the job site.

3.2.1.5. Pipe Materials. Meet the requirements of AWWA C-900 for 4 inch through 12 inch sizes, and AWWA C-905 for 14 inch through 36 inch pipe. Provide pipe that is Underwriters Laboratories (UL) approved. Furnish all PVC pressure pipe in cast iron pipe equivalent outside diameters and a standard laying length of 20 feet. Provide a minimum pressure class of 235 psi (DR 18) for 4 inch through 12 inch diameters and 200 psi (DR 21) for 14 inch through 16 inch pipe.

3.2.1.6. Joints. Furnish push-on flexible, elastomeric gasketed pipe joints. The pipe length must contain one bell-end or couple with a synthetic elastomeric gasket.

Gaskets must meet the requirements of ASTM F-477. The bell will be an integral part of the pipe length, and have the same strength and DR as the pipe. The spigot pipe end will be beveled.

All push-on joint PVC pipe must have dual insertion marks on the spigot indicating proper penetration when the joint is assembled and only one mark remains visible. The sockets and/or spigot configurations for the fittings and couplings will be compatible to the pipe. Socket configuration must prevent improper installation of gasket and will ensure that the gasket remains in place during joining operations.

Cartridge-style restrained joint PVC pipe will be joined using a non-metallic coupling to form an integral system. Coupling will be designed for use at or above the pressure class of the pipe with which they are utilized and will incorporate twin elastomeric sealing gaskets meeting ASTM F-477. High strength, flexible thermoplastic splines will be inserted mating, machined grooves in the pipe and coupling to provide full 360° restraint.

Restrained joint pipe systems must have a restrained joint that in and of itself prevents over bellings of the pipe during assembly of the joint and every joint already assembled in that string of pipe. Restrained joint system will allow the installer to both push and pull the pipe during installation without the risk of over bellings of any of the pipe joints in the string. Joint will not require electrical power or other additional equipment (other than hand tools) to assemble.

3.2.1.7. Fittings. Provide DIP, cement lined pipe fittings in accordance with AWWA C-110 and Article 7, "Valves and Fittings". Provide mechanical joint (MJ) pipe fittings unless otherwise specified.

3.2.1.8. Provisions for Thrust. For 12-inch diameter water mains and smaller, concrete thrust blocks or other approved thrust restraint method will be installed at all fittings and valves per design plans and in accordance with these Specifications. If approved, thrust restraint devices may be installed in lieu of thrust blocks as per manufacturer's specifications.

For 16-inch diameter water mains and larger, thrust restraint devices must be installed at all fittings and valves per manufacturer's specifications and as shown on design plans. Concrete thrust blocks are not allowed unless approved by the Engineer.

Acceptable thrust restraint devices include EBAA Iron, Ford Uni-Flange, or approved equal.

NOTE: At connection of new water line to existing main, both concrete thrust blocking in accordance with this Specification and thrust restraint devices must be used, regardless of main size.

Thrust restraint devices must be used for a sufficient distance from each bend, tee, plug, or other fitting to resist thrust which will be developed at the test pressure of the pipe. For the purposes of thrust restraint, test pressure will be 1.5 times the design working pressure indicated. Length of pipe with restrained joints to resist thrust forces will be determined by pipe manufacturer.

3.2.1.9. Pipe Trenching, Installation and Backfill. Except as noted, Pipe Trenching, Installation and Backfill for PVC Pressure Pipe will be in accordance with AWWA M-23, C-900, C-905, and conforming to "Excavation and Backfill for Structures" Item 400 and details shown on construction plans.

3.2.1.9.1. Trench Width. Provide a minimum trench clear width of 1 foot greater than the outside diameter of the pipe and a maximum clear width at a point 1 foot above the top of the pipe equal to the pipe outside diameter plus 2 feet. If the maximum recommended trench width is exceeded or if the pipe is installed in a compacted embankment, compact pipe embedment to a minimum point of 2 1/2 pipe diameters from the side of the pipe or to the trench walls.

3.2.1.9.2. Pipe Zone Embedment. Unless otherwise specified, embed PVC pressure pipe in Class II material as defined in Item 400, "Excavation and Backfill for Structures". Native material or imported material meeting or exceeding Class II requirements may be used. Class I material is acceptable at the Engineer's discretion.

- 3.2.1.9.3. Installation. Install plastic pressure pipe in accordance with AWWA M 23 and C-900/C-905 and/or manufacturer's printed recommendations, whichever is applicable. Where a conflict arises, this Specification controls.

Exercise care to insert the pipe spigot to the correct reference mark per manufacturer's recommendation to prevent buckling or separation of the pipe joint. The second insertion mark must be visible after installation and not be further than 3/4-inch from the leading edge of the pipe bell. Verify that the manufacturer's reference marks are correct per manufacturer's literature.

Do not drop pipe or accessories into the trench. When pipe laying is not in progress, close the open ends of installed pipe to prevent entrance of trench water, dirt, and foreign matter into the line.

- 3.2.1.9.4. Marking Tape. Mark PVC pressure water pipe by installing the appropriate marking tape for detection purposes concurrently. Provide a high visibility blue detectable tape consisting of a 5.0 mil inert polyethylene plastic material with the standard warning and identification for potable water imprinted on the tape. Provide a minimum width of 6 inches for all potable water lines and bury tape to a depth of 36 inches, measured from finished grade. Use detecting tape manufactured by Empire, Lineguard, or approved equal.

- 3.2.1.9.5. Deflection. Maximum ring deflection (cross-sectional deflection) of installed PVC pressure pipe is 5 percent. Joint deflection (horizontal deflection) will not exceed manufacturer's recommendations for the particular pipe size.

- 3.2.1.9.6. Corrosion Protection. As a precaution against corrosion, coat all flanges, bolts, nuts and other exposed metal surfaces underground with Texaco, Koppers, or approved equal rustproof compound.

- 3.2.1.10. Testing. Disinfect and test the piping system as detailed in AWWA C-651 and in accordance with Article 10, "Cleaning, Disinfection, and Testing of Water System".

- 3.2.2. **Ductile Iron Pipe.** The following specifications cover the requirements for ductile iron pipe (DIP) materials.

- 3.2.2.1. Quality Assurance. Manufacturer must have a minimum of ten years successful experience in designing and manufacturing DIP, pipe joints of similar design, pipe diameter, and pressure class of the type specified. The entire pipeline will be the product of one manufacturer. Pipe must conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 "Drinking Water System Components - Health Effects" and be certified by an organization accredited by ANSI. Such compliance will be evidenced by an affidavit from the manufacturer or vendor. If the pipe does not presently conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted.

- 3.2.2.2. Submittals. Submit documentation on pipe products, fittings, and related materials as required by the plans or Engineer. Review all submittals prior to submission. Submit in a timely manner so as not to delay the project. Allow sufficient time for Engineer's review and resubmission, if necessary. Include certifications from manufacturer that the DIP complies with appropriate AWWA Standards and ANSI/NSF Standard 61. Provide by an affidavit from the manufacturer or vendor as evidence of compliance. If the pipe does not presently conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted. If requested, provide copies of results of factory hydrostatic tests.

- 3.2.2.3. Standards. Comply with applicable requirements of the following items listed below. In case of conflict between the requirements of this Specification and those of the listed documents, the requirements of this Section will prevail:

- ANSI/NSF 61 Drinking Water System Components - Health Effects
- ASTM A-536 Specification for Ductile Iron Castings
- AWWA C-104 Standard for Cement Mortar Lining for Ductile Iron Pipe and Fittings
- AWWA C-105 Standard for Polyethylene Encasement for Ductile Iron Piping
- AWWA C-110 Standard for Ductile Iron and Gray Iron Fittings

- AWWA C-111 Standard for Rubber Gasket Joints for Ductile Iron Pipe and Fittings
- AWWA C-150 Standard for Thickness Design of Ductile Iron Pipe
- AWWA C-151 Standard for Ductile Iron Pipe
- AWWA C-214 Tape Coating Systems for the Exterior of Steel Water Pipelines
- AWWA C-600 Standard for Installation of Ductile Iron Water Mains & Appurtenances
- AWWA C-651 Disinfecting Water Mains
- Texas Commission on Environmental Quality, Chapter 290 - Public Drinking Water

3.2.2.4. Pipe Materials. Manufacture DIP in accordance with AWWA C-151 and conform to ASTM Specification A-536 with physical properties of Grade 60-40-18 with a minimum pressure class rating of 350 psi, unless otherwise specified. Design pipe for five (5) feet of cover or for the depths shown on the plans, whichever is greater. Provide a standard joint length of 18 or 20 feet and an industry standard inside diameter. Replace any material found to be damaged or defective in manufacture at Contractor's expense.

3.2.2.5. Joints. Provide push-on standard joints for DIP manufactured in accordance with AWWA C-111, AWWA C-151. Where indicated on the plans, joints will be mechanical or flanged. Flanged joints will have pressure ratings equal to or greater than adjacent pipe. Flange pattern will match pattern of valve, fitting, or appurtenance to be attached.

3.2.2.6. Fittings. Provide DIP in accordance with AWWA C-110 and Article 7 of this Specification. Fittings will be rated for a minimum working pressure of 250 psi, unless otherwise specified. Factory welded outlets, minimum pressure rating 250 psi, may be used in lieu of tee fittings for 18 inch and larger tee fittings. Do not use factory welded outlets near sources of vibration, such as pump stations or roads, unless specifically noted on the plans.

3.2.2.7. Exterior Coating. Provide a standard asphaltic coating in accordance with AWWA C-151, unless otherwise specified. The finished coating will be continuous, and smooth and strongly adherent to the pipe.

For DIP sizes 30 inches and smaller, use a 30 mils minimum thickness polyethylene wrap applied wrap in accordance with AWWA C-105/A21.5.

Tape coat DIP 36 inches and larger. The exterior of the pipe must have a prefabricated cold-applied tape coating system conforming to the requirements of ANSI/AWWA C-214, except as noted herein. Blast clean the surface to achieve a surface preparation at least equal to that specified in SSPC SP6. The blast profile must have an anchor pattern as specified by the tape manufacturer. Hold the coating back from the end of the pipe the minimum distance recommended by the pipe manufacturer for the type of joint used. Taper the tape wrap cut back. Provide a nominal thickness of 80 mils.

3.2.2.8. Interior Lining. DIP Pipe and fittings will have a cement mortar lining in accordance with AWWA C-104 and bituminous seal coat. Cement Type for lining will be appropriate for pipe application. Provide lining thickness as specified in AWWA C-104.

3.2.2.9. Provisions for Thrust. Where indicated and where required for thrust restraint, joints must be restrained. Restrained joints will be mechanically interlocking joints. Provide restrained joints such as U.S. Pipe "TR Flex", American Cast Iron Pipe "Flex Ring", or Clow Corporation "Super-Lock" that are capable of sustaining the specified design pressure. If thrust cannot be accommodated using restrained joints, such as bends adjacent to casing pipe, use approved thrust restraint devices.

Thrust at bends, tees, plugs, or other fittings must be resisted using thrust restraint devices. Concrete thrust blocks are not allowed unless approved by the Engineer. Acceptable thrust restraint devices are as manufactured by EBAA Iron, Ford Uni-Flange, or approved equal.

NOTE: At connection of new water line to existing main, both concrete thrust blocking (per Article II of these Specifications) and thrust restraint devices must be used.

Restrained joints and thrust restraint devices must be used for a sufficient distance from each bend, tee, plug, or other fitting to resist thrust which will be developed at the design pressure of the pipe. For the purposes of thrust restraint, design pressure is 1.5 times the design working pressure class indicated. Length of pipe with restrained joints and restraint devices will be determined by pipe manufacturer and/or in accordance with the Handbook of Ductile Iron Pipe.

The following parameters will be used: laying condition equal to AWWA C-600 Type 5 soil, safety factor of 1.8, a unit bearing resistance equal to zero, an a factor for polyethylene encasement as recommended by DIPRA (Ductile Iron Pipe Research Association), if required.

- 3.2.2.10. Pipe Trenching, Installation, and Backfill. Except as noted, perform pipe trenching, Installation, and Backfill for DIP in accordance with AWWA C-600 and Article 6 of this Specification.
- 3.2.2.10.1. General. Repair any damage to polyethylene wrap according to AWWA C-105. Keep pipe clean during installation. Provide two coats of Koppers Bitumastic No. 50, or approved equal to exposed ferrous metal that cannot be protected with field-applied tape coating. Install pipe and fittings to line and grade indicated. In areas where the line and grades indicated cannot be achieved using standard manufactured bends and fittings, make slight adjustments by deflecting joints according to the limitations of AWWA C-600.
- 3.2.2.10.2. Pipe Zone Embedment. Unless otherwise specified, embed DIP in Class II material as defined in Article 6. Native material or imported material meeting or exceeding Class II requirements may be used.
- 3.2.2.10.3. Marking Tape. Mark DIP by installing the appropriate marking tape for detection purposes concurrently. Provide a high visibility blue detectable tape consisting of a 5.0 mil inert polyethylene plastic material with the standard warning and identification for potable water imprinted on the tape. Provide a minimum width of 6 inches for all potable water lines and bury tape to a depth of 36 inches, measured from finished grade. Use detecting tape manufactured by Empire, Lineguard, or approved equal.
- 3.2.2.10.4. Pipe Cutting. When required, machine cut DIP leaving a smooth cut at right angles to the axis of the pipe. Bevel ends of cut pipe to be used with a push-on joint bell to comply with manufactured spigot end. Do not damage cement lining.
- 3.2.2.10.5. Corrosion Protection. As a precaution against corrosion, coat all flanges, bolts, nuts and other exposed metal surfaces underground with Texaco, Koppers, or equal rustproof compound.
- 3.2.2.11. Testing. Disinfect and test the piping system in accordance with Article 10 of this Specification and as detailed in AWWA C-651.
- 3.2.3. **Steel Main Pressure Pipe (STEEL).** The following specifications cover the requirements for steel main pressure pipe (STEEL) materials and for proper and function of the pipe.
- 3.2.3.1. Quality Assurance. Conform to applicable standards of ASTM and AWWA and ANSI/NSF Standard 61 "Drinking Water System Components – Health Effects".

Manufacturer must have a minimum of five years successful experience in manufacturing pipe of the particular type and size indicated. The entire pipeline will be the product of one manufacturer and pipe manufacturing operations (pipe, fittings, lining, coating) must be performed at one location. Clearly mark one end of each pipe joint and fitting with the class for which it is designed, the date of manufacturer and the identification number.

The quality of materials, the process of manufacture and finished pipe will be subject to inspection and approval. Inspections may be made at the place of manufacture, on the jobsite or both places. Pipe may be subject to inspection by an independent testing laboratory selected and retained by the El Paso Water Utilities (EPWU). Pipe manufacturer must provide proper facilities for access and inspection and allow laboratory representatives or Engineer to inspect whenever work is in preparation or progress. Notify EPWU, through Engineer in writing, at least two weeks prior to pipe fabrication so that the manufacturer is advised of the decision regarding independent laboratory tests to be performed. Material, fabricated parts,

and pipe, discovered to be defective, or do not conform to the requirements of this specification are subject to rejection at any time prior to final acceptance of the product. Promptly remove rejected materials from the jobsite.

The inspection and testing by the independent testing laboratory anticipates that production of pipe be done over a normal period of time and without "slowdowns" or other abnormal delays. In the event that an abnormal production time is required, and EPWU is required to pay excessive costs for inspection, reimburse EPWU for such laboratory costs over and above those incurred under a normal schedule of production as determined by the Engineer.

Welders must be certified as qualified in accordance with Chapter 9 of the ASME Boiler and Pressure Vessel Code and AWWA C-206. Welds will be tested for conformance with ASTM E-165. Submit welded test specimens upon request.

- 3.2.3.2. Submittals. Provide record drawings from the pipe manufacturer for pipe and fittings prior to fabrication that a schematic location-profile and a tabulated layout schedule, both of which are appropriately referenced to the stationing of the proposed pipeline as shown on the plan-profile sheets. Base record drawings on the plans and specifications and incorporate changes necessary to avoid conflicts with existing details of reinforcement, lining, and dimensions for pipe and fittings. Include details for the design and fabrication of all fittings, specials and provisions for thrust restraint. Where welded joints are required, include proposed welding requirements and provisions for thermal stress control. Record drawings are for record purposes only and will not be reviewed or approved.

Provide an affidavit stating that the pipe to be furnished complies with AWWA C-200, AWWA C-205, AWWA C-214, and these specifications.

Furnish the procedure, specifications and qualification records of welding procedures for all pipe welding to be performed for review and approval. Submit a list of the welders and the type of welding for which each has been qualified. All qualification and requalification tests costs are at Contractor's expense.

- 3.2.3.3. Standards. Comply with the following applicable requirements:
- ASTM A-307 Low Carbon Steel Externally Threaded Standard Fasteners
 - AWWA C-200 Standard for Steel Water Pipe 6-inches and Larger
 - AWWA C-205 Standard for Cement Mortar Protective Lining and Coating for Steel Water Pipe – 4" and Larger
 - AWWA C-206 Standard for Field Welding of Steel Water Pipe
 - AWWA C-207 Standard for Steel Pipe Flanges Waterworks Service – Sizes 4"-144"
 - AWWA C-208 Standard for Dimensions for Steel Water Pipe Fittings
 - AWWA C-209 Standard for Cold Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings
 - AWWA C-214 Standard for Tape Coating Systems for the Exterior of Steel Water Pipelines
 - AWWA M-11 Manual: Steel Pipe – A Guide for Design and Installation

- 3.2.3.4. Delivery and Storage. Deliver, handle, and store pipe in accordance with the Manufacturer's recommendations to protect coating systems. Prepare pipe for shipment to afford maximum protection from normal hazards of transportation and allow pipe to reach project site in an undamaged condition. Do not deliver pipe damaged in shipment to the project site unless such damaged pipe is properly repaired.

Band plastic end covers to pipe ends and maintain until pipe is placed in the trench. Maintain moisture inside the pipe by periodic application of water, as necessary.

Support pipes carefully during shipment and storage. Internally support and brace each end of each length of pipe, fitting, or special and the middle of each pipe joint with stulls to maintain a true circular shape. Provide internal supports consisting of timber or steel stulls firmly wedged and secured so that the stulls remain in place during handling. Rotate pipe so that one of the stulls is vertical during storage, shipment and

installation. Do not remove stulls from pipe until backfill operations are complete. Separate pipe, fittings, and specials so that they do not bear against each other, and securely fasten the entire load to prevent movement in transit. Ship pipe on padded bunks with tie-down straps approximately over stulling. Store pipe on padded skids, sand or dirt berm, tires, or other suitable means to protect the pipe from damage.

- 3.2.3.5. Pipe Materials. Steel pipe manufactured under AWWA C-200 must be fabricated from sheet or coil conforming to the requirements of ASTM A-570, Grades 30, 33, 36, or 40. It can also be fabricated from plate in coil form conforming to the requirements of ASTM A-36, A-283, Grades C or D, or A 572, Grade 42, or coil conforming to the requirements of ASTM A-139, Grades B or C. Butt weld all longitudinal and girth seams, whether straight or spiral using an approved electric-fusion weld process. Standard laying length is 45 feet.
- 3.2.3.5.1. Wall Thickness. Determined wall thickness by performance requirements as follows: Minimum pipe wall thickness is 0.188" or pipe O.D./230, whichever is greater for pipe and fittings with no minus tolerance. Maximum fiber stress for minimum wall thickness must not exceed 21,000 psi at design working pressure and not exceed 50% of the minimum yield strength of the steel used at the specified maximum working pressure for each class of pipe. In addition, the fiber stress must not exceed 75% of the maximum yield strength at the working pressure plus transient pressure. Minimum wall thickness for pipe placed in casing or tunnel liner is O.D./144 or 0.25" whichever is greater.
- 3.2.3.5.2. Exterior Tape Coating. Coat and wrap pipe outside with the pre-fabricated multi-layer cold-applied polyethylene tape coating in accordance with AWWA C-214. Provide machine-applied tape coating system in accordance with AWWA C-214 and is 80 mils consisting of a primer, 20 mil inner layer, and two 30 mil outer layers. Hold coating back from the end of the pipe the minimum distance recommended by the pipe manufacturer for the specified joint type. Taper tape wrap cut back. Hand wrap specials and fittings that cannot be machine wrapped. The application must conform to AWWA C-209 and consist of three layers, a primer layer and two 35 mm tape layers. Allow the fitting coating system to overlap the machine-applied coating system a minimum of 6-inches and bond together. Use the same manufacturer for hand wrap tape and machine wrap tape. Tape coating manufacturer will recommend the procedure and tape product required to smooth sharp or abrupt changes at bell, spigot, or flanged joints.
- 3.2.3.5.3. Cement Mortar Lining. Shop-applied cement linings must conform to the requirements of AWWA C-205. Use ASTM C-150 Type I or II cement and silica sand. Field applied cement mortar-lining must conform to the requirements of ASTM C-602. Linings on fittings and specials, such as miters, angles, bends and reducers, may be hand troweled. Thoroughly cleaned the pipe interior a method acceptable to the Engineer.
- 3.2.3.5.4. Mortar for Interior Joints. Furnish mortar that is one part cement to two parts sand using ASTM C-150 Type I or II cement and silica base sand is plaster and meets ASTM C-35 requirements. Dry mix cement and sand adding sufficient water added to permit packing and troweling without crumbling.
- 3.2.3.6. Pipe Design. Design, manufacture, and test steel pipe in accordance with AWWA C-200, AWWA Manual M-11, and with the criteria specified herein for sizes and pressure classes (working pressure) shown. For the purpose of pipe design, the total design internal pressure (transient pressure plus working pressure) will be 1.5 times the working pressure class specified. Design fittings, specials, and connections for the same pressure as the adjacent pipe. Base pipe design on trench conditions and the design pressure in accordance with AWWA Manual M-11. The trench depth is as shown on the plans. Provide the Unit Weight of Fill (W) of 130 pcf, and use live load for AASHTO HS-20 truck load (unless otherwise specified). Use a deflection lag factor 1.1, a bedding constant of 0.1, the modulus of Soil Reaction (E') for design purposes of 700 and the maximum allowable horizontal or vertical deflection of 2% after backfill. Submit design calculations for approval prior to the fabrication of the pipe. Standard laying length is 45 feet with special lengths, field trim pieces and closure pieces as required by plan and profile for location of elbows, tees, reducers, and other in-line fittings.
- 3.2.3.7. Joints. The standard field joint for steel pipe is either a single welded lap joint or a rubber gasket joint. Mechanically coupled or flanged joints are required where shown. Use butt strap joints where shown. Furnish joints that have the same or higher pressure rating as the abutting pipe.

- 3.2.3.7.1. Lap Welded Slip Joint. Provide lap welded slip joint at all locations where pipe is to be installed in casing or tunnels and where specified. Do not exceed a clearance of 1/8 inch at any point around the periphery between the surfaces of lap joints. In addition to the provisions of AWWA C-200 for a minimum lap of 1-1/2", the depth of bell must provide a minimum distance of 1inch between the weld and the nearest tangent of the bell radius when welds are to be located on the inside of the pipe. Weld joints from the outside for pipe diameters 30 inches or smaller and on the inside for pipe diameters larger than 30 inches. If specified on the plans, weld joints on the inside and outside.
- 3.2.3.7.2. Bell and Spigot with Rubber Gasket. The standard joint is bell and spigot with rubber gasket at locations where other joint types are not specified and for working pressures not exceeding 250 psi. Joints must conform to AWWA Standards C-200 and AWWA M-11. Form and size the spigot and groove designed to retain the O-ring rubber gasket and size by rolling on male-female dies to match the bell. The differences in diameter between the I.D. of bell and the O.D. of spigot shoulder, at point of full engagement with allowable deflection, is 0.00" to 0.04" as measured on the circumference with a diameter tape. Provide gasket with sufficient volume to approximately fill the area of the groove in conformance to AWWA C-200 and AWWA M-11. Ensure that the joint is suitable for a safe pressure equal to the pressure class of the pipe and operates satisfactorily with a deflection tangent not to exceed 0.75D where D is the outside diameter of the pipe in inches or with a pull-out of 3/4 inch.
- 3.2.3.7.3. Flanged Joints. Provide flanged joints on pipe, fittings and specials on welded steel piping exposed in vaults, on buried pipe system to connect valves and appurtenances or where otherwise indicated that conform to the requirements of AWWA C-207 and AWWA C-206. Ends to be fitted with slip-on flanges must have the longitudinal or spiral welds ground flush to accommodate the type of flanges provided. Rate pipe flange pressure equal to or greater than the adjacent pipe class and match the fittings or appurtenances that are to be attached.
- 3.2.3.7.4. Butt Strap Closure Joints. Provide butt strap closure joints in accordance with AWWA C-206 and applicable provisions of this specification where necessary to provide closure to previously laid pipe.
- 3.2.3.7.5. Flexible Couplings. Provide flexible couplings where specified. Prepare ends to be joined by flexible couplings as stipulated in AWWA C-200 with plain end type. Ground flush welds on ends to be joined by couplings to permit slipping the coupling in at least one direction to clear pipe joint. Provide harness bolts and lugs that comply with AWWA Manual M-11.
- 3.2.3.8. Fittings and Specials. Employ special shop fabricated fittings fabricated in accordance with AWWA C-200 and M-11 where abrupt changes in grade and direction occur. Provide fittings in conformance to the dimensions specified in AWWA C-208. Provide elbows with a minimum radius of 2.5 times the pipe O.D. Provide welded fittings of the sizes and types indicated on the plans. Provide steel plate thickness for fittings equal to or greater than nominal thickness of steel pipe. Reinforce all tees, laterals, and outlets in accordance with M-11. Do not field cut the ends of the steel pipe to accomplish angular changes in grade or direction of the line.
- 3.2.3.9. Provisions for Thrust. Use restrained joints to resist thrust at bends, tees, or other. If thrust cannot be resisted using restrained joints, such as bends adjacent to casing pipe, use thrust blocking or concrete anchors. Restrained joints consist of welded joints and will be used a sufficient distance from each side of the bend, tee, plug, or other fitting to resist thrust which develops at the design pressure of the pipe. For the purposes of thrust restraint, use a design pressure of 1.5 times the working pressure class. The length of pipe with restrained joints to resist thrust forces will be determined by the pipe manufacturer in accordance with AWWA Manual M-11. Apply the following criteria for unsaturated soil conditions: calculate the earth weight as the weight of the projected soil prism above the pipe, soil density = 110 pcf (maximum value to be used) and the coefficient of friction = 0.25 (maximum value to be used). In locations where groundwater is encountered, reduce the soil density to its buoyant weight for all backfill below the water table and reduce the coefficient of friction to 0.20.
- 3.2.3.10. Pipe Trenching, Installation, and Backfill. Except as noted, Pipe Trenching, Installation, and Backfill for DIP will be in accordance with AWWA C-600 and Article 6 of this Specification.

- 3.2.3.10.1. General. Inspect and "jeep" each joint for holidays just before it is lowered into the ditch. Repair all holidays before the pipe is lowered into the trench. Place and consolidate embedment and backfill prior to removing pipe stulls.
- 3.2.3.10.2. Trench Width. The minimum clear width of the trench is the outer diameter plus 36 inches.
- 3.2.3.10.3. Pipe Embedment. Unless otherwise specified or shown on the plans, embed steel pipe in Native material as defined in Article 6. If Native material is not suitable, use Class II material as defined in Article 6.2.4.2
- 3.2.3.10.4. Installation-Welded Joints. Weld joints in accordance with the AWWA C-206. Provide full circle fillet welds. Remove the pipe from the line if the ends of the pipe are laminated, split, or damaged to the extent of satisfactory welding contact cannot be obtained.

Welders are required to identify their work with a code marking. Furnish a listing of the welder's names with corresponding code marks. Any welder making defective welds will not be allowed to continue to weld. If a disagreement arises with the Engineer's interpretation of welding tests, test sections may be cut from the joint for physical testing. Repair joint, regardless of the results of physical testing, at no additional cost to the Department. Submit repair procedure for approval before proceeding.

Provide adequate provisions for reducing temperature stresses.

Shim or tack the spigot and bell essentially concentric to obtain clearance tolerance around the periphery of the joint after the pipes have been joined and properly aligned and prior to the start of the welding procedure. Clearance tolerances are not permitted to accumulate.

Before welding, thoroughly clean pipe ends. Weld pipe by machine or by the manual shielded electric arc process. Perform welding in a manner that does not damage lining or coating. Cover the tape coating as necessary to protect from welding.

Furnish labor, equipment, tools and supplies, including shielded type welding rod. Protect welding road from any deterioration prior to its use. If any portion of a box or carton is damaged, reject entire box or carton.

Deposit metal in successive layers so that there will be at least 2 passes or beads in the completed welds. Deposit no more than 1/4 inch of metal on each pass. Thoroughly clean each pass, including the final pass, by wire brushing and hammering to remove dirt, slag, or flux.

In all hand welding, deposit metal in successive layers so that there are at least as many passes or beads in the completed weld as indicated in Table 1.

**Table 1.
Hand Welding Requirements**

Plate Thickness Inches	Fillet Weld, Minimum Number of Passes
3/16	1
1/4	2
5/16	2
3/8	3
13/32	3
7/16	3
15/32	4
1/2	4
More than 1/2	1 for each 1/8" and any remaining fraction thereof

Do not deposit more than 1/8" of metal in each pass for hand welds. Thoroughly bob or peen each pass except the final one, whether in butt or fillet welds, to relieve shrinkage stresses and to remove dirt, slag, or

flux before the succeeding bead is applied. Thoroughly fuse each pass into the plates at each side of the welding groove or fillet and do not permit to pile up in the center of the weld. Undercutting along the side is not permitted.

Construct welds free from pin holes, non-metallic inclusions, air pockets, undercutting and/or any other defects.

- 3.2.3.10.5. Installation – Rubber Gasket Joints. Join rubber gasket joints in accordance with the manufacturer's recommendations. Clean bell and spigot of foreign materials. Lubricate gaskets and relieve gasket tension around the perimeter of the pipe. Engage spigot as far as possible in bell, allowing for a 3/8 inch to 1 inch gap for inside joint grouting after any joint deflection.
- 3.2.3.10.6. Interior Joint Grouting for Pipe with Plant-Applied Mortar Lining. Upon completion of backfill, fill the inside joint recess with a stiff cement mortar as indicated. Prior to the placing of mortar, clean out dirt or trash that has collected in the joint, and moisten the mortar surfaces of the joint space by spraying or brushing with a wet brush. Ram or pack the stiff mortar into the joint and take extreme care to insure that no voids remain in the joint space. After the joint has been filled, level the surface of the joint with the interior surfaces of the pipe by steel troweling. Carefully inspect every joint to ensure a smooth continuous interior surface. Thoroughly clean the interior of the pipe and remove any obstructions that may reduce its carrying capacity. Butter with mortar the bottom of the bell on the interior joints of pipe smaller than 21 inches in diameter prior to inserting the spigots, such that when the spigot is pushed into position it extrudes surplus mortar from the joint. Strike off the surplus mortar flush by pulling a filled burlap bag or inflated ball through the pipe.
- 3.2.3.10.7. Field-Applied Outside Joint Coating. Clean the surface of foreign materials. Remove weld slag, splatter, and scale. Remove by grinding or filing the sharp edges or burrs that could puncture or cut the tape. Clean the surface using a solvent wash and wire brushing, dry, and prime the surface prior to tape coating. Wrap joints with a tape coating system conforming to AWWA C-209, consisting of three layers, a primer layer and two (2) 35 mm tape layers. Overlap the factory-applied coating system with the field-applied coating system a minimum of 6 inches and bond together.
- 3.2.3.10.8. Protection of Exposed Metal. Coat exposed ferrous metal such as bolts and flanges that cannot be protected with field-applied tape coatings with a coat of Koppers Bitumastic No. 50 or approved equal.
- 3.2.3.10.9. Patch of Coating: When visual inspection shows a portion of the tape system has sustained physical damage, the area in question may be subjected to an electrical holiday test to 6000 volts. When the area is tested and there are no holidays or tearing of the material (only wrinkling or bruising), no patching is required. When the damaged area has a tearing of material, remove the damaged layer(s) of outer-wrap by carefully cutting with a sharp razor type utility knife. Wipe the area clean and dry with a rag. Apply the repair tape using a "cigarette wrap" in accordance with the tape manufacturer's recommendation of sufficient size to completely cover the damaged areas, plus a minimum overlap of 6 inches tape in all directions. Apply a second patch of repair tape over the first patch. Overlap the first patch a minimum of 6 inches with the second patch.
- 3.2.3.10.10. Patch of Lining. Repair cracks larger than 1/16 inch and disbonded linings. Excessive patching of lining is not permitted. Field-patching of lining will be allowed where area to be repaired does not exceed 100 sq. in. and has no dimension greater than 12 inches. Repair larger areas by gunite method and reinforce work. No more than one patch in the lining of any joint of pipe is allowed. Wherever necessary to patch the pipe, make the patch with the mortar indicated. Do not install patched pipe until the patch has been properly and adequately cured and unless approved for laying by the pipe manufacturer's technician and by the Engineer.
- 3.2.3.11. Testing. Disinfect the piping system in accordance with Article 10 of this Specification and as detailed in AWWA C-651. Test the field-applied joint coating for holidays after field-applied coating and prior to backfilling as per AWWA C-209. Where welds cannot be tested by hydrostatic tests, such as fittings adjacent to test valves, perform a dye penetrant test in accordance with ASTM E-165. Replace or repair welds that prove to be defective. Engineer must approve all patch work necessary during such tests.

3.2.4. Cathodic Protection.

3.2.4.1. Anodes. Magnesium bar in pre-packaged backfill with test lead wire in weights shown on plans.

3.2.4.2. Chemical Composition of Magnesium Anodes: Percent by weight in accordance with Table 2.

Table 2.
Chemical Composition of Magnesium Anodes

Chemical	Standard	High Potential
Aluminum	5.0-7.0	0.01 Max.
Zinc	2.0-4.0	0.05 Max.
Manganese	0.150 Min.	0.5-1.30
Copper	0.100 Max.	0.02 Max.
Silicon	0.300 Max.	0.05 Max.
Iron	0.003 Max.	0.03 Max.
Nickel	0.003 Max.	0.001 Max.
Others	0.300 Max.	0.50 each or 0.300 Max Total
Magnesium	Balance	Balance

3.2.4.3. Pre-packaged Backfill.

- 75 percent ground hydrated gypsum
- 20 percent powdered bentonite
- 5 percent anhydrous sodium sulfate
- In water permeable fabric sack with anode centered in sack

3.2.4.4. Lead Wire: No. 12 AWG 600 volts solid copper wire with THW, THWN, or THHN white insulation, at least 15-feet long and factory connected to core with silver brazing alloy with minimum silver content of 15 percent.

3.2.4.5. Detectable Warning Tape. Yellow Mylar encased aluminum foil, minimum 6 inches wide, with imprinted words "CATHODIC PROTECTION".

3.2.4.6. Thermite Welding Of Wires. Thermite weld test lead and joint bond wires to ductile iron and steel pipe joints and fittings, except where limited use of lugs is permitted following standard details. This weld process may be specified for use on other metallic structures.

3.2.4.7. Select and use thermite welding equipment following equipment manufacturer's instructions and standard details.

- Use equipment and molds to accommodate wire size, metallic structure's shape, wire position of attachment (vertical or horizontal) and other criteria specified.
- Before a mold is used, remove and clean slag, dirt, and other foreign matter from mold.
- Use cartridge and charge size based on manufacturer's recommendations for specific application.
- Different charges are required for steel and ductile iron.

3.2.4.8. Surface Preparation

Surfaces with Little or No Coating. Clean to bare metal by grinding or filing area approximately 3-inches square to produce bright metal surface. Remove coating, dirt, mill scale, oxide, grease, moisture, and other foreign matter from weld areas.

Surfaces with High Performance or Thick Coating. Cut 4 inch square window through coating and clean 3 inch square of surface to bright metal, avoiding damage to surrounding coating.

- 3.2.4.9. Preparation for Welding. Before welding, remove wire insulation as required to fit mold, avoiding damage to exposed copper wire
- If wire is cut or nicked over half way through its diameter, cut off and strip new end.
 - If manufacturer requires use of copper sleeve, crimp it securely to wire and remove excess wire protruding from end of sleeve.
- 3.2.4.10. Test Connection. After charge is set, remove mold and slag from weld area with welder's hammer. Strike top and sides of weld with hammer to test secureness of connection. If weld does not hold, remove scrap weld material, clean, and begin weld process again. After welding and before coating cleaned weld area, joint bond wires may be test for electrical continuity.
- 3.2.4.11. Weld Caps. When weld passes test for soundness and electrical continuity, repair coating in weld area with petrolatum or petroleum wax mastic and weld cap placed over weld following standard details.
- Apply mastic to fill weld cap or pre-filled weld cap and cover exposed metal of structure and wire to minimum thickness of 1/4 inch. Repair damage to coating around weld area following coating manufacturer's recommendations.
 - If weld cap will not fit due to physical space limitations, coat bare metal and wire in weld area with minimum 1/4-inch thickness of petrolatum or petroleum wax mastic
- 3.2.5. **Flowable Backfill.** Backfill trenches to the elevations shown with flowable backfill as per Item 401, "Flowable Backfill".
- 3.2.6. **Cutting and Restoring Pavement.** Where water facilities must be installed in streets or other paved areas beyond limits of the roadway improvements, the work includes saw-cutting of the pavement and base to neat lines and prompt replacement of these materials after water excavation and backfill are completed. The replacement materials, as to type and thickness, are shown on the plans.
- 3.3. **Measurement.**
- 3.3.1. **Water Main (PVC).** This Item will be measured in place by the linear foot of PVC along the centerline of pipe as installed.
- 3.3.2. **Water Main (DIP).** This Item will be measured in place by the linear foot of DI pipe along the centerline of pipe as installed.
- 3.3.3. **Water Main (STEEL).** This Item will be measured in place by the linear foot of STEEL pipe along the center line of pipe as installed.
- 3.3.4. **Abandon and Fill Existing Water Pipe.** This Item will be measured by the linear foot of existing water main pipe that is abandoned in place for the size indicated
- 3.3.5. **Remove Existing Water Pipe.** This Item will be measured by the linear foot of existing water main pipe that is removed as identified in the plans.
- 3.3.6. **Cutting and Restoring Pavement.** This Item will be measured by the square yard as shown under Item 400, "Excavation and Backfill for Structures.
- 3.3.7. **Flowable Backfill.** This Item will be measured by the cubic yard as shown under Item 401, "Flowable Backfill".
- 3.4. **Payment.**
- 3.4.1. **Water Main (PVC).** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Water Main (PVC)" of the type and size specified. This price is full compensation for furnishing all required materials, including all

pipe, valves, fittings and accessories; mechanical joint restraints; and all appurtenances defined herein to include, but not limited to the following items: gate valves, tapping sleeves and valves, butterfly valves with manholes, air/vacuum release valves, blow-off valve assemblies, bonnet boxes, valve/access manholes, concrete collars, end plugs, bends, tees, couplings, reducers, marking tape, concrete thrust blocks, thrust restraint devices and all other items for the project not indicated as being covered under the other specific bid items shown on the proposal; furnishing all required labor, including coordination, traffic control, potholing, excavation, including hand-digging, if needed; embedment and backfilling; compaction and compaction testing; disinfection, pressure testing, dewatering of groundwater, where required; cutting, capping, and connection of new water main to existing water lines.

All fittings and appurtenances shown on the plans will not be paid for directly but will be subsidiary to the water pipe installation.

Cutting and restoring pavement will be paid for in accordance with Item 400, "Excavation and Backfill for Structures". Flowable fill will be paid for in accordance with Item 401, "Flowable Fill". Trench excavation protection will be paid for in accordance with Item 402, "Trench Excavation Protection".

- 3.4.2. **Water Main (DIP).** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Water Main (DIP)" of the type and size specified. This price is full compensation for furnishing all required materials, including all pipe, valves, fittings and accessories; mechanical joint restraints; and all appurtenances defined herein to include, but not limited to the following items: gate valves, tapping sleeves and valves, butterfly valves with manholes, air/vacuum release valves, blow-off valve assemblies, bonnet boxes, valve/access manholes, cathodic protection, concrete collars, end plugs, bends, tees, couplings, reducers, marking tape, polyethylene wrap, concrete thrust blocks, thrust restraint devices and all other items not indicated as being covered under the other specific bid items; furnishing all required labor, including coordination, traffic control, potholing, excavation, including hand-digging, if needed; embedment and backfilling; compaction and compaction testing;; disinfection, pressure testing, dewatering of groundwater, where required; cutting, capping, and connection of new water main to existing water lines.

All fittings and appurtenances shown on the plans will not be paid for directly but will be subsidiary to the water pipe installation.

Cutting and restoring pavement will be paid for in accordance with Item 400, "Excavation and Backfill for Structures". Flowable fill will be paid for in accordance with Item 401, "Flowable Fill". Trench excavation protection will be paid for in accordance with Item 402, "Trench Excavation Protection".

- 3.4.3. **Water Main (STEEL).** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Water Main (STEEL)" of the type and size specified. This price is full compensation for furnishing all required materials, including all pipe, valves, fittings and accessories; welded joint restraint systems; and all appurtenances defined herein to include, but not limited to the following items: gate valves, tapping sleeves and valves, butterfly valves with manholes, air/vacuum release valves, blow-off valve assemblies, valve/access manholes, cathodic protection, bonnet boxes, concrete collars, end plugs, bends, tees, couplings, reducers, marking tape, concrete thrust blocks, welded thrust restraint and all other items for the project not indicated as being covered under the other specific bid items shown on the proposal; furnishing all required labor, including testing, coordination, traffic control, potholing, excavation, including hand-digging, if needed; embedment and backfilling; compaction and compaction testing; disinfection, pressure testing, dewatering of groundwater, where required; cutting, capping, and connection of new water main to existing water lines.

All fittings and appurtenances shown on the plans will not be paid for directly but will be subsidiary to the water pipe installation.

Cutting and restoring pavement will be paid for in accordance with Item 400, "Excavation and Backfill for Structures". Flowable fill will be paid for in accordance with Item 401, "Flowable Fill". Trench excavation protection will be paid for in accordance with Item 402, "Trench Excavation Protection".

- 3.4.4. **Abandon and Fill Existing Water Pipe.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Abandon and Fill Existing Water Pipe" of the size specified. This price is full compensation for furnishing all required materials, labor, and equipment, including but not limited to the following items: coordination, traffic control, potholing, excavation, complete draining (dewatering) of pipe, flowable backfill, cutting, capping, complete filling with approved flowable backfill of water mains to be abandoned, removal of bonnet boxes from abandoned valves, and all other items for the project not indicated as being covered under the other specific bid items shown on the proposal.
- 3.4.5. **Remove Existing Water Pipe.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Remove Exist Water Pipe" of the size specified. This price is full compensation for furnishing all required materials, labor, and equipment, including but not limited to the following items: coordination, traffic control, potholing, excavation and backfill, complete draining (dewatering) of pipe, groundwater dewatering, flowable backfill, cutting, capping, removal of pipe, disposal of materials, and all other items not indicated as being covered under the other specific bid items.

4. CONCRETE

- 4.1. **Description.** Furnish all labor, materials, equipment and incidentals necessary to mix and place concrete, consisting of Portland cement, fine aggregate, coarse aggregate, admixtures, and water in the proper proportions as specified herein for use in Water and Sewer Mains.
- 4.2. **Materials.**
- 4.2.1. Quality Assurance. Proportion cement to give the necessary workability and strength and conform to the requirements shown on Table 3.

Table 3.
Cement Requirements

CLASS	MINIMUM 28-DAY COMPRESSIVE STRENGTH	MINIMUM CEMENT	MAXIMUM SIZE COARSE AGGREGATE	SLUMP (inches)
A	3,000 psi	5.5 bag/cy	3/4"	3 1/2"
B	2,500 psi	4 bag/cy	1 1/2"	4"
C	4,000 psi	6 bag/cy	3/4"	4"

- 4.2.2. Class Designations. The class designations provided above are as defined by El Paso Water Utilities (EPWU) and are to be used as listed:
- Class A Use for curb, gutter, and sidewalk replacement, unless otherwise directed.
 - Class B Use for thrust blocks, pipe encasement, ground anchors for piping and as noted in the plans.
 - Class C Use for cast in place sewer manhole bases, special structures or as required by manufacturer's specifications for pre-cast structures, unless otherwise indicated.
- 4.2.3. Submittals. Submit certified test reports regarding concrete mix design and reinforcing steel as may be required by the plans or the Engineer. Submit in a timely manner so as not to delay the project. Allow sufficient time for Engineer's review and resubmission, if necessary.
- 4.2.4. Standards. Comply with the following applicable requirements for concrete and related products:
- ASTM C-33 Specification for Concrete Aggregates
 - ASTM C-150 Specification for Portland Cement
 - ASTM C-260 Specification for Air-Entraining Admixtures for Concrete
 - ASTM C-494 Specification for Chemical Admixtures for Concrete

4.2.5. Portland Cement. Conform to ASTM C-150 for the appropriate required Type.

Aggregates. Conform to ASTM C-33. Use fine aggregate consisting of natural, washed, and screened sand having clean, hard, strong, durable, un-coated grains complying with ASTM C-33. Use coarse aggregates that comply with ASTM C-33 Size 467, Size 57, or Size 67. Local aggregates of proven durability may be used with prior approval

Use air-entraining admixture for concrete of 3,000 psi or greater and complies with ASTM C-260. The total average air content will be in accordance with ACI 211.1.

Use water reducing admixture when required by job conditions in conformance with ASTM C-494. Use only admixtures that have been tested and accepted in mix designs, unless otherwise acceptable. Use according to manufacturer's recommendations.

Use set retarding admixtures as approved, in conformance with ASTM C-494 and according to manufacturer's recommendations.

Use water that is clean and free from impurities. Drinking and ordinary household water is acceptable.

4.2.6. Manufactured Products. Provide forms of wood or metal of sufficient strength to support the concrete without bulging between supports and sufficiently water tight to hold the concrete mortar. Construct forms to the shape and dimensions of finished concrete shown on the plans. For exposed surfaces, provide form work material and construct to produce a smooth, even surface when the concrete is poured. Oil all forms before use. Remove wall forms after the concrete has been in place for 24 hours. Chamfer all exposed edges 3/4 inch chamfer. Repair any honeycombed sections immediately upon removal of the form as directed.

Embedded Items. Accurately set in place and maintained in position during concreting operations all bolts, pipe, pipe sleeves, inserts, or other fixtures, required by the plans or this specification to be embedded in the concrete.

Reinforcing Steel. Provide bar reinforcement that is round, deformed bars, Grade 60, conforming to either "Specification for Rail Steel Deformed and Plain Bars for Concrete Reinforcement" (ASTM A-616), or "Specifications for Axle Steel Deformed and Plain Bars for Concrete Reinforcement" (ASTM A-617).

- Rail Steel Bars will be permitted only where bending is not required.
- Permanently mark all reinforcement bars with grade identification marks or, on delivery, be accompanied by a manufacturer's guarantee of grade that will identify variation.
- Protect reinforcement stored on the site from accumulation of grease, mud or other foreign matter and from rust producing conditions.
- Ensure that bars are free from rust, scale, oil, mud, or structural defects when incorporated in the structures.
- Accurately place and securely hold in place reinforcement during concrete placement in accordance with the ACI Detailing Manual.

4.2.7. Concrete Thrust Blocking. Block with concrete all underground piping bearing solidly against undisturbed trench walls, at all changes in direction subsidiary to the installation of fittings, valves, and all other appurtenances requiring provisions for thrust restraint.

Place concrete blocking against undisturbed trench walls with a minimum 18 inches between trench wall and pipe extending a minimum of 0.75 times the pipe diameter shown on Table 4 and above the centerline of pipe. Do not extend beyond any joints. Place blockings in accordance with the recommendations of "A Guide for the Installation of Ductile Iron Pipe" published by Cast Iron Pipe Research Association. If requested, contain the ends of the thrust blocks in wood or metal forms. Reinforce concrete anchor where upward thrusts are to be resisted.

Use Class B concrete for Blocking. The minimum area of concrete bearing against undisturbed trench bank is shown on Table 4.

Table 4.
Bearing Surface Per Bend

PIPE SIZE	TEE, DEAD END, 90 DEGREE BEND	45 AND 22-1/2 DEGREE BEND
6"	4 sq. ft.	3 sq. ft.
8"	6 sq. ft.	3 sq. ft.
12"	13 sq. ft.	7 sq. ft.
16"	23 sq. ft.	12 sq. ft.
20"	37.02 sq. ft.	20.04 sq. ft.

- 4.3. **Measurement and Payment.** The work performed and the materials furnished in accordance with this Article will not be measured or paid for individually as it is considered subsidiary to the various water main bid items and related appurtenances items. This includes furnishing all required materials including concrete used for thrust blocking or anchoring fitting (bends, plugs, reducers, etc.), valves, fire hydrants, manholes, water services or water fire lines, and all other concrete items damaged by Contractor due to negligence during the course of the project; and all hauling, mixing, manipulation, tools, labor, equipment, forming and incidentals necessary to complete the work.

5. GROUT

- 5.1. **Description.** Provide all labor, materials, equipment, and incidentals for grout uses other than masonry.
- 5.2. **Materials.**
- 5.2.1. Non-shrink, Epoxy Type. Provide a non-metallic, 100% solids, high strength epoxy grout such as Epoxite as manufactured by A.C. Horn Company, or Five Star Epoxy Grout by U.S. Grout Corporation, or approved equal.
- 5.2.2. Non-shrink, Non-metallic Type. Provide a premixed non-staining cementitious grout requiring only the addition of water at the job site. Provide Darex In-Pakt Grout Pre-mix by A.C. Horn Company, or Masterflow 713 by Master Builders Company, or approved equal.
- 5.2.3. Ordinary Cement-Sand Grout. Consisting of one part by weight of Portland cement complying with ASTM C-150, Type V, to three parts by weight of clean sand of suitable gradation and complying with ASTM C-33. Ordinary grout may be of masonry cement, 4 sacks per cu. yd. of clean sand, together with approved air-entraining agent and a minimum of clean water for placing. Where water repelling and shrinkage reducing requirements are shown or specified, use approved admixtures.
- 5.2.4. Water. Use clean, fresh, potable water free from injurious amounts of oils, acids, alkalies, or organic matter.
- 5.3. **Standards.** Comply with the following applicable requirements:
- ASTM C-33 "Specification for Concrete Aggregates"
 - ASTM C-150 "Specification for Portland Cement"
- 5.4. **Measurement and Payment.** The work performed and the materials furnished in accordance with this Article will not be measured or paid for individually as it is considered subsidiary to the various water main bid items.

6. EXCAVATION, INSTALLATION, AND BACKFILL

- 6.1. **Description.** Excavation classification is defined as "unclassified" and involves removing unnecessary materials and excavating trenches to the alignment, width, and depth as indicated in the plans or as required

for the proper installation of the pipe and appurtenances. Protect adjacent structures from damage by construction equipment. Pile all excavated material along the trench in a manner that will not endanger the work.

6.2. **Materials.**

6.2.1. Standards. Comply with the following applicable requirements for embedment materials:

- ASTM D-75 "Methods for Sampling Aggregates"
- ASTM D-448 "Specification for Standard Sizes of Coarse Aggregate for Highway Construction"
- ASTM D-2321 "Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe"
- ASTM D-2487 "Classification of Soils for Engineering Purposes"

6.2.2. Definitions. For the purpose of this specification, "pipe zone" defines the area extending from the bottom of the trench bedding to 12 inches above the top of the pipe and to the undisturbed trench walls on either side of the pipe. "Embedment" is defined as those vertical stratas of backfill material in the pipe zone consisting of bedding, haunching, and initial backfill, as defined in ASTM D-2321.

6.2.3. Submittals. Include certified test reports for embedment material from an independent laboratory. Include sieve analysis and Atterberg's limits on test reports. Submit a gradation of Class I material for approval prior to installation.

6.2.4. Pipe Zone and Backfill. Classify materials according to The Unified Soil Classification System as defined in ASTM D-2487.

Class I Material. Provide manufactured angular, well-graded, crushed stone per ASTM D-2321, 1/4 inch to 3/4 inch size material. Acceptable materials under this class designation are: ASTM D-448 - Stone Sizes 4, 67, 5, 56, 57, and 6. Pea Gravel and other uniformly graded material are not acceptable under this class.

Class II Material. Provide coarse sands and gravels per ASTM D-2487 with maximum particle size of 3/4 inch, including variously graded sands and gravels, containing less than 5 percent fines (material passing the #200 sieve) generally granular and non-cohesive, either wet or dry. Soil Types GW, GP, SW and SP are included in this class.

Class III Material. Provide fine sand and clayey (clay filled) gravels, per ASTM D-2487, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Class III includes soil Types GM, GC, SM and SC.

Do not use Class IV or V material, as defined in ASTM D-2487, for embedment of flexible pipe.

6.2.5. Final Backfill. Unless otherwise shown, material for backfilling above the pipe zone is defined as follows:

Native. The most granular material excavated from the trench comprising the spoil bank may be used, provided it is devoid of rocks larger than three inches in greatest dimension, organic material, and other unsuitable material. If initially saturated during the excavation, allow backfill to dry sufficiently, being manipulated if necessary, prior to placing back into trench, to achieve the specified compaction at plus or minus 2 percent of optimum moisture content.

Select. Select material is designated as Class II as described in 6.2.4.2. If material excavated from the trench is unsuitable as backfill material, or the required compaction is unattainable for the particular spoil backfill material, import select material to be mixed with or used in place of the spoil material.

Soil Cement. When shown on the plans, cement stabilized backfill will consist of a mixture of soil or sand and 2 sacks of Portland cement per cubic yard. Use a sandy material, free from lumps, clods or organic material. If excavated material is not suitable, use pit-run sand. Mix cement stabilized backfill in a concrete mixer or transit mixer.

6.3. **Construction.**

6.3.1. Sources and Evaluation Testing. Obtain materials to be used for embedment and for backfill in accordance with a sampling plan and ASTM D-75. Perform testing of materials to certify conformance with specification requirements by an approved independent testing laboratory. Perform tests and provide results upon change of source and at sufficient intervals to certify conformance of all material furnished.

6.3.2. Trench Excavation and Preparation. Construct trench walls in the "pipe zone" vertically.

Trench Width. See Tables 5 and 6 below for trench widths for flexible and rigid pipes.

**Table 5.
Flexible Pipe Trench Width**

PIPE DIAMETER	TRENCH WIDTH = BARREL OUTER DIAMETER PLUS	
	Minimum	Maximum
Less than 24 inch	15 inches	18 inches
24 inch – 48 inch	18 inches	24 inches
Greater than 48 inch	24 inches	1/2" Pipe O.D.

**Table 6.
Rigid Pipe Trench Width**

Do not exceed the outside diameter of the pipe barrel plus the following allowance for RIGID PIPE trench width:	
PIPE DIAMETER	TRENCH WIDTH = BARREL OUTER DIAMETER PLUS
Less than 18-inch	16 inch
18 inch - 24 inch	19 inch
27 inch – 39 inch	22 inch
42-inch & Larger	½ Pipe O.D.

If maximum trench width specified above is exceeded at the top of the pipe, provide additional load-bearing capacity by means of improved bedding, concrete cradle, cap, or encasement, or other approved means

Lay back or bench the trench walls above the pipe zone, where space permits, as necessary to satisfy the requirements of OSHA and additional requirements for Trench Support as specified herein.

Wherever the prescribed maximum trench width is exceeded, remove all loose and sloughed-in material from the trench and replace with compacted granular material such that haunching and initial backfill is compacted to at least 2.5 pipe diameters from either side of the pipe or to the trench walls.

Unless otherwise agreed upon, no additional payment will be made for extra material and labor required to fill excessive trench widths caused by Contractor's equipment or natural collapse of trench walls.

6.3.3. Trench Bottom. Excavate the trench to an even grade so that the full length of the pipe barrel is supported and joints may be properly assembled.

For 30 inch diameter and smaller pipe, "rough cut the trench a minimum of 4 inches below the bottom of the pipe. For 33 inches and larger pipe, "rough cut the trench a minimum of 6 inches below the bottom of the

pipe. Increase the "rough cut" dimension as necessary to provide a minimum clearance of 2 inches from the bottom of the trench to the bottom of the bells, flanges, valves, fittings, etc.

The entire foundation area at the bottom of all excavations will be firm, stable material. Remove loose material leaving a clean, flat trench bottom. Do not disturb material below required subgrade except as described elsewhere in this specification.

If the subgrade is soft, spongy, disintegrated, or where the character of the foundation materials is such that a proper foundation cannot be achieved at the elevation specified, deepen the excavation, not less than 6 inches to a depth where a satisfactory foundation may be obtained. Bring back subgrade to the required grade with Class I coarse gravel compacted to 70% relative density per ASTM D-4254.

- 6.3.4. Over Excavation. If the trench is excavated to a faulty grade (at a lower elevation than indicated), correct the faulty grade at no additional cost as follows:
- In uniform, stable dry soils, correct the faulty grade with Class II granular embedment material thoroughly compacted to 90% Modified Proctor Density per ASTM D-1557.
 - In soft spongy disintegrated soils, or where necessary to allow proper drainage, correct the faulty grade with Class I coarse gravel compacted to 70% of relative density.
- 6.3.5. Rock Excavation. When pipe is to be laid in rock cut, provide a clearance of at least 6 inches below parts of the pipe, valves or fittings. Provide adequate clearance at bell holes to permit proper jointing of pipe laid in rock trenches. Refill excavation to pipe grade with Class II granular embedment material compacted to 90% Modified Proctor Density. Blasting is not be permitted unless specifically required and called for in the plans and with a permit issued by governing authorities.
- 6.3.6. Bell Holes. Dig, in trenches, bell holes of ample dimension at each joint of pipe to permit the jointing to be made properly, visually inspected, and so that the pipe will rest on the full length of the barrel.
- 6.3.7. Dewatering. Dewater excavations by physically installing/drilling dewatering wells, laying of discharge piping, other preparatory work and the maintenance of the operating system so that the work is performed in dry conditions.

Use coarse gravel and geo-synthetic material to maintain the integrity of pipe and embedment material. Geo-synthetic material must wrap completely around pipe and gravel.

Determine and record the elevation of the groundwater level prior to dewatering. Unless otherwise specified, the method of dewatering will maintain a phreatic water surface a minimum of 18 inches below pipe grades. Should over-excavation be necessary due to unsuitable foundation conditions, lower the ground water as necessary.

Direct water removed from trenches to natural drainage ways, drains, or storm sewers in such a manner as to prevent damage to adjacent property or to the public. Provide pumps of ample capacity and in duplicate to ensure that once an excavation is dried, the water level remains below the trench depth until that portion of the work is completed. Obtain approval for discharge from the appropriate governing agency. Do not discharge into the sanitary sewer systems.

Determine if any wells used for domestic purposes are affected by the dewatering and furnish potable water to any affected residents when dewatering may affect the production of private wells along the route. Prepare baseline water level analysis in area to confirm affect on private wells.

Dispose of the water from the dewatering operation according to the conditions of the discharge permit. Coordinate dewatering effort with El Paso Water Utilities Engineering staff, insofar as compliance with discharge permit is concerned, and where dewatering effluent will enter drainage ditches operated and maintained by the Department.

Equip engines or engine generators used to run the dewatering pumps with residential grade silencers. Provide silencers that have an attenuation range of 25 to 30 dBA as required by the El Paso Municipal Code, Title 9, Chapter 9.40.

Submit a dewatering plan indicating proposed locations of dewatering wells, pumping facilities, collector and discharge pipe-lines, and discharge points (names of ditches, laterals, etc.). If discharging into El Paso County Water Improvement District No. 1 (EPCWID #1) drains, provide the plan for EPCWID#1 comments and approval. To comply with the requirements of the discharge permit between EPWU and the EPCWID #1, provide discharge monitoring points. EPWU personnel will obtain samples for laboratory analysis to check water quality limitations imposed by the permit.

Record pumping rates at dewatering wells, pump times, and flows and become familiar with the methods of measurements as shown on Table 7.

**Table 7.
Pumping Rates Schedule**

DATA RECORDED	METHOD OF MEASUREMENT	FREQUENCY OF MEASUREMENT
Pumping Rate At Each Dewatering Well or Discharge Point	"California-Pipe Method"	Daily If Changes Occur
Pumping Time	Hours	Daily
Total Dissolved Solids (TDS)	PSB Laboratory	Monthly
Total Discharge	Rate x Time	Continuous

Record obtained data on a standard data sheet and submit monthly. Comply with EPCWID #1 requirements and allow EPCWID#1 inspection of dewatering system at any time during project life.

Submit a Dewatering Plan, a Final Schedule for Dewatering, and an estimate of fees due EPCWID #1 within fifteen (15) working days from the date of the Notice to Proceed. The Plan is a mandatory submittal and must include the estimated quantities of dewatering for each month and the point(s) of discharge. The Engineer will review and approve the Dewatering Submittal and forward it, through the EPWU, to the District. EPWU must receive the approved plan at least two weeks in advance of the planned dewatering operations. Dewatering Fees due are estimated on the following basis:

- Non-refundable application fee of \$1,000
- \$150 per acre-foot of estimated groundwater estimated that will be discharged into the EPCWID #1's facilities during term of the agreement
- Payment due a minimum of seven (7) calendar days in advance of any discharge.

EPWU will prepay dewatering fees to EPCWID #1 based upon the estimates in the approved Submittal. EPWU is responsible for all Dewatering Fees, including those for water pumped in addition to the quantities presented in the approved Dewatering Plan.

Provide monthly reports of discharge quantities and quality (TDS and sulfates), which specific requirements may be more particularly described in the Technical Specifications, to EPWU through the Engineer for submittal to EPCWID #1. Resolve high TDS penalties with EPCWID#1.

6.3.8.

Trench Support. Brace and sheet excavations to provide complete safety to persons working therein in conformance with applicable federal (OSHA), state and local laws and ordinances. Meet the requirements specified in the current OSHA Standard for all trenches exceeding 5 feet in depth as measured from the ground surface at the highest side of the trench to the trench bottom.

Provide sufficient and adequate bracing for excavations with respect to work under construction and to adjacent utility lines and private property. Where soil conditions within trench area require support, use tight

sheeting, skeleton sheeting, stay bracing, trench jacks, movable trench shield, or other approved methods to support the trench during pipe installation operations such as bedding preparation, pipe laying, and backfilling of haunches and initial zone.

Do not extend trench support below the pipe crown whenever possible. Where trench support must extend below the crown, such support should either be left in place or consist of approved steel sheets that can be retracted with minimal disturbance. Treat remaining voids with grout or granular embedment material.

When a movable trench shield is used, the trailing half of the shield should be notched to the height of the top of the pipe. This will allow the haunch area of the pipe to be compacted properly to the wall of the trench. Dragging of a trench shield at pipe grade may be done provided such practice does not disturb the bedding. Fill and compacted voids created by the shield properly.

- 6.3.9. Trenching in Public Right-of-Way. Except where otherwise specified, indicated on the plans, or approved in writing, do not exceed the maximum length of open trench shown on Table 8, where the construction is in any stage of completion. The definition of "open trench" for the purposes of this description includes excavation, pipe laying, backfilling, and pavement replacement. The descriptions under the area designations are general in nature and may be amended in writing by the Engineer due to particular or peculiar field conditions.

Table 8.
Maximum Open Trench Lengths

TYPE OF AREA	MAX LENGTH (LF)	DESCRIPTION
Business District	300	Store front areas
Commercial	300	Industrial, shopping centers, churches, schools, hotels, motels, markets, gas stations, government and private office buildings, hospitals, fire and police stations, and nursing homes
Residential	One (1) block or 300 linear feet, whichever is the least.	Single and multi-family residences, apartments, and condominiums
Undeveloped	1,500	Parks, golf courses, farms, undeveloped subdivided land

Any excavated areas is considered "open trench" until all pavement replacement has been made, or until all trenches outside of pavement replacement areas have been backfilled and compacted in accordance with the plans. Completely backfill trenches across streets with temporary or permanent pavement in place within 72 hours after pipe laying. An open trench is not permitted overnight, unless approved and adequately barricaded.

Provide steel plates with adequate trench shoring and bracing, designed to support traffic loads where required to bridge across trenches at street and alley crossings, commercial driveways, and residential driveways where trench backfill and temporary patch have not been completed during regular working hours. Provide safe and convenient passage for pedestrians. Maintain access to fire stations, fire hydrants, and hospitals at all times.

- 6.3.10. **Pipe Installation.** Install pipes true to lines and grades as indicated on the plans. Inspect all pipe and fittings before placing in the trench. Clean all joint surfaces and soiled materials prior to connecting one another. As work progresses, maintain interior of pipes clean.
- 6.3.10.1. Standard Cover. Standard cover depends on the water main size and installation conditions and is generally
- 6 and 8 inch diameter Main: Minimum of 4-foot cover from top of pipe to finished grade
 - 12 inch & larger diameter Main: Minimum of 5-foot cover from top of pipe to finished grade
- 6.3.10.2. Potholing. Existing utilities shown on plans are for informational purposes only. Prior to new pipe installation, pothole all existing utilities and structures to confirm their location, depth, and size. In the event

of conflict or discrepancy that affects the project design, notify Engineer before proceeding with pipe installation in order to formulate a solution

- 6.3.10.3. Pipe Zone Embedment. Unless otherwise specified or shown on the plans, embed pipelines either Class I, II, or III material defined in this Article 6.2.4 and installed as described. Native or imported material for embedment may be used provided material conforms to this Specification.

Place embedment materials in lifts not exceeding 8 inches loose depth. Unless otherwise specified or directed in writing, provide homogenous material in the embedment zone

Place bedding to provide uniform and adequate longitudinal support under the pipe. Place the first lift of bedding material from the bottom of the trench to slightly above the bottom of the pipe grade. Unless otherwise shown on the plans, provide a minimum bedding of 4 inches in depth for pipe sizes 30 inches and smaller, and 6 inches for pipe sizes greater than 30 inches.

Install material true to line and grade with bell holes of ample dimension to permit pipe to rest on the full length of the barrel and to permit joint make-up and coating application at joints. Consolidate and compact the bedding material as described in Article 6, and lay pipe to indicated grade.

Place a second lift, and if required, subsequent lifts, of embedment material to the springline of pipe. This process is defined as Haunching. Slice material under the haunches of the pipe, carefully filling all voids, and using care to prevent movement of the pipe.

Place Initial Backfill using a third lift from the springline of the pipe to the pipe crown, and a fourth lift from the pipe crown to a point 12 inches above the pipe.

- 6.3.10.4. Groundwater Installation. In areas where the pipe is installed below existing or future ground water levels, use Class I material throughout the pipe zone and enclose with a layer of approved geotechnical filter fabric. Place fabric carefully along the bottom of the trench and up the side of the trench a sufficient distance to lap over the top of the completed pipe installation. Lap fabric a minimum of 3 feet in the longitudinal at the end of one roll and beginning of the next, and lap 2 feet in the transverse at the top of pipe, except that for trench widths greater than 3 feet measured at the top of pipe, the top overlap will be 3-feet. Follow manufacturer's recommendations for installation. Provide fabric that is either Mirafi 140N, Dupont Tyvar 3401, or approved equal.

- 6.3.10.5. Embedment Class Schedule. Unless otherwise shown on the plans, use the Utility Standard Embedment Class designations for the pipe material types listed in this Article to define each particular pipe's Embedment Condition allowed. Examine the detail drawings for additional information or other special bedding requirements.

- 6.3.10.6. Consolidation Methods in Embedment Zone. Compact embedment backfill by equipment that is suitable for the type of soil encountered, and is capable of producing the degree of compaction specified. Where applicable, provide backfill materials that is moisture conditioned to produce the required degree of compaction.

Do not use flooding or jetting methods for compaction of embedment material.

Use hand or mechanical tamping to compact Class II or III material used in bedding, haunching, and initial backfill, except that the use of mechanical tampers or vibratory compactors directly over the pipe in the embedment area is prohibited. Exercise caution in the use of mechanical compactors in the haunch and initial backfill to 12 inches above the pipe to avoid damaging or misaligning the pipe.

- 6.3.10.7. Compaction and Testing of Pipe Embedment Zone. Class I material used in the embedment zone may be placed by loose dumping with a minimum of compactive effort, exercising care to assure proper placement of material under the pipe haunches.

Class I material does not specifically require testing unless directed by the ENGINEER, in which case, such test will be measured by ASTM D-4254 by percent of relative density.

Compact Class II material used in the embedment zone to a density of not less than 90% of Standard Proctor Density defined by ASTM D-698.

Compact Class III material used in the embedment zone to a density of not less than 90% of Standard Proctor Density defined by ASTM D-698.

Do not exceed a moisture content of 3% over the optimum in Class II or III material to assure proper compaction.

Unless otherwise directed, one compaction test in the embedment zone for Class II or III material will be taken at 200 feet intervals along the trench on either side of the pipe, or at any other intervals as may be judged warranted by questionable installation conditions. For pipe sizes 8 inches to 12 inches diameter, perform the first test on the side level with the top of pipe. For sizes 15 inches and larger, perform the first test at the springline of the pipe. For all sizes, perform the second test at the top of the embedment zone.

- 6.3.10.8. Density Control and Laboratory Testing. Unless otherwise specified, reference to "maximum dry density" means maximum density defined by ASTM D-1557 or D-698. Determination of density of backfill in-place, will be in accordance with the requirements of ASTM D-2922.

Unless otherwise specified, the Engineer selects a soils testing laboratory to perform initial density testing of in-place backfill and Contractor is responsible for all density testing of backfills, including tests found not to be within the minimum requirements of the specifications.

Provide laboratory materials testing, including but not limited to determination of Atterberg Limits, Proctor Curves, Grain Size Analysis, as well as laboratory certification of manufactured materials and as required by this Article

Notify the soils testing laboratory and Engineer 24 hours in advance to obtain soil density tests to fulfill the compaction requirements.

- 6.3.11. **Final Backfill.**

- 6.3.11.1. General. Backfill trench, as soon as practicable after laying and jointing of the pipe, the completion of embedment and the completion of structures. Take the necessary precautions to protect the pipe during backfilling operations.

Remove sheeting and shoring as backfilling operations progress. Incorporate methods so that a good bond is achieved between the backfill material and the undisturbed trench walls. Where sheeting or trench protection is intact below the top of pipe and their removal cause obvious damage to the bedding and haunching, it may be necessary to leave portions of sheeting or bracing in place.

Exercise caution in the use of mechanical compactors in the haunch and initial backfill to 12 inches above the pipe avoid damaging or misaligning the pipe. Provide at least 3 feet of compacted cover over the top of the pipe before the trench is wheel-loaded, and 4 feet of cover before using pneumatic hammers during compaction. Avoid contact between pipe and compaction equipment at all times.

- 6.3.11.2. Consolidation Methods. Backfill above the pipe zone to surface subgrade with backfill material as indicated on the plans and described in this Article. Compact backfill above the pipe zone by mechanical means. Water consolidation (flooding) may be used if approved.

Mechanical Compaction. Place backfill material above the pipe zone in lifts not exceeding 8 inches loose depth, moisten or aerate to obtain optimum moisture, and compact to the required density as described in this Article.

Ponding Method. When permitted, place backfill material above the pipe zone in the trench not exceeding 3 feet loose depth, and flood until free water is evident on the surface for at least two hours. Place approximately 1 foot of water in the trench and start subsequent lifts by depositing backfill material in the water until a maximum 3 foot lift is placed. Add additional water to the backfill material until free water is again evident as before. Repeat procedure until the entire trench is filled and thoroughly settled

Jetting Method of water tamping is not allowed.

6.3.11.3. **Cement Stabilized Backfill.** Stabilize backfill material with a minimum of 2 sacks per cubic yard of Portland cement of material placed. Place stabilized soil as shown on the plans under roads, driveways, concrete slabs, and in the excavation zone for structures. Cement stabilized soil placed around all adjusted manholes is subsidiary to the various manhole installation items. No compensation will be made for use of soil cement backfill at the Contractor's discretion, without prior approval, or for over-excavated trenches.

6.3.11.4. **Compaction and Testing Final Backfill.** This subsection may be superseded by the Department requirements, if stricter. Under existing or proposed paved streets, compact final backfill to the Modified Proctor Densities shown on Table 9 and as per ASTM D-1557 and to standard plan detail layouts, "Typical Trench Backfill Detail under Existing or Proposed Paved Streets".

Table 9.
Paved Street Compaction Densities

ZONE	SOIL CONDITION	% OF PROCTOR
Top of Pipe Embedment to 18 inches Below Finished Subgrade	Native Material As Specified	90%
Top of Finished Subgrade to 18 inches Below Top of Subgrade	Cohesive Non-cohesive	90% 95%

Compaction tests are required on backfill under proposed or existing streets and easements as follows, unless otherwise directed and deemed necessary.

- Tests at 8 inches below subgrade at 200 feet intervals and not less than two per street at this level
- One test for every 2 feet of vertical trench backfill between top of pipe bedding and 18 inches below subgrade at 200 feet horizontal intervals and not less than two per street at each level

Obtain density of not less than 85% ASTM D-1557 from top of pipe bedding to ground surface for all other areas not in existing or proposed paved streets.

Provisions for selection of the testing laboratory and responsibilities for density control as described in this Article also apply to this backfilling section.

6.4. **Measurement**

6.4.1. **Excavation and Backfill.** This Item will not be measured individually and is subsidiary to the installation of the various water mains, sanitary sewer mains, and related appurtenances.

6.4.2. **Cement Stabilized Backfill.** Unless shown on the plans as a pay item, quantities shown are for informational purposes. When specified as a pay item, this Item will be measured by the cubic yard as shown under Item 401, "Flowable Backfill".

6.5. **Payment.** The work performed and the materials furnished in accordance with this Article will not be measured or paid for individually as it is considered subsidiary to the various bid items for water main, sanitary sewer mains and manhole installations, including related appurtenances, such as all excavation, bedding, backfill for pipe zone (embedment), final backfill, compaction and compaction testing. Associated dewatering is subsidiary to the different materials and sizes of water mains, sanitary sewer mains, steel casings, valves, fittings and appurtenances, and service installation, including but not limited to excavation, embedment and final backfill for "Additional Fittings" as described in Article 7.

When Flowable Backfill is specified as a pay item, flowable backfill will be paid as provided in Item 401, "Flowable Backfill."

7. VALVES AND FITTINGS

7.1. **Description.** Furnish all valves and fittings as shown on the plans and as called for in this specification or as required for proper operation of the equipment in general. Unless otherwise indicated, conform to requirements as specified herein. Upon acceptance, provide and install valves similar and comparable to valves specified for similar and comparable duty in other parts of the project where proper operation and utilization of equipment and facilities require installation of valves not indicated or specified.

7.2. **Materials.** Conform to the pertinent material requirements of the items listed. Furnish complete shop drawings and specifications. If requested, submit a list of similar installations that have been in satisfactory operation for at least three years.

Furnish a complete set of installation, operation, and maintenance instructions, bound in a cover, for each type of valve furnished.

Quality Assurance. Conform to American National Standards Institute / National Sanitation Foundation (ANSI/NSF) Standard 61 "Drinking Water system Components - Health Effects" and be certified by an organization accredited by ANSI. Provide an affidavit from the manufacturer or vendor. If the pipe does not presently conform to this standard, submit information from the manufacturer regarding action being taken to comply with this standard. Include manufacturer's name or trademark permanently stamped or cast on all valves and fittings along with "No Lead" brass alloy, e.g. "NL". Design all valves installed in a given line to withstand the test pressure for that particular line and fabricate with ends to fit the piping.

7.2.1. **Valves.**

7.2.1.1. **Non-Rising Stem Double Disc Gate Valves (NRS).** Provide Non-Rising Stem Gate Valves that are iron-body, bronze mounted, parallel seat internal wedging type with non-rising stem and designed for a gauge working pressure of 200 psig. Comply with latest revisions of AWWA C-500 "Gate Valves for Water and Sewage Systems"

Provide 12 inches or smaller valves for horizontal installation with a minimum number of turns to open at least three times the valve diameter. Acceptable manufacturers and models are:

- American-Darling 52NRS (Flanged Ends), 55NRS (Mechanical Joint Ends)
- Clow F5065 (Mechanical Joint Ends), F5070 (Flanged Ends)
- Kennedy 561X (Flanged Ends), 571X (Mechanical Joint Ends)
- M&H Style 67NRS
- MuellerA-2380-6 (Flanged), A-2380-20 (Mechanical Joint Ends)

Submittals. Provide submittals for approval. Provide manufacturer's Affidavit of Compliance in accordance with Section 6.3 of AWWA Standard C-500. Provide records of all tests performed in accordance with Section 5.1 of AWWA Standard C-500 that are representative test results per Section 5.1 of AWWA Standard C-500 along with an affidavit of testing for the valve assembly as outlined in Section 6.3 of AWWA Standard C-500 (300 ft-lbs.).

Markings. Cast markings on the bonnet or body of each valve. Include the manufacturer's name or mark, the year the valve casting was made, the size of the valves, and the designated working pressure.

Valve Ends. Provide mechanical joint or flanged with drilling valve ends and size, as specified, in compliance with ANSI B16.1.

Valve Body and Bonnet. Provide in cast iron conforming to ASTM A-126 Class B, or ductile iron conforming to ASTM A-395 or ASTM A-536.

Gate. Manufacture in cast iron or Grade A bronze. Grade A gate rings must be rolled, peened, or pressed into grooves machined in the discs, or may be fastened by some other accepted method.

Body-Seat Ring. Construct of Grade A bronze, back-face threaded and machined screwed into the valve body.

Wedges. Equip double-disc gate valves with a free and positive-operating internal device that presses the disc seats firmly against the body seats when the valve is closed and releases the load before the discs begin to move when the valve is opened. Provide a simple and rugged design with materials as specified in AWWA C-500. Iron to iron contact surface is not allowed.

Valve Stem. Construct of low zinc bronze CDA Copper Alloy No. C99500 with a minimum yield strength of 40,000 psi and minimum elongation in 2 inches of 10%.

Stem Seals. Provide two O-rings such that the seal above the stem collar can be replaced with the valve under pressure in the fully open position meeting the requirements of ASTM D-2000 and have physical properties suitable for the application.

Valve Operator. Provide a cast iron, ASTM A-126 Class B, wrench nut that has a 2 inch square base, a 1 15/16 inch square top and 1 3/4 inch high, opening counterclockwise (left). Paint wrench nut black with and cast an arrow indicating direction of opening in accordance with AWWA C-509.

Protective Coating. Apply an epoxy coating to all exterior and all stationary interior ferrous surfaces including all interior openings in the valves body in accordance with AWWA C-550 and the manufacturer's instructions. After the coating is completely cured, test coated surface for porosity, holidays, and pinholes using a holiday detector. Repair all holidays or irregularities and test the coating again. Do not apply coating to the gasket surfaces of the end flanges

7.2.1.2.

Outside Screw and Yoke (OS&Y) Gate Valves. Provide iron-body, bronze mounted, parallel seat internal wedging type with outside screw and yoke in conformance with AWWA C-500 "Gate Valves for Water and Sewage Systems". Provide OS&Y gate valves for the size specified. Acceptable manufacturers and models are listed:

■ American Darling	52 OS&Y
■ Clow	F5072
■ Kennedy	566
■ M&H	STYLE 68
■ Mueller	A-2483-6

Submittals. Provide submittals for approval. Provide manufacturer's Affidavit of Compliance in accordance with Section 6.3 of AWWA Standard C-500. Provide records of all tests performed in accordance with Section 5.1 of AWWA Standard C-500 that are representative test results per Section 5.1 of AWWA Standard C-500 along with an affidavit of testing for the valve assembly as outlined in Section 6.3 of AWWA Standard C-500 (300 ft-lbs.). Provide records of all tests performed in accordance with Section 5.2 and 6.3 of AWWA Standard C-504.

Markings. Cast markings on the bonnet or body of each valve. Include the manufacturer's name or mark, the year the valve casting was made, the size of the valves, and the designated working pressure.

Valve Ends. Provide flanged ends with drilling in compliance with ANSI B16.1 or otherwise specified.

Valve Body and Bonnet. Provide in cast iron conforming to ASTM A-126 Class B, or ductile iron conforming to ASTM A-395 or ASTM A-536.

Gate. Manufacture in cast iron or Grade A bronze. Grade A gate rings must be rolled, peened, or pressed into grooves machined in the discs, or may be fastened by some other accepted method.

Body-Seat Ring. Construct of Grade A bronze, back-face threaded and machined screwed into the valve body.

Wedges. Equip double-disc gate valves with a free and positive-operating internal device that presses the disc seats firmly against the body seats when the valve is closed and releases the load before the discs begin to move when the valve is opened. Provide a simple and rugged design with materials as specified in AWWA C-500. Iron to iron contact surface is not allowed.

Valve Stem. Construct of low zinc bronze CDA Copper Alloy No. C99500 with a minimum yield strength of 40,000 psi and minimum elongation in 2 inches of 10%. Brush the opening through the bonnet for the stem with grade A, B, C, D, or E bronze as defined in AWWA C-500.

Yoke. The yoke may be either integral or bolted on to bonnet such that a hand may not be jammed between the yoke and handwheel.

Valve Operator. Provide a cast iron, ASTM A-126 Class B, wrench nut that has a 2 inch square base, a 1 15/16 inch square top and 1 3/4 inch high, opening counterclockwise (left). Paint wrench nut black with and cast an arrow indicating direction of opening in accordance with AWWA C-509.

Protective Coating. Apply an epoxy coating to all exterior and all stationary interior ferrous surfaces including all interior openings in the valves body in accordance with AWWA C-550 and the manufacturer's instructions. After the coating is completely cured, test coated surface for porosity, holidays, and pinholes using a holiday detector. Repair all holidays or irregularities and test the coating again. Do not apply coating to the gasket surfaces of the end flanges.

7.2.1.3.

Tapping Valves. Provide iron-body, bronze mounted, parallel seat internal wedging type with non-rising stem tapping valves that conform to AWWA C-500 "Gate Valves for Water and Sewage Systems" except that tapping valves will have over-sized seat rings to accommodate full size cutters. Provide for the size specified. Acceptable manufacturers and models are listed:

- American Darling 565
- Clow 2640 (Figure F-6114)
- Kennedy 8950 KEN-SEAL II
- M&H STYLE 751
- Mueller H-667

Minimum number of turns to open is three times the valve diameter.

Submittals. Provide submittals for approval. Provide manufacturer's Affidavit of Compliance in accordance with Section 6.3 of AWWA Standard C-500. Provide records of all tests performed in accordance with Section 5.1 of AWWA Standard C-500 that are representative test results per Section 5.1 of AWWA Standard C-500 along with an affidavit and certificate of testing for the valve assembly as outlined in Section 6.3 of AWWA Standard C-500.

Markings. Cast markings on the bonnet or body of each valve. Include the manufacturer's name or mark, the year the valve casting was made, the size of the valves, and the designated working pressure.

Valve Ends. Provide mechanical joint outlet ends unless otherwise specified.

Valve Body and Bonnet. Provide in cast iron conforming to ASTM A-126 Class B, or ductile iron conforming to ASTM A-395 or ASTM A-536.

Gate. Manufacture in cast iron or Grade A bronze. Grade A gate rings must be rolled, peened, or pressed into grooves machined in the discs, or may be fastened by some other accepted method.

Body-Seat Ring. Construct of Grade A bronze, back-face threaded and machined screwed into the valve body.

Wedges. Equip double-disc gate valves with a free and positive-operating internal device that presses the disc seats firmly against the body seats when the valve is closed and releases the load before the discs begin to move when the valve is opened. Provide a simple and rugged design with materials as specified in AWWA C-500. Iron to iron contact surface is not allowed.

Valve Stem. Construct of low zinc bronze CDA Copper Alloy No. C99500 with a minimum yield strength of 40,000 psi and minimum elongation in 2 inches of 10%.

Stem Seals. Provide two O-rings such that the seal above the stem collar can be replaced with the valve under pressure in the fully open position meeting the requirements of ASTM D-2000 and have physical properties suitable for the application.

Valve Operator. Provide a cast iron, ASTM A-126 Class B, wrench nut that has a 2 inch square base, a 1 15/16 inch square top and 1 3/4 inch high, opening counterclockwise (left). Paint wrench nut black with and cast an arrow indicating direction of opening in accordance with AWWA C-509.

Protective Coating. Apply an epoxy coating to all exterior and all stationary interior ferrous surfaces including all interior openings in the valves body in accordance with AWWA C-550 and the manufacturer's instructions. After the coating is completely cured, test coated surface for porosity, holidays, and pinholes using a holiday detector. Repair all holidays or irregularities and test the coating again. Do not apply coating to the gasket surfaces of the end flanges.

7.2.1.4.

Non-Rising Stem (NRS) Resilient-Seated Gate Valves. Provide NRS gate valves that are resilient seat, non-rising stem and have a minimum rated gauge working pressure of 200 psig that comply with AWWA C-509 "Resilient-Seated Gate Valves for Water and Sewage Systems" and AWWA C-550 "Standard for Protective Coatings for Valves and Hydrants". Valve designed with recesses, insets in the bottom of the waterway that would promote build-up or collection of residue and debris are not acceptable. Provide NRS Gate Valves the size specified. Acceptable manufacturers and models are listed:

- American Flow Control Series 500, Series 2500
- Clow 2640 (Figure F-6100)
- Kennedy 8571 KS – FW
- M&H 3067
- US Pipe METROSEAL 250
- Mueller A-2360
- J&S Series 6800, Series 6900

Submittals. Provide submittals for approval. Provide manufacturer's approved certified test data or an affidavit stating that the valve complies with AWWA C-509 Section 5.1 and the following, in accordance with AWWA C-509 Section 6.3:

- Hydrostatic Test. Provide results of manufacturer's pressure test for one valve of each size and class with 400 psi applied to one side and zero to the other made in each direction across the closed gate.
- Torque Test. Provide results of manufacturer over-torque test on one valve of each size to demonstrate that no distortion of the valve stem occurs. Applied torque for a 4-inch valve is 250 ft-lb and 350 ft-lb for the larger valves in both the open and closed position.
- Leakage Test. Provide results of manufacturer's leakage test where manufacturer selects two valves of each size to be fully opened and closed for 500 complete cycles with a 200 psi differential pressure across the gate and the valve is drip tight upon completion of the test.
- Pressure Test. Test one valve of each size with the gate fully open to a pressure of 500 psi. No evidence of rupture or cracking of valve body, bonnet or seal plated should be detected

Markings. Cast markings on the bonnet or body of each valve. Include the manufacturer's name or mark, the year the valve casting was made, the size of the valves, and the designated working pressure.

Valve Ends. Provide mechanical joint or flanged ends as specified.

Valve Body and Bonnet. Provide in cast iron conforming to ASTM A-126 Class B, or ductile iron conforming to ASTM A-395 or ASTM A-536.

Bolts. Provide all bonnet and seal plate bolts that are factory installed and made from stainless steel ASTM A-276 with either regular-square or hexagonal heads with dimensions conforming to ANSI B18.2.1.

Wedge. Provide cast iron or ductile iron fully encapsulated wedge with resilient rubber material bonded to the disc in conformance with ASTM D-429 as required by AWWA C-509.

Valve Stem. Construct of low zinc bronze CDA Copper Alloy No. C99500 with a minimum yield strength of 40,000 psi and minimum elongation in 2 inches of 10%.

Stem Seals. Provide two O-rings such that the seal above the stem collar can be replaced with the valve under pressure in the fully open position meeting the requirements of ASTM D-2000 and have physical properties suitable for the application.

Valve Operator. Provide a cast iron, ASTM A-126 Class B, wrench nut that has a 2 inch square base, a 1 15/16 inch square top and 1 3/4 inch high, opening counterclockwise (left). Paint wrench nut black with and cast an arrow indicating direction of opening in accordance with AWWA C-509.

Protective Coating. Apply an epoxy coating to all exterior and all stationary interior ferrous surfaces including all interior openings in the valves body in accordance with AWWA C-550 and having a minimum dry film thickness of 8 mils. After the coating is completely cured, test coated surface for porosity, holidays, and pinholes using a holiday detector. Repair all holidays or irregularities and test the coating again. Do not apply coating to the gasket surfaces of the end flanges.

7.2.1.5.

Butterfly Valves. Provide butterfly valves that are tight-closing, rubber-seated type for Class 150B service and comply with the requirements of AWWA C-504, "Standard for Rubber-Seated Butterfly Valves". Provide valves for the size specified. Acceptable manufacturers and models are listed:

■ Val-Matic	Class 150B Flanged or Mechanical Joint
■ M&H	450, 4500, 1450
■ Kennedy	30A, 30C
■ Mueller	Lineseal III
■ Pratt	Groundhog Flanged or Mechanical

Submittals. Provide submittals for approval. Provide manufacturer's approved certified test data or an affidavit stating that the valve complies with the performance tests, leakage tests, hydrostatic test and proof-of-design tests as described in Sections 5.2 and 6.3 of AWWA C-504.

Valve Ends. Provide short body flanged, mechanical joint valve ends or as otherwise specified.

Valve Bodies. Construct valve bodies of cast iron ASTM A-126, Class B, or ASTM A-48, Class 40 or Ductile Iron, ASTM A-536, Grade 65/45/12.

Valve Discs. Construct valve discs of cast iron conforming to ASTM A-126, Class B or Ductile Iron conforming to ASTM A-536, Grade 65/45/12, seat in a position of 90 degrees to the pipe axis and rotates 90 degrees between full open and tight closed position. Dimensions of clearance for valve discs are required.

Valve Shafts. Provide Type 304 or 316 Stainless Steel valve shafts, keys, dowel pins, or taper pins used for attaching valve shaft to the valve disc in conformance with ASTM A-276, or equivalent corrosion resistant material. All portions of shaft bearings must be stainless steel or bronze. Valve shafts may consist of a one-piece unit extending completely through the valve disc, or may be of the "stub shaft" type as defined in AWWA C-504. Provide butterfly valves with an extended bonnet, unless otherwise specified.

Shaft Seals. Provide a Split-V or O-ring type shaft seal that allows replacement without removing the valve shaft.

Valve Seats. Provide new natural or synthetic rubber resilient seats attached to either the disc or the body that provide tight shut off at the specified pressure. Seats must be clamped, mechanically secured, bonded or vulcanized to either the disc or body, be stainless steel and fastened by stainless steel cap screws.

Mating Seat Surface. Conform to ASTM A-276, stainless steel 18-8, Type 304, or have a 95% pure nickel overlay.

Valve Bearings. Manufacture bearings from corrosion resistant, and "self-lubricated" materials that will not damage natural or synthetic rubber and are sleeve type.

Valve Operators. Provide manual valve operations with a 2-inch square operating-nut and turn left (counterclockwise) to open. Totally enclose, pre-lubricate or grease pack all gearing. Provide operators of the worm gear or traveling nut and link type with field adjustable stops capable of withstanding 300 ft. lbs. input torque, as required by AWWA C-504.

Protective Coating. Except as otherwise specified, shop coat all interior steel or cast iron surfaces in accordance with the requirements of AWWA Standard C-504. Shop coat all external surfaces for buried valves with two coats of asphalt varnish according to AWWA C-504. When specified, apply a standard epoxy interior coating in accordance with AWWA Standard C-550, "Standard for Protective Interior Coatings for Valves and Hydrants".

7.2.1.6. **Air Release, Air/Vacuum, and Combination Air Valves.** Conform to AWWA C-512 requirements, testing requirements found in Section 5.1 of AWWA C-512 and the following specifications that apply to valve sizes 6" and smaller.

Air Release Valves (AR). Design to automatically release accumulated air pockets within the pipeline while in operation and under pressure. Provide air release valves APCO Model 200, Val-Matic Model 38, or Crispin Model P.

Air/Vacuum Valves (AV). Design to allow large volumes of air to escape through the valve orifice when filling a pipeline and to close watertight once the air has been expelled. Permit large volumes of air to enter through the valve orifice when the pipeline is being drained to break the vacuum. Provide AV valves that are APCO Series 140, Val-Matic Series 100, or Crispin Model AL.

Combination Air Valves (CAV). Provide heavy-duty air and vacuum valves with air release designed to release accumulations of air at high points within a pipeline by exhausting large volumes of air as the pipeline is being filled and by releasing accumulated pockets of air while the pipeline is in operation and under pressure. Also design CAV to permit large volumes of air to enter the pipeline during pipeline drainage. Provide CAV that are APCO, Val-matic Series 200, or Crispin Model C.

Submittals. Provide submittals for approval. Provide manufacturer's affidavit stating that the valve and all materials used in its construction conform to the applicable requirements of AWWA C-512 and these specifications. When required, the manufacturer shall provide and affidavit stating that the valve has been tested and is in compliance with the requirements specified in Section 5.1 of AWWA C-512.

Markings. Cast markings on the bonnet or body of each valve. Include the manufacturer's name or mark, the year the valve casting was made, the size of the valves, and the designated working pressure.

Body and Cover. Provide each air valve with a cast or ductile iron body and cover that complies with ASTM A-126 Class B, or ASTM A-48 Class 35. Ductile iron requirements in conformance with ASTM A-536, Grade 65-45-12. Meet or exceed the strength requirements of ASTM A-307 for bolting material. Provide all internal trim of stainless steel.

Float. Provide stainless steel float that is baffled to prevent air from blowing valve closed until air is exhausted. Design valve body, float, etc., for a working pressure equal to that of the system in which it is installed. Floats for valves with inlet sizes less than 4 inches must be capable of withstanding a collapse pressure of 1000 psig. For larger inlet sizes, floats must be capable of withstanding a collapse pressure of 750 psig.

Valve Outlet. Fit outlet to attach discharge pipe as indicated. Provide N.P.T valve inlet for 2 inch and smaller valves and ANSI flange for 3 inch and larger valves. Flange rating must equal or exceed the maximum working pressure of the system in which it is installed.

Installation. Install AR and AV valves within valve vaults, or manhole, in accordance with Utility Standard Details 263-1, 263-2, 263-3, 263-4 and plans.

Protective Coatings. Interior surface coatings are not required unless otherwise specified. Coat external surfaces with the manufacturer's standard primer.

7.2.1.7.

Swing Check Valves. Provide swing check valves 2 1/2 inches to 12 inches in diameter that withstand a working pressure of 175 psig, comply with the requirements of AWWA C-508 and are tight seating to prevent the backflow of the media during pump shut-off or power failure. Design the closure assembly to assume the closed position by gravity under no flow conditions in a horizontal position. Provide fully open swing check valves with a net flow area not less than the area of a circle with a diameter equal to the nominal pipe size. Check valves can be either Swing Type Spring and Lever or Swing Type Lever and Weight. Acceptable manufacturers are Kennedy Company, Mueller, or equal.

Provide internals that are replaceable in the field without removing the main valve from the pipeline.

Submittals. Comply with the requirements of Article 7.2.1.2 in accordance to the applicable requirements of AWWA C-508. When required, the manufacturer must provide an affidavit stating that the valve has been tested and is in compliance with the requirements specified in Section 5.2 of AWWA C-508.

Markings. Cast markings on the bonnet or body of each valve. Include the manufacturer's name or mark, the year the valve casting was made, the size of the valves, and the designated working pressure.

Valve Ends. Provide flanged valve ends unless otherwise specified.

Body. Provide heavy cast-iron body conforming to ASTM Standard A-126, Class B.

Disc. Provide cast-iron disc conforming to ASTM Standard A-126, Class B that is either Rubber-Faced, or Bronze-Faced conforming to ASTM B-584 "Specification for Copper Alloy Sand Castings for General Applications".

Disc Seat or Plate. Provide resilient Buna-N material or Bronze disc seat or plate conforming to ASTM Standard B-62 for drip tight shut-off and easily replaced in the field without the use of special tools.

Seat Ring. Provide Bronze seat ring conforming to ASTM Standard B-584 and is mechanically attached to machined surfaces in the body.

Hinge or Clapper Arm. Provide Bronze hinge or clapper arm conforming to ASTM Standard B-584.

Hinge Pins. Provide stainless steel hinge pins conforming to ASTM A-276 "Specification for Stainless and Heat Resisting Steel Bars and Shapes" in accordance with AWWA C-508.

Lever. For Swing-Type Lever and Weight, provide the lever with an adjustable counterweight to control opening and closing of clapper arm. For Swing-Type Spring and Lever, provide lever with an adjustable spring tension to control opening and closing of clapper. Install lever on either side of valve.

Protective Coating. Apply epoxy coating to all stationary interior ferrous surfaces including all interior openings in the valves body in accordance with AWWA C-550 and the manufacturer's instructions. Do not apply coating to the gasket surfaces of the end flanges. Paint valve exterior with Red Oxide Phenolic Primer Paint as accepted by the FDA for use on materials in contact with potable water.

7.2.1.8.

Pressure Reducing Valves. Provide pressure reducing valves that maintain a constant downstream pressure regardless of varying inlet pressure and, unless otherwise specified, will be a direct acting, spring loaded, normally open globe pattern valve designed to permit flow when controlled pressure is less than the spring setting. Acceptable manufacturers and models are listed:

- Cla-Val Co. Model 90
- Fisher Governor Co. Type 616
- Bailey Model 30A

2 inches or smaller. Provide valves with a bronze body, nylon reinforced diaphragm, single seat, composition disc, Watt No. 223 or Masoneilan No. 227, or approved equal.

Larger than 2 inches. Provide valves with a cast iron body conforming to ASTM B-61, bronze main valve trim conforming to ASTM B-61, a reinforce neoprene diaphragm, stainless steel stem and flanged ends.

Pressure Rating. Provide a pressure rating of 125 psi with an adjustment range of 30-300 psi.

Valve Components. Provide removable and repairable components while the valve body remains in the line.

Diaphragm Assembly. Provide a synthetic rubber assembly a stem fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. Do not use diaphragm as a seating surface.

Resilient Disc. Provide discs that form a sealed chamber against the disc seat when the valve is closed. Provide seat that is removable and has a smooth surface that will not induce seal cutting or wear.

Strainer: For valves 3 inches and smaller, provide a standard flow clean strainer mounted in the inlet supply port of the main valve. For valves 4 inches and larger, provide a standard y-strainer externally mounted for the protection of the control circuit.

Protective Coating: Apply an epoxy coating to all exterior and all stationary interior ferrous surfaces including all interior openings in the valves body in accordance with AWWA C-550 and the manufacturer's instructions. After the coating is completely cured, test coated surface for porosity, holidays, and pinholes using a holiday detector. Repair all holidays or irregularities and test the coating again. Do not apply coating to the gasket surfaces of the end flanges.

7.2.2.

Fittings. Provide ductile iron (DIP) fittings for use with ductile iron and polyvinyl chloride (PVC) for water pressure or transmission pipe that are smooth cement lined in accordance with AWWA C-104 and outside asphaltic coated per AWWA C-110. The size, body type, type of joint ends, and applicable reference standard are shown on plans or are specified.

Standards. Comply with the following applicable requirements:

ANSI B16.1 "Cast Iron Pipe Flanges and Fittings"

AWWA C-104 "American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water"

AWWA C-105 "Standard for Polyethylene Encasement for Ductile Iron Pipe and Fittings"

AWWA C-110 "American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 inches through 48 inches, for Water and Other Liquids"

AWWA C-111 "Rubber-Gasket Joints"

AWWA C-153 "American National Standard for Ductile-Iron Compact Fittings, 3 inches through 16 inches, for Water and Other Liquids"

Minimum Requirements. Apply minimum requirements of shown Table 10 and Table 11 to the specified fittings.

Table 10.
Standard Short-Body Fittings per AWWA C-110

TYPE OF JOINT	DIAMETER	RATE WORKING PRESSURE	MATERIAL
Mechanical (Rubber Gasket/C-111)	4-24 inches	350 psi	DI
Flanged	4-24 inches	250 psi	DI
All Types	30-80 inches	250 psi	DI
Push-On (Rubber-Gasket/C-111)	4-24 inches	250 psi	DI

Table 11.
Compact Short-Body Fittings per AWWA C-153

TYPE OF JOINT	DIAMETER	RATE WORKING PRESSURE	MATERIAL
Mechanical or Push-On (Rubber Gasket/C-111)	4-24 inches	350 psi	DI

Provide all joint accessories such as gaskets, glands, bolts, and nuts with mechanical joints, and gaskets and lubricant furnished with push-on joints in sufficient quantity for assembly of each joint.

Mark push-on joint fittings with the proprietary name or trademark of the joint marked on the outside with their applicable AWWA Standard and information specified in the standard.

Provide polyethylene wrapped fittings in accordance with AWWAC-105.:

7.2.3. **Valve Vaults.** Provide pre-cast vaults with pre-cast or cast-in-place bases as shown on the plans.

Quality Assurance. Provide vaults that meet the requirements of ACI 318 and are designed for a minimum H-20 loading per AASHTO Specifications, plus a 30% impact factor, or greater if shown on the plans or specified. Mark date of manufacture and name or trademark of manufacturer on inside of each pre-cast vault section.

Submittals. Submit structural calculations sealed by a Structural Engineer registered in the State of Texas for approval along with shop drawings.

Materials. Provide concrete with a minimum 28 days compressive strength of 4,000 psi and reinforcing steel that meets the requirements of Article 4. Provide metal frames, covers, steps, toe pockets and similar required items as shown. Each pipe entering and exiting the vault required an approved flexible joint the provides a watertight installation. Submit jointing system or material for approval..

Installation. Cast-In-Place. Place cast-in-place bases on suitable foundations after the pipes are laid. Exercise special care when placing the concrete around the bottom of the pipes to obtain a waterproof structure. Cast an approved bell in the base to receive the pipe sections forming the barrel.

Pre-Cast. Set pre-cast bases on a concrete or crushed stone foundation as shown at the proper grade and carefully aligned. Set pre-cast vault sections vertical in true alignment. Install sections, joints, and gaskets in accordance with manufacturer's recommendations.

Seal lifting holes tight with a solid rubber plug driven into hole and the remaining void filled with cement-sand mortar.

- 7.3. **Provisions for Thrust.** Block all underground piping with concrete, bearing solidly against undisturbed trench walls, at all changes in direction, fittings, and valves subsidiary to the installation of fittings, valves, and all other appurtenances requiring provisions for thrust restraint.

Place concrete blocking against undisturbed trench walls with a minimum 18 inches between trench wall and pipe. Extend blocking a minimum of 0.75 times pipe diameter below and above the centerline of pipe and do not extend beyond any joints. Place blockings in accordance with the recommendations of "A Guide for the Installation of Ductile Iron Pipe" published by Cast Iron Pipe Research Association and according to details shown on the plans.

If directed, contain the ends of the thrust blocks in wood or metal forms as provided for under Item 420, "Concrete Structures". Where upward thrusts are to be resisted, reinforce concrete anchor with reinforcing conforming to the provisions of Item 440, "Reinforcing Steel".

Use Class B concrete used for Blocking in accordance Item 421, "Portland Cement Concrete" and Table 12 depicting the minimum area of concrete bearing against undisturbed trench bank.

Table 12.
Bearing Surface Per Bend

PIPE SIZE	TEE, DEAD END, 90 DEGREE BEND	45 AND 22-1/2 DEGREE BEND
6 Inch	4 sq. ft.	3 sq. ft.
8 Inch	6 sq. ft.	3 sq. ft.
12 Inch	13 sq. ft.	7 sq. ft.
16 Inch	23 sq. ft.	12 sq. ft.
20 Inch	37.02 sq. ft.	20.04 sq. ft.

Install mechanical joint restrainers as specified that are manufactured by EBAA Iron, Uni-Flange or approved equal.

- 7.4. **Construction.**

Valve Installation. Polyethylene-wrap valves in accordance with AWWA C-105, unless otherwise specified. Provide thrust blocking as specified. Carefully handle and install valves horizontally in such a manner as to prevent damage to any parts of the valves in accordance with manufacturer's instruction. Valves delivered closed to the site will be opened by Contractor prior to installation. Record number of turns required to open the valve and submit information on the standard valve report to EPWU through Engineer.

Valve Testing. Upon completion of installation of the valves, conduct an acceptance test to verify the satisfactory operation of the valves. Check unit for operation and leakage. The valves must perform in a manner acceptable to the Engineer.

- 7.5. **Measurement.**

- 7.5.1. **Valves.** This Item will not be measured individually and is subsidiary to the installation of the various water mains and related appurtenances.

- 7.5.2. **Fittings.** This Item will not be measured individually and is subsidiary to the installation of the various water mains and related appurtenances.

- 7.5.3. **Additional Fittings.** This Item will be measured in place by the pound of additional fittings installed.
- 7.6. **Payment.**
- 7.6.1. **Valves.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be not paid for individually as it is considered subsidiary to the various water mains Items. All valves shown on the plans are subsidiary to the various water mains and services pay items and include all costs associated with coordination; excavation; disposal of excess material; backfill, compaction, compaction testing for utilities, all labor, equipment and materials required for furnishing and installing all valves shown on the plans to include those required as part of the different pay items, complete in place, including but not limited to: thrust blocking, mechanical joint restrainers, concrete anchoring, polyethylene wrapping, and provisions for corrosion protection. Use of mechanical joint restrainers in lieu of or in conjunction with concrete thrust blocking is not be considered for additional compensation.
- 7.6.2. **Fittings.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be not paid for individually as it is considered subsidiary to the various water mains pay items. All fittings shown on the plans are subsidiary to the different pay items for water mains and services and include all costs associated with coordination; excavation; disposal of excess material; backfill, compaction, compaction testing for utilities, all labor, equipment and materials required for furnishing and installing all fittings shown on the plans to include those required as part of the different pay items, complete in place, including but not limited to: thrust blocking, mechanical joint restrainers, concrete anchoring, polyethylene wrapping, and provisions for corrosion protection. Use of mechanical joint restrainers in lieu of or in conjunction with concrete thrust blocking will not be considered for additional compensation.
- 7.6.3. **Additional Fittings.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Additional Fittings". This price is full compensation for furnishing all required materials based on the cost of material only. Include labor costs, all costs associated with coordination; excavation; backfill, compaction, compaction testing for utilities; disposal of excess material; equipment and materials required for cutting and removal of water mains, furnishing and installing additional valves, bends, tees, crosses, couplings, reducers, adaptors, flexible fittings, not originally shown on the plans or details, as deemed necessary, complete in place, including but not limited to: thrust blocking, mechanical joint restrainers, concrete anchoring, polyethylene wrapping, and provisions for corrosion protection in the unit price for Water Main (PVC), Water Main (DIP) and/or Water Main (STEEL). Mechanical joint restrainers in lieu of or in conjunction with concrete thrust blocking are not considered for individual payment through the "Additional Fittings" provisions. The actual amount of additional fittings may be less than, but may not exceed the total quantities on the plans without approval.

8. WATER SERVICE CONNECTIONS

- 8.1. **Description.** Furnish labor, materials, equipment and incidentals necessary to construct and install pre-cast concrete meter boxes and vaults, water service connections and fire lines, complete for potable water supply including .
- 8.2. **Materials.**
- General. Provide fittings and valves in contact with potable water in conformance to the latest revision of NSF/ANSI Standard 61 (Annex F) and the requirements of Article 7. Include certifications from manufacturers that the products comply with appropriate ASTM, AWWA and Utility Standards with required submittals. New water meters will be furnished by EPWU when required unless otherwise specified.
- Quality Assurance. Fittings and valves in contact with potable water must conform to the latest revision of NSF/ANSI Standard 61 (Annex F). Such compliance must be evidenced by an affidavit from the manufacturer or vendor.

All fittings and valves must have the manufacturer's name or trademark permanently stamped or cast on it and "No Lead" brass allow, e.g. "NL" shall be cast or stamped on the valves and fittings.

8.2.1.1. **Water Service Connections.**

Castings and Washer Nuts. Provide certified cast bronze composition castings and washer nuts, 85-5-5-5 percent per ASTM B-62, fully formed, tapped threads meeting requirements of AWWA C-800 for underground service.

Gaskets. Provide gaskets that are self-sealing, 100 percent neoprene or Buna-N rubber, formulated for water service.

Service Saddles. Provide two or three piece all-bronze, double strap with National Coarse Class 2 thread saddles suitable for Class 200 asbestos cement pipe, cast iron pipe and ductile iron pipe with double straps. Provide single strap saddles for C-900 or C-905 PVC pipe. Extend saddle body 180 degrees around pipe. Acceptable manufacturers and models are listed:

- Ford Meter Box Co. Model S90
- James Jones Co. J-996
- A.Y. McDonald Mfg. Co. 3805
- Mueller H-1344X

Straps. Provide silicon bronze straps, approximate tensile strength of 70,000 psi chamfered for easy nut starting and flattened to provide wide bearing surface.

Valves. Provide valves in accordance with Utility acceptable standards and requirements for Article 7.2.1.11, "Gate Valves".

Use bronze valves for copper pipes with minimum 85% copper content casting and cast iron valves for PVC pipe that conform to requirements for Article 7.2.1.11, "Gate Valves".

Provide corporation stops manufactured by Ford Meter Box Co., Mueller, or approved equal and conform to the requirements of AWWA C800.

Provide angle ball valves with padlock wings that are copper flared inlet and female iron pipe thread outlet such as James Jones Company Model J-1965W, McDonald MFG Model 74606B, or approved equal. Use outlet meter coupling nut for 3/4 inch and 1 inch meters. Use inlet female iron pipe by outlet oval flange ends valves for 1 1/2 inch and 2 inch meters.

Service Pipe. Provide copper Type "K" for service pipe sizes up to and including 2 inch, meeting ASTM B-88 requirements with bronze fittings. For 3-inch services, provide 4 inch PVC per AWWA C-900 with reducers at meters. For 4 inch services and larger, provide PVC pipe per AWWA C-900. Provide ductile iron fittings for PVC pipe.

8.2.1.2. **Meter Boxes.** Meet the standards listed:

- ASTM A-27 Specifications for Steel Castings, Carbon, for General Application
- ASTM A-36 Specification for Structural Steel
- ASTM A-48 Specification for Gray Iron Castings
- ASTM C-33 Specification for Concrete Aggregates
- ASTM C-150 Specification for Portland Cement
- ASTM C-309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- ASTM C-615 Specification for Granite Building Stone

Shop Drawings. Submit shop drawings on molds, meter boxes, and associated hardware for approval prior to fabrication. Provide manufacturer's certification that products comply with appropriate ASTM, AWWA, and Utility standard details

Testing. When requested, provide compressive tests results and allow Engineer to inspect of the manufacturing process at any time, perform tests on materials used and to extract cores from completed meter boxes for compressive strength testing and placement of reinforcement.

Cement. Use Portland cement conforming to ASTM C-150, Type I or Type III. Provide concrete with a minimum 28 day compressive strength of 4,500 psi, a water cement ratio of 0.5 or less by weight, and a maximum 5.5 gallons water per sack cement. Handle concrete from the mixer or transport vehicle to the place of final deposit in a continuous manner, as rapidly as practicable, and without segregation or loss of ingredients, until the operation is completed. Place concrete in layers not exceeding 2 feet deep. Compact each layer by mechanical internal or external vibrating equipment. Limit duration of the vibration cycle to the time necessary to produce satisfactory consolidation without causing objectionable segregation.

Aggregates. Conform to specifications outlined by ASTM C-33 for aggregates other than lightweight aggregates. Provide aggregate that is free of deleterious substances and graded in a manner as to produce a homogeneous concrete mix. Accurately weigh all materials at a central batching facility for mixture.

Curing. For the purposes of early re-use of forms, concrete may be heated in the mold, after initial seat has taken place. Do not exceed a temperature of 71.11°C (160°F) and raise temperature from normal ambient temperatures at a rate not to exceed 4.44°C (40°F) per hour. Do not remove the cured unit from the forms until sufficient strength is obtained for the unit to withstand any structural strain that may be subjected during the form stripping operation. After the stripping of forms further curing by means of water spraying or a membrane curing compound of a clear or white type, conforming to ASTM C-309 may be used.

Steel Reinforcing. Comply with ASTM A-615 Grade 60 steel, $F_y = 60,000$ psi. Minimum concrete cover on re-bar top slab is 1 1/4 inch and 1 1/2 inch on re-bar for walls. Comply latest ACI Standards for bar bending and placement. Provide all reinforcing steel, including welded wire mesh, of the size and place in location shown on the plans. Tie all reinforcing sufficiently to withstand displacement during the pouring operation. Design lifters to handle the imposed weights, and place as shown on the plans or manufacturer's requirements.

Steel Frames and Covers. Conform to ASTM A-27, Grade 70-36. For structural welded steel, conform to the requirements of ASTM A-36 with dimensions as specified on the plans.

Cast Iron Ring and Covers. Conform to the requirements of ASTM 48, Class 30. Provide all castings of uniform quality, free from blowholes, shrinkage, distortion or other defects, smoothed and well cleaned by shot-blasting. Manufacture true to pattern. Provide component parts that fit together in a satisfactory manner. Provide round frames and covers with continuously machined bearing surfaces to prevent rocking and rattling. Do not exceed tolerances of 1/16 inch per foot and deviation in weight of 5%.

8.2.1.3. **Tapping Sleeves and Pipe Couplings.** Furnish labor, materials, equipment and incidentals necessary to install tapping sleeves and pipe couplings as specified suitable for operation at pressures as specified for the pipelines in which they will be installed, including test pressures and surge allowances. Furnish shop drawings a required.

8.2.1.3.1. **Cast Tapping Sleeves.** Provide tapping sleeves of suitable construction and reinforced to provide resistance to line pressures that are designed for the pipe size and material on which they will be used. Build tapping sleeves in halves for assembly around the main to be tapped. The branch outlet will have a flanged face for bolting to the tapping valve with the inside diameter of outlet branch larger than the nominal size to provide clearance for the full size cutters of the tapping machine. Acceptable manufactures are Mueller Company, Kennedy Valve Squareseal and M&H.

Type 1. Cast tapping sleeve allows water to circulate between the sleeve and the outside surface of the pipe. Gaskets of suitable material, designed for use on potable water must form watertight joints along the

entire length of the sleeve. Seal circumferential joints at the ends of the run of the sleeves by mechanical joints, conforming to AWWA C-111 as to dimensions, clearances, and materials, except that gaskets and glands from mechanical joints must be totally confined or compressed between ridges or grooves extending continuously for the full length of both halves of the sleeve casting. Locate bolts close to the outside of the gaskets and spaced so as to exert sufficient pressure to form a watertight joint and withstand stresses imposed by the intended use.

Type 2. Water is confined to the immediate area of the tap opening. Fit the outlet half of each sleeve with a continuous gasket of approximately circular cross section, permanently cemented into a groove surrounding the outlet opening and the back half of each sleeve fitted with elastomeric pads, a metal shoe, or other device for developing adequate pressure on the gasket to prevent leakage at any pressure within the design capacity of the pipe.

Protective Coating: Coat all surfaces exposed to flow in accordance with AWWA C-550.

8.2.1.3.2. Fabricated Tapping Sleeves. Fabricated tapping sleeves must be rated for a working pressure of 150 psi and meet the following requirements. Acceptable manufacturers and models are listed:

- Ford FTSC
- JCM 412
- Romac FTS 420
- Powerseal 3490

Markings: Permanently mark each tapping sleeve to identify the outer diameter size range.

Test Plug: Provide a 3/4" NPT with standard square head.

Nuts and Bolts: Provide high strength, corrosion resistant 18-8 Type 304 Stainless Steel.

4 inch to 12 inch. Provide tapping sleeve body and flange 18-8 Type 304 Stainless Steel or AWWA C111 Carbon Steel with fusion epoxy coating. Provide body, lug, and gasket armor plate in compliance with ASTM A-240 having all metal surfaces passivated, in accordance with ASTM A-380, after fabrication.

- Provide gasket with a watertight sealing surface around the full circumference of the pipe formed of natural or synthetic rubber.
- Weld lugs to the shell and prevent alignment problems by allowing the bolts to pass through. Do not weld bolts to the sleeve.

16 inch and Larger: Provide tapping sleeves that have a heavy welded steel body in compliance with ASTM A-36 or ASTM A-285, Grade C.

- Provide natural or synthetic rubber compounded gaskets for water use providing a watertight sealing surface.
- Construct flanges in accordance with AWWA C-207 Class D and properly recess for aligning the sleeve and tapping valves.
- Coat steel tapping sleeves with 8 mils minimum thickness epoxy

8.2.1.3.3. Flexible Couplings. Furnish and install couplings where shown on the plans, specified, or in locations as approved. Use ductile iron flexible couplings and Type 316 Stainless Steel nuts and bolts when installed underground. When flexible couplings are used as expansion joints, separate the pipe ends to allow for expansion. Where indicated on the plans or required by field conditions, flexible couplings must be suitable for connecting pipes having different outside diameters. Restrain flanged coupling adapters with tie rods.

Protective Coating: Coat entire coupling assembly with a 20 mil coating of T.C. Mastic as manufactured by Tape Coat Company, Bitumastic No. 50 as manufactured by Koppers Company, or approved equal.

Ductile Iron Pipe. Flexible Joint Couplings will be Dresser Style 38, Rockwell Style 411, or equal. Flanged coupling adapters for ductile iron pipe will be Dresser Type 127, Rockwell International 112, Baker Series 600, or equal.

Steel Pipe. Flexible couplings will be Dresser Style 38, Rockwell International 411, or equal, except where other styles are required for special conditions.

Provide neoprene rubber or equal gaskets.

- 8.2.1.3.4. Installation. Install tapping sleeves in accordance with the manufacturer's recommendations. Construct disc and seat ring in a manner that the inside diameter of the ring is at least 3/16 inch larger than nominal size of valve. Block tapping sleeve and valve assembly blocked as indicated.

8.3. **Construction.**

- 8.3.1. General. Furnish and install service taps for 3/4 inch to 2 inch services with service saddle. Direct taps, i.e. without the saddle, are not allowed. For 3 inch and 4 inch services, construct taps using 4 inch tapping sleeve and valve. Insulate copper service pipe attached to metallic water mains at the corporation stop with a dielectric insulator in accordance with Utility Standards for Excavating, Backfilling, and Compacting.

Do not install multiple tapping, two or more taps on a length of pipe, on a common line parallel to the longitudinal axis of the pipe and no closer than 18 inches on the longitudinal axis of the pipe.

Splices are not allowed in any portion of the service pipe run between the main line connection and the meter assembly. Connect all services to new main by means of wet-tapping. Dry or direct taps are not allowed.

Perform meter installations larger than 1-inch with a bypass meter connection as listed:

- 1 1/2 inch and 2 inch meters 1-inch bypass
- 3 inch and 4 inch meters 2-inch bypass
- 6 inch and 8 inch meters 3-inch bypass

- 8.3.2. Existing Services. Where existing water services are indicated on the plans to be replaced, relocated, or reconnected to new water lines, make prior arrangements with each water customer as to the time and length of shutdown necessary. Notify the customer 24 hours before any connections are made. A maximum shut-off time of four (4) hours will be allowed for making connections, after which time supply the customer with potable water from an approved source at no additional cost to Department.

- 8.3.3. Metallic Tracer Tape. For 3-inch services and larger (i.e. PVC), provide a minimum width of 6 inches or twice the line diameter. Do not exceed a burial depth of 36 inches below final grade or be at an elevation of less than 12 inches above the utility line. Follow tape manufacturer's recommended burial depths.

- 8.3.4. Meter Box Installation. Install in accordance with these specifications and Utility Standard Details to grade matching top of curb.

Do not install under sidewalks, driveways, or proposed above-ground structures. Where no curbing exists, install boxes in accessible locations beyond limits of street surfacing, walks, and driveways.

Install standard meter boxes for their respective meter size according to Table 13.

Table 13.
Standard Meter Boxes

METER SIZE	BOX TYPE	CONSTRUCTION	DIMENSIONS W x H
3/4 inch	Type A	Single Unit	19.25 inch O.D. x 17 inch
1 inch	Type B	Single Unit	26 inch O.D. x 17 inch
1 1/2 inch to 2 inch	Type C	Single Unit	50 inch sq. x 24 inch
3 inch and larger	Type D	Modular	7 ft.-8 inch sq. x 4 ft.-6 inch

Where it is necessary to install Type A or B boxes for 3/4 inch or 1 inch meters under roadways or traffic bearing surfaces, encase boxes in 12 inches concrete 3,000 psi minimum.

- 8.3.5. Testing and Flushing Procedures. Pressure test all services for leakage by opening the corporation or service valve at the main service connection point, maintaining the meter angle valve closed, and visually observing all connections and piping for leaks. If no leaks are observed, then flush service line as follows. The angle valve is opened to "full" and then the corporation valve is slowly opened to full capacity. Water is allowed to flow until piping has been thoroughly flushed. Then the angle valve is slowly closed to prevent water hammer or shock pressure, which might rupture the main or adjacent water service connections. If no customer piping is currently connected to the meter outlet connection, use a fitted plug at the end of this connection to prevent the entrance of dirt or muddy water.
- 8.4. **Measurement.**
- 8.4.1. **Water Service Replace and Reconnect.** This Item will be measured in place by each water service replaced and reconnected for the size and type indicated.
- 8.4.2. **New Water Service Installation.** This Item will be measured in place by each new service installed for the size and type indicated.
- 8.4.3. **Meter Boxes.** This Item will not be measured for individual payment and is subsidiary to the water connection items.
- 8.5. **Payment.**
- 8.5.1. **Water Service Replace and Re-connect.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Water Service Replace & Reconnect" of the size and type specified. This price is full compensation for furnishing all required materials, including all costs associated with: furnishing labor, new materials, equipment, and incidentals to replace and reconnect existing water services of the specific size and type (water service or fire line); complete restoration to its original condition, any disturbed areas associated with the replacement and reconnection of existing water services; coordination; and all appurtenances defined herein to include, but not limited to the following items: concrete meter boxes, all fittings and valves in accordance with EPWU requirements and as indicated on the plans.
- 8.5.2. **New Water Service Installation.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "New Water Service Installation" of the size and type specified. This price is full compensation for furnishing all required materials, including all costs associated with: furnishing labor, new materials, equipment, and incidentals to install new water services of the specific size and type (water service or fire line); complete restoration to its original condition, any disturbed area associated with the installation of new water services; coordination; and all appurtenances defined herein to include, but not limited to the following items: concrete meter boxes and vaults, all fittings and valves in accordance with EPWU requirements and as indicated on the plans.
- 8.5.3. **Meter Boxes.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" are subsidiary to the "Water Service Replace & Reconnect" or "New Water Service Installation" bid items.

9. FIRE HYDRANTS

9.1. **Description.** Furnish labor, materials, equipment and incidentals to install fire hydrants as shown on the plans in accordance with Utility requirements and typical fire hydrant installation.

9.2. **Materials.**

Submittals. Submittals include certified drawing showing dimensions and construction details and certification from manufacturers that the products comply with appropriate AWWA Standards and this Specification. Submit catalog data illustrating equipment to be furnished and a schedule of parts and materials. Provide manufacturer guarantee that friction loss meet the requirements of AWWA C-502.

Standards. Comply with requirements of AWWA C-502, Dry-Barrel Fire Hydrants, and AWWA C-550, Protective Epoxy Interior Coatings for Valves and Hydrants.

9.2.1. **Manufactured Products.**

General. Provide dry-barrel compression type fire hydrants, with the main valve opening against the pressure, in accordance with AWWA C-502. Design hydrant for a minimum working pressure of 150 psi and tested at 300 psi hydrostatic pressure.

Provide hydrant with permanent markings identifying name of manufacturer, size of main valve opening and year of manufacture that are easily located and legible after the hydrant has been installed.

Construct hydrant so that the standpipe may be rotated to eight (8) different positions.

Provide center of the lowest nozzle a minimum ground clearance of 15 inches. Supply with extension sections in multiples of 6 inches with rod and coupling as required to increase barrel length.

The fire hydrant manufacturer must provide local representation and support services, through an established vendor, within the County of El Paso. Acceptable manufacturers and models are listed.

- | | |
|-------------------------|-----------|
| ■ American Flow Control | B84B |
| ■ Clow | Medallion |
| ■ M&H | Model 129 |
| ■ Mueller | Centurion |

Size. Provide a minimum inside barrel diameter of 7 inches with a minimum diameter of the main valve opening of 5 inches.

9.2.2. **Traffic Type.** Design the barrel and operating mechanism that the main valve will remain closed and reasonably tight against leakage in the event of an accident, damage, or breaking of the hydrant above or near the grade level.

Provide manufacturer guarantee that the hydrant valve stem will not be bent when the hydrant is damaged or broken at or near ground level. Provide a safety breaking flange or thimble. Make provisions in the design of the stem to disconnect the stem from the hydrant parts above the standpipe break point in the event of a traffic accident.

If breakable couplings are used, design the barrel safety flange and stem safety collar to break before any other hydrant part in the event of an accident. Design coupling so that no part of the coupling will drop into the hydrant barrel in the event of an accident.

Corrosion Resistant Valve: Include a Davidson Anti-Terrorism Corrosion Resistant Valve Kit (DATV) designed to protect against accidental backflow and intentional contamination of drinking water via the

hydrant. The DATV must be a stealth check valve located internal to the upper barrel of the hydrant and consisting of four main parts.

- A sleeve-insert valve seat, made of E-coated or fusion-bonded epoxy steel. Provide a machined slot to the top of the valve seat to accommodate an EPDM quad ring that will provide an impenetrable seal between the seat and the valve and separates the valve from the insert to prevent the chance of galvanic corrosion. The sleeve will have a plug in the drain hole located at the bottom of the sleeve.
- A valve made of brass with machined slots to accommodate a Viton O-ring between the valve and the upper stem.
- A 304 stainless steel machined upper stem to replace the original upper stem. Attach the brass valve to the upper stem in such a manner as to provide free vertical movement along the shaft and be sealed and separated from the stem by a Viton o-ring that prevents contact between dissimilar metals to eliminate the chance of galvanic corrosion.
- A 302 stainless steel spring that fits around the upper stem and is of adequate compression strength and length such that sufficient pressure is placed on the valve to provide an impenetrable seal when the hydrant is not in use and yet allows water to flow freely when the hydrant is flowed.

Provide a technician certified by the DATV manufacturer to install the DATV. The DATV manufacturer or authorized representative must provide both initial and ongoing refresher training, free of charge to governmental entities utilizing their product. Install DATV in a manner that does not alter the standard warranty offered by the hydrant manufacturer, except that such warranty will not cover the DATV itself

The DATV must be shop-installed by the hydrant distributor and be delivered to the project site ready for installation. The hydrant distributor will order the hydrants without the hydrant parts that are to be replaced by the DATV. Provide DATV with a minimum 10 year warranty against defects in workmanship and materials that also guarantees that its installation inside the hydrant will not cause failure of any of the original fire hydrant parts while the hydrant is under warranty, provided that: (a) the hydrant and DATV are installed and maintained in accordance with the corresponding manufacturers' recommendations; (b) the installer of the DATV was certified for such installation by the DATV manufacturer; and (c) that analysis of the failure clearly establishes that installation of the DATV as the primary cause of the failure.

Ensure that the DATV does not interfere with the breakaway functionality of the fire hydrant.

Drain Outlet. Provide upper valve plate, seat ring and drain ring or shoe bushing in bronze, to form an all bronze drain way and drains the hydrant properly by opening as soon as the main valve is closed.

Inlet Connections. Provide mechanical joint, with accessories, gland, bolts, gaskets, and a 6 inch diameter inlet connection. Provide synthetic rubber main valve facing against seats. Equip top of the stem or bonnet with O-ring seal. Provide oil or grease lubricated hydrant.

Outlet and Pumper Nozzles. Provide two hose outlets with two 1/2 inch nozzles with National Standard hose coupling screw threads. Provide outlet nozzles of the caulked type or mechanically connected into the barrel with an O-ring seal and a non-corrosive locking pin to lock the nozzle to the barrel.

Provide pumper Nozzle with an inner diameter of 4 inches with threads conforming to the City of El Paso Standards.

Provide nozzle caps with one, 1 inch square nut, gaskets and non-kinking chains. Provide operating nut and nozzle cap nuts that have one, 1 inch square at the base and tapered to 7/8 inch square at the end and not less than 1 inch deep. Provide nozzle caps with rubber gaskets.

Hydrant Operator. Provide operator that is 1 inch square at the base and tapered to 7/8 inch at the end and not less than 1 inch deep. Attachment of the operator nut must not, in any way, hinder operating the hydrant with the wrench and must open by turning left (counterclockwise). Design hydrants with O-ring seals to prevent water from damaging the operating threads.

Tamper Proof Cover. Equip hydrant with a tamper proof cover, minimum inside diameter of 2 1/4 inches, with drainage holes, that deters unauthorized operation of the hydrant and provides adequate wrench clearance. The height of the cover ranges from 2 1/4 inches to 2 1/2 inches, measured from the base at the bonnet to the top of the collar.

Painting. Prime coat barrels above ground with two coats of aluminum colored paint as approved by EPWU.

Protective Coating. Epoxy coat all interior ferrous surfaces of shoe exposed to flow to a minimum dry thickness of 4 mils. Factory- apply epoxy coating by an electrostatic or thermosetting process in accordance with manufacturer's printed instructions. Epoxy materials must be 100 percent powder epoxy or liquid epoxy conforming to AWWA C-550 and to the current requirements of the Food and Drug Administration and the EPA for potable water.

- 9.3. **Construction.** Install hydrants at locations shown on the plans or in approved standard locations. Touch up paint damaged during installation. Disinfect hydrants with the connecting pipe in accordance with Article 10, "Cleaning, Disinfection and Testing of Water System" in this Specification. Ensure installed hydrants are left in good working order with control valve open.
- 9.4. **Measurement.**
- 9.4.1. **Fire Hydrant (Relocate & Reconnect).** This Item will be measured in place by each fire hydrant reconnected to the new or existing water main.
- 9.4.2. **Fire Hydrant (New).** This Item will be measured in place by each new fire hydrant connected to the new water main.
- 9.4.3. **Fire Hydrant (Remove and Salvage).** This Item will be measured in place by each fire hydrant removed and salvaged.
- 9.5. **Payment.**
- 9.5.1. **Fire Hydrant (Relocate & Reconnect).** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Fire Hydrant (Reconnect Only)" as specified. This price is full compensation for furnishing all required materials, including new piping from the new or existing water main to the fire hydrant, new gate valve with bonnet box, concrete thrust blocking or mechanical joint restraints, Davidson Anti-Terrorism Corrosion Resistant Valve Kit (DATV), new spool extensions as needed, new fittings and appurtenances for a complete installation as shown in plans.
- 9.5.2. **Fire Hydrant (New).** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Fire Hydrant (New)" as specified. This price is full compensation for furnishing all required materials, installation of new fire hydrant, Davidson Anti-Terrorism Corrosion Resistant Valve Kit (DATV), spool extensions as needed, mechanical joint tee at the main, gate valve with bonnet box and lid, all PVC C900 pipe from the main to the fire hydrant, thrust blocking or mechanical joint restrainers and all fittings and appurtenances for a complete installation as shown in the plans.
- 9.5.3. **Fire Hydrant (Remove and Salvage).** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Fire Hydrant (Remove and Salvage)" as specified. This price is full compensation for furnishing all required labor, materials, equipment, and incidentals to remove and salvage existing fire hydrants as indicated on the plans in accordance with EPWU's requirements.

10. CLEANING, DISINFECTION, AND TESTING OF WATER SYSTEM

- 10.1. **Description.** Perform disinfection and testing of all water mains and related appurtenances.

10.2. **Materials.**

Standards. Comply with applicable requirements of AWWA B-300 "Standard for Hypochlorites", AWWA B-301, "Standard for Liquid Chlorine" and AWWA C-651, "Standard for Disinfecting Water Mains".

Water. Provide water required for filling, flushing and testing the line at such points along the pipeline as water is available from the existing distribution or supply systems (See "Water for Construction" in Project General Notes). Do not waste water. Such action may require appropriate charges. Provide water, by tank truck or other means, to the points necessary to produce specified test pressure. Coordinate disposal of water with Engineer and El Paso Water Utilities Operations Division. Do not dispose water onto the streets as that will be considered "wasting of water", unless otherwise approved.

Chlorinating Material. Provide either liquid chlorine conforming to AWWA B-301 or hypochlorite conforming to AWWA B-300.

10.3. **Construction.**

General. After completion of all pipe line section, use the following procedure to clean, sterilize and pressure test the pipeline. Fill the pipeline and flush until all evidence of dirt or debris has been washed from the pipeline, then refill line, if necessary, introducing the chlorinating material. Perform pressure and leakage test at each valved section. After all sections have been approved, clean all valves and leave line full of sterilizing water.

Quality Assurance. Exercise special care to keep the interior of the pipe clean during storing, handling, and laying operations in order to reduce the need for flushing to an absolute minimum. In addition, tightly cover all open ends whenever unattended to prevent small animals and dirt from entering the pipeline after it is in place.

10.3.1.1. **Sterilization.** Before acceptance for operation, sterilize each unit of completed water system as specified below or as prescribed by AWWA Standard C-651. (As per C-651, collect two consecutive sets of acceptable samples taken at least 24 hours apart from the new main.)

- Thoroughly flush with water the unit to be sterilized until all entrained dirt and mud have been removed before introducing the chlorinating material.
- Provide all chlorination material for sterilization and introduce the chlorinating material into the water line in an approved manner at a dosage of not less than 50 parts per million.
- Retain treated water in the pipe at least 25 hours to destroy all nonspore-forming bacteria except where a shorter period is approved. Retention time should produce not less than 10 ppm of chlorine at the extreme end of the line at the end of the retention period.
- Open and close all valves on the lines being sterilized several times during the contact period.

10.3.1.2. **Hydrostatic Pressure and Leakage Testing.** Furnish meter, pressure gauges, pump, small piping and hose connections, and all labor necessary for conducting hydrostatic pressure and leakage tests. Check all valves and hydrants for proper operation and pressure. Subject the pipe system to a hydrostatic pressure and leakage test after completion of each valved section and following the filling and disinfection of the section.

After the section of pipeline has been filled, pump water into the section and raise the pressure to 150 psi. Maintain this test pressure for a period of at least two (2) hours. Deliver water required to maintain this pressure through the meter. The amount of water through the meter during the two-hour test period will be the total leakage. Should this leakage exceed the allowable amount, make repairs as may be required until the actual leakage, as determined by succeeding tests, is no greater than the allowable as determined by the following formula:

$$L = S \times D \times (P^{1/2}) / 133,200 \quad \text{except that } L = 0 \text{ in above ground systems and otherwise}$$

L = Allowable Leakage in gallons/hour

S =Length of pipe tested in feet

D =Nominal diameter of pipe in inches

P =Average test pressure during the test, in pounds per square inch, gage; determined by computing the weighted average of actual pressures on various portions of the section

After all sections of the pipeline have been tested, as described above, close all valves and leave line filled with the water used for disinfection and testing.

- 10.4. **Measurement and Payment.** The work performed and the materials furnished in accordance with this Article will not be measured or paid for individually as it is considered subsidiary to the various water main and related appurtenances bid items.

11. SANITARY SEWER FACILITIES

- 11.1. **Description.** Furnish all labor, materials, equipment and incidentals required and install sanitary sewer systems and adjustments as shown on the plans and as specified.

Verification of Utilities. The data furnished in the plans regarding the size and location of utility lines has been obtained from field surveys and the various utility companies. Verify the location of all utilities prior to commencing sewer construction. Perform all work within public right-of-way. Do not extend into or encroach upon private property including basements, residences, and places of business.

Coordination with El Paso Water Utilities (EPWU). Coordination with EPWU is required for sewer line tie-ins and bypassing, where indicated in the specifications and on the plans, and for CCTV video-inspection of new sewer lines. EPWU will perform video-inspection of all new sewer lines to determine acceptance. Notify EPWU through Engineer, a minimum of 48 hours in advance of any scheduled inspection; and provide a staging area that is free and accessible for TV camera activities.

Water Main Crossing. Where gravity or force main sewers are constructed in the vicinity of water mains, ensure that the most current requirements of the Texas Commission on Environmental Quality (TCEQ) are met.

- 11.2. **Materials.**

- 11.2.1. **Polyvinyl Chloride (PVC) Flexible Pipe.** These standard specifications designate the requirements for furnishing and installing PVC gravity pipe for sanitary sewage, with a standard dimension ratio (SDR) as shown in the plans and/or specified herein. Furnish all materials, equipment, tools, labor, superintendence, and incidentals required for the complete construction of the work designated.

Quality Assurance. Code all PVC pipe to provide positive identification and prevent accidental damage to or interruption of the sanitary sewer facilities. Only provide pipe manufactured in the United States of America. Provide new materials including all pipe, fittings, and accessories. Perform manufacturer's physical and chemical tests according to the ASTM standard applicable to the respective PVC pipe type and diameter herein specified, in order to demonstrate pipe quality.

Submittals. Submit documentation on pipe products, fittings, and related materials as may be required by the contract documents or the Engineer. Review all submittals prior to submission. Submit in a timely manner so as not to delay the project. Allow sufficient time for Engineer's review and resubmission, if necessary. Include certifications from manufacturer that the product complies with appropriate ASTM standards.

Standards. Comply with applicable following requirements:

- ASTM D-1784 Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
- ASTM D-2321 Specification for Underground Installation of Flexible Thermoplastic Sewer Pipe

- ASTM D-3034 Specification for Type PSM Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings
- ASTM D-3212 Joints for Drain and Sewer Pipes Using Flexible Elastomeric Seals
- ASTM F-477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- ASTM F-679 Specification for Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings
- ASTM F-789 Specification for Type PS-46 Poly (Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings
- ASTM F-794 Specification for Poly (Vinyl Chloride) (PVC) Large Diameter Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter

Delivery and Storage. Inspect pipe, fittings, and accessories upon delivery and during progress of the work. Any material found defective will be rejected. Remove rejected material promptly from site.

Replace, at no additional cost to Department, any material found to be defective in manufacture or damaged.

Unload at point of delivery all pipe, fittings, and other accessories, haul to and distribute at the work site. In loading and unloading, lift materials by hoists or rolled on skidways so as to avoid shock or damage. Do not incorporate materials that have been dropped into the work. Do not skid or roll pipe handled on skidways against pipe already on the ground.

Do not store PVC pipe outside exposed to prolonged periods of sunlight. Any discoloration of pipe due to such exposure is an indication of reduced pipe impact strength, and will be sufficient cause for rejection of the pipe. Remove rejected all pipe from the job site.

Pipe Schedule. PVC pipe will be designated as gravity sewer conduit and must meet the requirements shown on Table 14.

Table 14.
Gravity Sewer Conduit Dimensions

Pipe Size	ASTM Standard	Material	Wall Type	Minimum Stiffness	Standard Length
8"	D-3034	PVC	Solid SDR-35	46 psi	20'
12" 15"	F-789	PVC	Solid T1-Wall	46 psi	20'
18"	F-679	PVC	Solid T1-Wall	46 psi	20'
	F-789	PVC	Solid T1-Wall	46 psi	20'
	F-794	Large Dia PVC	Profile Open	46 psi	13'
21"- 27"	F-679	PVC	Solid T1-Wall	46 psi	20'
	F-794	Large Dia PVC	Profile Open or Closed	46 psi	13'
30"- 36"	F-794	Large Dia PVC	Profile Open or Closed	46 psi	13'
39" - 60"	F-794	Large Dia PVC	Profile Closed	46 psi	13'

Joints. Provide push-on, bell and spigot type joints with elastomeric seals that conform to the requirements of ASTM D-3212. Provide factory installed gaskets that are chemically bonded to the bell end of the pipe with gasket material that conforms to the requirements of ASTM F-477.

Pipe Materials. Provide pipe and fittings made from polyvinyl chloride compounds that comply with the requirements for minimum cell classification defined by ASTM D-1784. Provide PVC fittings, service risers, and laterals with a SDR 35 rating.

Pipe Trenching, Installation and Backfill. Except as noted, Pipe Trenching, Installation and Backfill of PVC gravity sewer pipe will be in accordance with ASTM D-2321 and Article 6 of this specification.

- Trench Width: Refer to Article 6.3.2.1 for FLEXIBLE PIPE
- Pipe Installation: Following the preparation of the trench bottom and trench bracing installed where required, proceed up grade with spigot ends pointing down grade. Lay pipe true to lines and grades as shown on plans. Grade may be established by laser beam, or batter boards (not exceeding 50 foot intervals), and string line may be used with each pipe set to grade, from the string line, with a grade rod equipped with a "shoe" designed to fit into the flow line of the pipe

Testing. Inspect PVC and test for leakage and deflection in accordance with Article 11.3.3.

11.2.2.

Ductile Iron Pipe (DIP). These standard specifications designate the requirements for furnishing and installing DIP for sanitary sewage. Furnish all materials, equipment, tools, labor, superintendence, and incidentals required for the complete construction of the work designated.

Quality Assurance. Manufacturer must have a minimum of ten years successful experience in designing and manufacturing DIP, pipe joints of similar design, pipe diameter, and pressure class of the type specified. The entire pipeline will be the product of one manufacturer. Pipe must conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 "Drinking Water System Components - Health Effects" and be certified by and organization accredited by ANSI. Such compliance will be evidenced by an affidavit from the manufacturer or vendor. If the pipe does not presently conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted.

Submittal. Submit documentation on pipe products, fittings, and related materials as required by the plans or Engineer. Review all submittals prior to submission. Submit in a timely manner so as not to delay the project. Allow sufficient time for Engineer's review and resubmission, if necessary. Include certifications from manufacturer that the DIP complies with appropriate AWWA Standards and ANSI/NSF Standard 61. Provide by an affidavit from the manufacturer or vendor as evidence of compliance. If the pipe does not presently conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted. If requested, provide copies of results of factory hydrostatic tests.

Standards. Comply with applicable requirements of the following items listed below:

- ASTM A-746 Specification for Ductile Iron Gravity Sewer Pipe
- AWWA C-104 Standard for Cement Mortar Lining for Ductile Iron Pipe and Fittings
- AWWA C-105 Standard for Polyethylene Encasement for Ductile Iron Piping
- AWWA C-110 Standard for Ductile Iron and Gray Iron Fittings
- AWWA C-111 Standard for Rubber Gasket Joints for Ductile Iron Pipe and Fittings
- AWWA C-150 Standard for Thickness Design of Ductile Iron Pipe
- AWWA C-151 Standard for Ductile Iron Pipe

Pipe Materials. Manufacture DIP in accordance with AWWA C-151 and conform to ASTM Specification A-746 with physical properties of Grade 60-40-18 with a minimum pressure class rating of 150 psi, unless otherwise specified. Design pipe for five (5) feet of cover or for the depths shown on the plans, whichever is greater. Provide a standard joint length of 18 or 20 feet and the inside diameter will be industry standard. Replace any material found to be damaged or defective in manufacture at Contractor's expense.

Joints. Provide push-on standard joints for DIP manufactured in accordance with AWWA C-111, AWWA C-151. Where indicated on the plans, joints will be mechanical or flanged. Flanged joints will have pressure ratings equal to or greater than adjacent pipe. Flange pattern will match pattern of valve, fitting, or appurtenance to be attached.

Fittings. Provide DIP in accordance with AWWA C-110 and Article 7 of this Specification. Fittings will be rated for a minimum working pressure of 250 psi, unless otherwise specified. Factory welded outlets,

minimum pressure rating 250 psi, may be used in lieu of tee fittings for 18 inch and larger tee fittings. Do not use factory welded outlets near sources of vibration, such as pump stations or roads, unless specifically noted on the plans.

Exterior Coating. Provide a standard asphaltic coating in accordance with AWWA C-151, unless otherwise specified. The finished coating will be continuous, and smooth and strongly adherent to the pipe.

For DIP sizes 30 inches and smaller, use a 30 mils minimum thickness polyethylene wrap applied wrap in accordance with AWWA C-105/A21.5.

Tape coat DIP 36 inches and larger. The exterior of the pipe must have a prefabricated cold-applied tape coating system conforming to the requirements of ANSI/AWWA C-214, except as noted herein. Blast clean the surface to achieve a surface preparation at least equal to that specified in SSPC SP6. The blast profile must have an anchor pattern as specified by the tape manufacturer. Hold the coating back from the end of the pipe the minimum distance recommended by the pipe manufacturer for the type of joint used. Taper the tape wrap cut back. Provide a nominal thickness of 80 mils.

Interior Lining. DIP Pipe and fittings will have an epoxy lining in accordance with ASTM D714. Provide epoxy lining appropriate for wastewater pipe application with a minimum lining thickness of 40 mils.

Provisions for Thrust. Where indicated and where required for thrust restraint, joints must be restrained. Restrained joints will be mechanically interlocking joints. Provide restrained joints such as U.S. Pipe "TR Flex", American Cast Iron Pipe "Flex Ring", or Clow Corporation "Super-Lock" that are capable of sustaining the specified design pressure. If thrust cannot be accommodated using restrained joints, such as bends adjacent to casing pipe, use approved thrust restraint devices.

Use thrust restraint devices to resist thrust at bends, tees, plugs, or other fittings. Do not use concrete thrust blocks unless approved by the Engineer. Acceptable thrust restraint devices are those as manufactured by EBAA Iron, Ford Uni-Flange, or approved equal.

NOTE: At connection of new sewer force main to existing main, use both concrete thrust blocking and thrust restraint devices as per Article 4.2.5 of this specification.

Use restrained joints for a sufficient distance from each bend, tee, plug, or other fitting to resist thrust which will be developed at the design pressure of the pipe. For the purposes of thrust restraint, design pressure will be 1.5 times the design working pressure class indicated. Pipe manufacturer will determine length of pipe with restrained joints to resist thrust forces in accordance with the Handbook of Ductile Iron Pipe. Use the following parameters:

- Laying condition equal to AWWA C-600 Type 5 soil
- Safety factor of 1.8
- Unit bearing resistance equal to zero
- Factor for polyethylene encasement as recommended by DIPRA, if required.

Pipe Trenching, Installation, and Backfill. Except as noted, perform pipe trenching, installation, and backfill for DIP in accordance with AWWA C-600 and Article 6 of this Specification.

General. Repair any damage to polyethylene wrap according to AWWA C-105. Keep pipe clean during installation. Provide two coats of Koppers Bitumastic No. 50, or approved equal to exposed ferrous metal that cannot be protected with field-applied tape coating. Install pipe and fittings to line and grade indicated. In areas where the line and grades indicated cannot be achieved using standard manufactured bends and fittings, make slight adjustments by deflecting joints according to the limitations of AWWA C-600.

Pipe Zone Embedment. Unless otherwise specified, embed DIP in Class II material as defined in Article 6. Native material or imported material meeting or exceeding Class II requirements may be used. Class I material may be acceptable only in groundwater conditions if approved.

Pipe Cutting: When required, machine cut DIP leaving a smooth cut at right angles to the axis of the pipe. Bevel ends of cut pipe to be used with a push-on joint bell to comply with manufactured spigot end. Do not damage cement lining.

Corrosion Protection: As a precaution against corrosion, coat all flanges, bolts, nuts and other exposed metal surfaces underground with Texaco, Koppers, or equal rustproof compound.

Testing. Inspect DIP and test for leakage and deflection in accordance with Section 11.3.3.

11.3. **Sanitary Sewer System.** Furnish labor, materials, equipment and incidentals to install sewer service lines as indicated on the plans in accordance with EPWU Standards.

11.3.1. Sewer Service Connections.

Materials. Conform to the material requirements of the City of El Paso's Plumbing Code and all amendments thereto. Fittings, service risers, and laterals are as specified for the material type utilized. Where additional service connections are required on an existing main line, install an approved service saddle compatible to the size and type of both the collection line and service lateral. Encase saddles with Class B (2500 psi) concrete where PVC saddles with rubber seals and stainless steel bands are used in accordance with EPWU Standards to protect the steel bands from corrosion and to add stability.

Tees and Riser. Install tee or wye fittings for future house service connections. Use bell-type fittings and seal on the branch outlet with an approved plug that can be easily removed for service riser or lateral line installation.

Where ground water is encountered, install the tee and a sufficient service line RISER, thereby raising the final bell above the ground water level. In deep trenches, extend the RISER to the depth of the intersecting service line, or to within 6 feet of the surface, whichever is designated in the plans or appropriate for field conditions.

Install a maximum of four service connections at manholes located at the ends of street cul-de-sacs. Connect additional services to the main line at a minimum 24 inch spacing.

Service Connections and Laterals. Provide new sewer service laterals and re-connections of all existing sewer service laterals to new lines installed to replace lines to be abandoned where required on the plans. Verify location of laterals indicated on the plans and ensure service is not interrupted to homes or other establishments.

Install wyes, bends, tees, stacks, and other hardware, where required, for service laterals as shown in the plans or as directed. Unless otherwise specified, provide minimum 4 inch diameter lateral service lines. Although the maintenance of service laterals is the responsibility of private property owners, including the portion within public right-of-way, as established by Public Service Board Rules and Regulations, the Contractor is be responsible for the integrity of the installation or re-connection of all such service lines during the warranty period.

Use proper specials and fittings to suit the actual conditions for connections between new work and existing work, where required. When it is necessary to interrupt service to existing facilities in order to make connection to an existing line, connections may need to be made at some time other than during normal working hours at no additional cost to Department.

Prior to service line installation, coordinate with EPWU through Engineer to have EPWU personnel curb mark the locations of proposed service tees. Lay service lines and/or tees that the branch makes an angle of 45° with the vertical on the side of the main facing the lot to be served.

Install and extend new service lines 6 inches beyond existing or proposed improvements such as pavement, curb and gutter, sidewalk, etc. unless otherwise specified or shown in the plans. For standard subdivisions

having curb and gutter for drainage, install new services lines at a minimum slope of 2 percent with a minimum cover at the terminus of 18 inches. For subdivisions with flat terrain and on-site ponding (no curb and gutter), provide a minimum cover of 3 1/2 feet, unless otherwise directed.

Uniformly support service pipe on bedding having a density of not less than 90% of maximum density per ASTM D-1557. Carefully place and compact backfill on service lines in accordance with the requirements of Article 6.3.4. Plug the terminus of the service line with an approved universal end cap compatible with the pipe size and material.

Utilize a qualified licensed plumber who is bonded and approved by the El Paso City Public Inspection Department to install service risers and lateral extensions. Provide evidence that plumber is licensed and insured in accordance with City of El Paso requirements.

Location Marking and Recording. Maintain as-built records of the horizontal and vertical location of installed sewer service lines. In unpaved areas without curb, mark the plugged ends of risers or laterals using a 1" by 2" by 24" wooden stake set vertically at the plugged terminus, and a sufficient length of plastic metallic marking tape extended vertically from the terminus to within 6 inches of ground surface. An electronic marker disk may be used in lieu of metallic tape. EPWU personnel will mark locations of the installed service line or riser ends by chipping an arrowhead mark on top of the curb directly over the service plug.

11.3.2.

Manhole Structures. Furnish all labor, materials, equipment and incidentals necessary to provide all manholes as required. Provide manholes for the various sized lines as listed.

- Standard Type "A" 48 inch inside diameter
- Standard Type "B" 72inch inside diameter
- Drop Manhole constructed at the designated locations and in accordance with Utility Standard Details, and as otherwise indicated in the project plans.
- Construct pre-cast concrete sections as specified herein

Quality Assurance. Provide manholes free of visible leakage and test each structure for leaks. Repair all leaks in a manner subject to Engineer's approval.

Submittals. Provide complete manufacturer's shop drawings on the manhole section(s), to include the joints, for approval. Revise shop drawings that do not meet specifications and re-submit approval. Include manufacturer's specification data and recommendations on the lifters and joint material. Submit documentation of compliance with ASTM C-478. Failure to provide either the detailed shop drawings, specification data and recommendation on lifters and joint material, or the letter certifying that all material provided meets specification is sufficient grounds to reject material.

Standards. Comply with the following applicable requirements:

- ASTM A-48 Specification for Gray Iron Castings
- ASTM A-82 Specification for Steel Wire, Plain, for Concrete Reinforcement
- ASTM A-185 Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
- ASTM A-615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- ASTM C-32 Specification for Sewer and Manhole Brick (Made from Clay or Shale)
- ASTM C-33 Specification for Concrete Aggregates
- ASTM C-144 Specification for Aggregate for Masonry Mortar
- ASTM C-150 Specification for Portland Cement
- ASTM C-309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- ASTM C-478 Specification for Pre-cast Reinforced Concrete Manhole Sections
- ASTM C-923 Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipe

- ASTM D-1557 Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in (457-mm) Drop

11.3.2.1. Manhole Structure Materials.

Frame and Cover: Provide manhole frame and cover of cast iron of the weight, dimensions, and pattern indicated by the EPWU Standard Details. Provide casting made from superior quality, gray cast iron conforming to the requirements of ASTM A-48 with no holes in the cover, but edge notches for embedded rings used for lifting. Imprint "SEWER" or a suitable designation on the cover. Machine mating surfaces to assure a snug fit of the cover and frame.

Manhole Rings. Provide manhole rings used for a maximum 2 foot final grade in conformance to the applicable requirements of ASTM Specifications C-32, Grade MS.

Cement. Provide Portland Cement conforming to ASTM Specifications C-150, Type V.

Mortar Sand. Provide mortar sand conforming to ASTM Specifications C-144.

Concrete Aggregates. Provide concrete aggregates conforming to ASTM Specifications C-33 except that the requirement for gradation will not apply to concrete manhole conical and riser sections.

Steel Reinforcement. Provide billet-steel bars conforming to ASTM Specifications A-615 and welded steel wire fabric conforming to ASTM Specifications A-82 or to ASTM Specifications A-185.

Water. Provide water that is clean, clear, free from oil, acid or organic matter and injurious amounts of alkali, salts or other chemicals or deleterious materials.

Mortar. Provide mortar that is composed of 1 part Portland Cement Type V and 3 parts mortar sand mixed in an approved manner with water to form a workable mixture.

11.3.2.2. Pre-Cast Concrete Manholes. Design manhole riser and conical section for sewer and water installations in the diameters specified or shown. Provide all manhole sections with 5 inch wall thickness and tongue and groove, unless otherwise specified. Rings will be available in various lengths from one foot to four feet. Design the conical sections to be concentric and adapted to the ring at one end and to El Paso Water Utilities standard cast iron frame at the other. Provide the base ring with a flat bottom joint. Steps or rungs are not required. Manufacture manhole section(s) in conformance with ASTM C-478 and any additional specifications listed here forth.

Concrete. Concrete to have a minimum 28 days compressive strength of 4000 psi. Water cement ratio to be 0.5 or less by weight or not more than 5.5 gallons per sack.

Aggregates. Conform to specifications outlined by ASTM C-33 except for lightweight aggregate. Aggregates will be free of deleterious substances causing reactivity with oxidized hydrogen sulfide. Grade both types of aggregates in order to produce a homogeneous concrete mix. Accurately weight all materials at a central batching facility for mixing.

Cement. Provide Portland Cement conforming to ASTM C-150, Type V (sulfate resistant) for sewer applications and sufficient to produce a minimum strength of 4,000 PSI, or other design strengths required.

Placing. Handled all concrete from the mixer or transport vehicle to the place of final deposit in a continuous manner, as rapidly as practicable, and without segregation or loss of ingredients, until (the approved unit operation) is completed. Place concrete in layers not to exceed two feet deep. Compact each layer by mechanical internal or external vibrating equipment. Limit duration of the vibration cycle to the time necessary to produce satisfactory consolidation without causing objectionable segregation.

Quality Assurance. The Engineer reserves the right to inspect the manufacturing process at any time to make tests on materials used, and to have cores cut out of the completed manholes for compressive strength testing and placement of reinforcement.

Curing. For purposes of early re-use of forms, the concrete may be heated in the mold after the initial set has taken place. Do not exceed a temperature of 160° and raise from normal ambient temperature at a rate not to exceed 40° per hour. Do not remove the cured unit from forms until sufficient strength is obtained for the unit to withstand any structural strain that may be subjected during the form stripping operation. After the stripping of forms, further curing by means of water spraying or a membrane curing compound of a clear or white type, conforming to ASTM C-309-58 may be used.

Steel Reinforcement. Use reinforcing steel as outlined in ASTM C-478 and any additional specifications herein. Apply the minimum steel area of 0.12 square inches to both risers and cone sections and the maximum center to center spacing of 6 inches as well. Place reinforcing steel for one line circumferential reinforcement on the tension side of the wall (the inner half part of the wall with a minimum 1-inch cover) for two lines circular reinforcement, refer to ASTM C-478. Sufficiently tie all reinforcing to withstand any displacement during the pouring operation.

Joint Reinforcement. Both tongue and groove will contain a #4 rebar.

Lifters. Design lifters to handle the imposed weights placed per manufacturer's requirements.

Joint Material. Seal all joints using Ram-Nek joint sealer in sufficient quantities by the vendor as part of the manhole section(s) in sizes per manufacturer's recommendations.

- 11.3.2.3. Cast-In-Place Concrete Manholes. In special circumstances, construct cast-in-place concrete manholes as shown in the plans, and provide the wall thickness not less than 6 inches. Ensure that the concrete is of good quality and well vibrated and the method of construction materials and type of forms used are approved by the EPWU.
- 11.3.2.4. Manhole Connectors. At manholes, a water-tight resilient connection will be made between the wall and the pipe by use of an engineering approved manhole waterstop adaptor such as Indiana Seal Manhole Adaptor, Kor-N-Seal, or approved equal, meeting the requirements of ASTM C-923. The connector must be compatible to both the type of pipe wall and manhole wall, and be installed in strict accordance with the recommendations of the connector manufacturer.
- 11.3.2.5. Installation. Construct manholes at the location and details shown on the plans or as. After the excavation has been completed, pour the concrete base or bottom.

The riser work may proceed when the concrete has sufficiently set. Neatly form the invert in the bottom of the manhole with concrete after the manhole rise has been completed. Construct invert with a true curve of as large a radius as the size of the manhole will permit and with a smooth trowel finish.

- 11.3.3. **Inspection and Testing.** Test all piping as specified herein unless otherwise directed.

Standards. Adhere to the following requirements when inspecting and testing sewer lines and manholes.

- ASTM C-828 Recommended Practice for Low-Pressure Air Test of Vitrified Clay Pipe Lines (4-12 Inches)
- ASTM C-1103 Standard Practice for Joint Testing of Installed Pre-Cast Concrete Pipe Sewer Line
- ASTM D-3034 Specification for Type PSM Poly(Vinyl Chloride)(PVC) Sewer Pipe and Fittings
- ASTM F-679 Specification for Poly(Vinyl Chloride)(PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
- UNI-BELL-6 Standards and Practices for Low-Pressure Air Testing of Installed Sewer Pipe

- UNI-BELL-9 Polyvinyl Chloride (PVC) Large Diameter Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter (Nominal Pipe Sizes 18-48 Inch)

Manufactured Products. Provide all testing apparatus including pumps, compressors, hoses, gauges and fittings, mandrels, and other equipment necessary to perform the required tests.

11.3.3.1. **Television Inspection.** Prior to placing lines into operation, completed sewer lines will be inspected by EPWU personnel with a television camera as a condition of final approval of the installation. Thoroughly clean and flush all lines and notify Engineer that the line is ready for television inspection. Correct any defects discovered in the pipe or construction methods at no additional cost. EPWU will bear cost of the initial TV inspection. Any additional inspection(s) required due to failure of the initial inspection is/are the Contractor's responsibility.

11.3.3.2. **Leakage Testing.** To ensure the integrity of the pipe and joints, test all sewer lines installed under these specifications for leakage using the guidelines established by ASTM C-828 and UNI-BELL B6, and the methods and procedures here forth described.

General. Provide all testing apparatus including pumps, compressors, hoses, gauges and fittings and other equipment necessary to perform the required tests. Acceptable equipment can be as manufactured by Cherne Industries Incorporated or approved equal.

Conduct tests in the presence of the Engineer unless otherwise approved. Notify Engineer 48 hours in advance of testing. Record test results on standard utility forms provided by EPWU.

Low pressure air testing may be conducted by Contractor or an approved independent testing firm with the full understanding to all persons conducting an Air Test that an Air Test may be dangerous if conducted improperly.

Test sewer lines after the "pipe zone" backfilling is completed and prior to construction of finished surfacing.

Where house laterals are included as integral part of the project, perform testing on the main and laterals after the risers or laterals have been completed and backfilled.

Thoroughly clean pipes prior to conducting leakage tests. Repair pipelines that exceed the allowable leakage rate and retest at no additional cost to the Department.

11.3.3.2.1. **Exfiltration Air Testing.** A Low Pressure Air Test is the standard method for testing sewer lines. Seal test pneumatic plugs above ground using a random pipe section pressurized to 5 psig. Plugs should remain intact without bracing or movement out of the section. Test procedure is as follows:

- Seal off each end of the section of pipe to be tested at a manhole connection. Securely brace test plugs.
- Introduce air slowly into the test section through the test plug until an internal pressure of 4.0 psi is reached. Allow internal air temperature to stabilize. Adjust the internal air pressure to 3.5 psi, disconnect the air supply and begin the test.
- Maintain the test pressure through section without losing more than 1.0 psi for a length of time as determined by Table 15. Sections losing more than 1.0 psi fail test and must be repaired and re-tested for acceptance. If the section being tested includes more than one size of pipe, calculate the test time for each size and add to determine the total test time for the section.

**Table 15.
Total Test Time**

Nominal Pipe Size (d)	Time (t).
Inches	Minutes/100 ft.
4	0.3
6	0.7

8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
30	4.8
36	6.0
42	7.3

- 11.3.3.2.2. Infiltration Test. Infiltration testing of sewer lines under groundwater is mandatory. Perform this test prior to initiating any service connections and after backfilling. At testing time, maintain the level of the groundwater over the entire section of the pipe or near its maximum level.

Measure the allowable infiltration for any portion of the sewer system by a weir or current meter placed in the appropriate manhole and do not exceed 50 gallons per inch of internal pipe diameter per mile per day, including manholes.

Provide suitable plugs or other facilities in order to measure the amount of infiltration. If infiltration is excessive, immediately proceed to locate the source of leakage. Once located, seal the source of leakage by grouting, cementing and rebuilding as required, or by approved methods.

- 11.3.3.2.3. Joint Testing. At Engineer's direction, perform individual joint testing of pipe larger than 24 inches in diameter in accordance with ASTM C-1103 for special conditions not covered by other test methods.

- 11.3.3.2.4. Inspection of Sewer Manholes. Visually inspect manholes installed under groundwater for infiltration leakage through all joints and the manhole base. Repair all leaks or cracks with an approved hydro-cement grout.

- 11.3.3.3. **Deflection Testing.** As a condition for acceptance of the pipeline, perform a mandrel test (deflection test) to verify the roundness and proper installation of the flexible pipeline. Within 30 days, but not less than 7 days after the installation and backfilling of the flexible sewer line, including any service connections, in the presence of the ENGINEER, test deflection of the pipe with a mandrel (GO-NOGO device).

Mandrel Fabrication. Provide mandrels of high quality fabrication and precision as commercially available by Cherne Industries Incorporated, or approved equal. Mandrels require Engineer's approval and must be equipped with proven rings and meet the following requirements:

- Fabricate mandrel outside diameter (gauge dimension):

$$\text{Mandrel O.D.} = \text{Pipeline Base I.D.} - (\% \text{ deflection limit} \times \text{Pipeline Base I.D.}) \text{ in accordance with ASTM D-3034, F-679, or UNI-BELL-9}$$

- Design mandrel open preventing debris buildup between channels of adjacent fins. Include a minimum of nine fin sets that are removable from the mandrel core. Assemble gauges of various diameters by substituting fin sets of appropriate dimension. Provide a length of the minimum radius portion of the mandrel not less than one-third of the nominal diameter of the pipe being tested.

Execution. Prior to testing, flush pipe and clean. Flow is not permitted in the pipeline throughout the duration of the deflection test. Manually pull mandrel through the pipeline with a suitable rope or cable that is connected to an eyebolt at one end of the gauge. Attach a similar rope or cable to the eyebolt at the opposite end of the mandrel and apply tension to it. This will ensure that the mandrel maintains its correct position during testing, while providing easy removal of the mandrel should it become lodged in an excessively deflected pipeline. Winching or other methods of forcing the mandrel through the pipeline is unacceptable.

For pipeline tested within 30 days of installation, do not exceed a deflection of 5% of the base inside pipe diameter as established by ASTM Standards D-3034 and F-679 listed in Table 16.

Table 16.
Deflection Gauge Dimensions: SDR35 OR RSC 160

Nominal Size	Average I.D.	Base I.D.	5% Deflection Gauge
6"	5.893	5.742	5.46
8"	7.891	7.665	7.28
10"	9.864	9.563	9.08
12"	11.737	11.361	10.79
15"	14.374	13.898	13.20
18"	17.564	16.976	16.13
21"	20.707	20.004	19.00
24"	23.296	22.480	21.36
27"	26.258	25.327	24.06

For pipeline tested beyond 30 days of installation, do not exceed a deflection of 7.5% of the nominal inside diameter or as established otherwise by the applicable governing body. Adjust mandrel gauge for 7.5% and seek Engineer approval. Make every effort to test for deflection prior to the 30 day expiration.

Maintain a permanent record of all testing with locations where excessive pipeline deflections occur and forward to Engineer after completion of testing on each line.

Replace all sections of pipe that deflect more than 5% (or 7.5%). Lay pipelines with acceptable ovality such that the larger diameter is situated in the vertical direction. All expenses for re-trenching, backfill, compaction, paving, and related work necessary due to failure to satisfy deflection test requirements are Contractor's responsibility.

11.4. **Sewer Line Bypassing and Draining.** This section specifies the requirements for temporary bypassing, draining, flushing and abandonment of sewer lines. Keep excavations free from water during construction. Do not damage property or create a public nuisance when disposing water. Provide hand pumping equipment and machinery in good working condition for emergencies and have workers available for its operation.

11.4.1. Requirements. Provide labor, equipment, materials and supervision to temporarily bypass flow around work during sewer construction and/or during work associated with sewer construction when necessary. Drain and flush all sewers to be abandoned with a minimum of twice the sewer's volumes of water. Drain all sewers lines to be abandoned. Coordinate all work with the Engineer.

11.4.2. Submittals. Twenty-one (21) calendar days prior to commencement of construction activities, the submit for review and approval drawings and complete design data showing methods and equipment proposed to utilize in sewer bypassing and draining. Include the following information:

- Drawings indicating the location of temporary sewer plugs and bypass discharge lines
- Schedule times for bypasses
- Capacities of pumps, prime movers, and standby equipment
- Design calculations proving adequacy of the system and selected equipment

11.4.3. Job Conditions. Existing sewer system map of the project area can be obtained from EPWU and are available for review at their office – 1154 Hawkins Blvd., El Paso, TX. 79925, during regular business hours.

Protection. Where bypassing or draining of the contents of a line is required, ensure that service for connecting sewer laterals are not disrupted. Discharge all flow into the nearest downstream manhole and only after consultation with EPWU operations to coordinate the discharge. Do not surcharge sewers or interfere with normal operation of related sewer facilities when bypassing and draining of the contents of a line. Discharging to the ground surface, receiving streams, storm drains, or discharging that result in groundwater contamination or potential health hazards is not permitted. In the event accidental discharging is caused by the Contractor's operations, EPWU is immediately entitled to employ others to stop the discharging without giving written notice to the Contractor.

Contractor is responsible for penalties imposed on the EPWU as a result of any discharge by the actions of Contractor's employees or subcontractors including legal fees and other expenses to the EPWU resulting directly or indirectly from the discharge.

Scheduling. Do not shut down the bypassing systems between shifts, on holidays or weekends, or during work stoppages without written permission from the ENGINEER. Submit a detailed outage plan and time schedule for operations when necessary to remove a sewer line or structure from service. Coordinate schedule with the Engineer and meet the restrictions and conditions specified in this section. In the detailed plan, describe the method for preventing accidental discharges, the length of time required to complete said operation, the necessary plan and equipment to be used in order to prevent accidental discharges. Observe the following restrictions:

- Systems or individual equipment items will be isolated, drained, decommissioned, de-energized, or depressurized in accordance with the detailed outage plan and schedule.
- Notify Engineer, in writing, at least one week in advance of the planned operation.

11.4.4. **Sewer Line Draining.** Flush sewers to be abandoned with two pipeline volumes of water and allow to drain fully prior to abandoning.

11.4.5. **Sewer Bypassing.** Accomplish sewer bypassing by pumping or diverting the upstream flow around the proposed work and as directed. Provide temporary pumps, conduits, and other equipment to bypass the sewer flow.

Furnish the necessary labor, equipment and material, and supervision to set up and operate the pumping and bypass system. Equip engines with mufflers and/or enclosed to keep the noise level within local ordinance requirements. Provide pumps and bypass lines of adequate capacity and size to handle the flows.

Unless otherwise directed, bypass flow around proposed work whenever the depth of flow, as measured at the inlet pipe to the upstream manhole adjacent to proposed work, exceeds the crown elevation of the pipe; or whenever the equipment operating in the sewer provides an obstruction that restricts flow and causes the depth of flow to exceed the crown elevation.

11.4.6. **Standby Equipment.** Maintain on site sufficient equipment and materials to ensure continuous and successful operation of the bypass and dewatering systems. Maintain standby pumps fueled and operational at all times. Maintain on site a sufficient number of valves, tees, elbows, connections, tools, sewer plugs, piping and other parts or system hardware to ensure immediate repair or modification of any part of the system as necessary.

11.4.7. **Damages.** Repair, without additional cost to the Department, any damage that may result from negligence, inadequate or improper installation, maintenance, and operation of bypassing and draining equipment, including mechanical or electrical failures.

11.5. **Flowable Backfill.** When indicated on the plans, backfill trenches to the elevations shown with stabilized backfill meeting requirements of Item 401.

11.6. **Cutting and Restoring Pavement.** Where sewers must be installed in streets or other paved areas, the work includes saw cutting of the pavement and base to neat lines and prompt replacement of these materials after sewer excavation and backfill are completed. The replacement materials, as to type and thickness, are shown on the plans. Any work done or damage to base and/or pavement outside the limits shown on the plans will not be measured for payment and must be restored at no additional cost to the Department.

11.7. **Measurement.**

11.7.1. **Sanitary Sewer Mains (PVC).** Longitudinal measurement of sanitary sewers will be made along the centerline of the sewer by the linear foot of the various sizes of sewers in place, in accordance with these specifications, complete and approved. The lengths of sewer mains will be measured center of manholes where the installation involves connection of the sewer into a manhole at each end of the line being

measured. Where the installation involves a connection to an existing sewer line, the measurement will be made from the end of the existing sewer line to the center of the manhole on the work being measured.

- 11.7.2. **Sanitary Sewer Mains (DIP).** Longitudinal measurement of sanitary sewers will be made along the centerline of the sewer by the linear foot of the various sizes of sewers in place, in accordance with these specifications, complete and approved. The lengths of sewer mains will be measured center of manholes where the installation involves connection of the sewer into a manhole at each end of the line being measured. Where the installation involves a connection to an existing sewer line, the measurement will be made from the end of the existing sewer line to the center of the manhole on the work being measured.
- 11.7.3. **Sanitary Sewer Manhole.** All sanitary sewer manholes satisfactorily completed in accordance with the plans and specifications will be measured by each of the various manhole types based on a standard 6 foot depth.
- 11.7.4. **Sanitary Sewer Manhole (Extra Depth).** This measurement will be measured by the linear foot and is the distance from the top of the frame to the invert of the manhole minus 6 feet.
- 11.7.5. **Adjusting Manhole.** Existing manholes remaining in service and required to be adjusted to proposed grade will be measured by each manhole adjusted.
- 11.7.6. **Remove Existing Manholes.** Existing manhole structures to be completely abandoned and removed as identified in the plans will be measured for each manhole removed.
- 11.7.7. **Sewer Service Re-Connections (Service Laterals).** Sewer Service Re-Connections (Service Laterals) will be measured by each sewer service re-connection of a particular size installed and accepted.
- 11.7.8. **New Sewer Service (Service Laterals).** New Sewer Service (Service Laterals) will be measured by each new sewer service connection of a particular size installed and accepted.
- 11.7.9. **Abandon and Fill Existing Sanitary Sewer Pipe.** This Item will be measured by the linear foot of existing sanitary sewer main that is abandoned in place.
- 11.7.10. **Remove Existing Sanitary Sewer Pipe.** This Item will be measured by the linear foot of existing sanitary sewer main pipe that is removed as identified in the plans.
- 11.7.11. **Flowable Backfill.** This Item will be measured by cubic yard as shown under Item 401, "Flowable Backfill".
- 11.7.12. **Cutting and Restoring Pavement.** This will be measured by the square yard as shown under Item 400, "Excavation and Backfill for Structures".
- 11.8. **Payment.**
- 11.8.1. **Sanitary Sewer Mains (PVC).** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid for at the unit price bid for "Sanitary Sewer Pipe (PVC)" of the type and size specified, complete in place.

This price is full compensation for furnishing all required materials and labor; potholing; excavation, including hand-digging, if needed, embedment and backfill; compaction and compaction testing for utilities, all fittings; removal and disposal of existing manholes, except where indicated as being covered under a specific bid item; pipe connections to existing manholes; relocation or replacement of existing water and sewer lines required for placement of new sewer line; pipe concrete caps; plugs (temporary and/or permanent); air/vacuum release valves; blow-off valve assemblies; testing; dewatering of groundwater, if needed; bypassing and any work related to the bypass including traffic control related to bypasses; removal and replacement of storm drains; removal and replacement of drainage structures; placing and joining of pipes and fittings; traffic control required for sewer work outside Project limits; coordination with utility companies, EPWU, and Engineer; locating and protecting of existing utilities; and for all other items of material, labor,

equipment, tools and incidentals necessary to complete the work in accordance with the plans and specifications

- 11.8.2. **Sanitary Sewer Mains (DIP).** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid for at the unit price bid for "Sanitary Sewer Pipe (DIP)" of the size specified, complete in place.

This price is full compensation for furnishing all required materials and labor; potholing; excavation, including hand-digging, if needed, embedment and backfill; compaction and compaction testing for utilities, all fittings; removal and disposal of existing manholes, except where indicated as being covered under a specific bid item; pipe connections to existing manholes; relocation or replacement of existing water and sewer lines required for placement of new sewer line; pipe concrete caps; plugs (temporary and/or permanent); air/vacuum release valves; blow-off valve assemblies; polyethylene wrap; testing; dewatering of groundwater, if needed; bypassing and any work related to the bypass including traffic control related to bypasses; removal and replacement of storm drains; removal and replacement of drainage structures; placing and joining of pipes and fittings; traffic control required for sewer work outside Project limits; coordination with utility companies, EPWU, and ENGINEER; locating and protecting of existing utilities; and for all other items of material, labor, equipment, tools and incidentals necessary to complete the work in accordance with the plans and specifications.

- 11.8.3. **Sanitary Sewer Manhole.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid for at the unit price bid for "Sanitary Sewer Manhole (6 foot Depth)" of the size and type specified or indicated on the plans". This price is full compensation for furnishing all required materials, labor, gaskets, rings, covers, concrete collars, pipe penetrations, drop connections, grout, groundwater dewatering, testing, concrete, excavation and backfill, grouting of inverts, coating interior and exterior where required, adjustment of new manhole to both temporary and finished grades, and tools and incidentals necessary to complete the work in accordance with the plans and specifications.

- 11.8.4. **Sanitary Sewer Manhole (Extra Depth).** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid for at the unit price bid for "Sanitary Sewer Manhole (Extra Depth)". This price is full compensation for furnishing all required materials, labor, equipment and performing all operations necessary to construct the depth of sanitary sewer manhole in excess of 6 feet; including but not limited to providing an external protective bituminous coating, such as coal-tar epoxy.

- 11.8.5. **Adjusting Manholes.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid for at the unit price bid for "Adjusting Manhole". This price is full compensation for furnishing all required materials and labor, plugs (temporary and permanent), excavation and backfill, cement stabilized backfill, groundwater dewatering, removal, disposal of materials, and all other incidentals necessary to necessary to complete the work in accordance with the plans and specifications.

- 11.8.6. **Remove Existing Manholes.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid for at the unit price bid for "Remove Existing Manhole". This payment will be for all labor, materials, plugs (temporary and permanent), excavation and backfill, cement stabilized backfill, groundwater dewatering, removal, disposal of materials, and all other incidentals necessary to complete the work in accordance with the plans and specifications.

- 11.8.7. **Sewer Service Re-Connections (Service Laterals).** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid for at the unit price bid for "Sewer Service Re-Connection" of the particular size installed. This price is full compensation for furnishing all required materials, labor and materials for the pipe; excavation and backfill; fittings; cutting; bypassing; coordination; testing; and plugging/capping of abandoned utilities; draining of lines; vertical and horizontal adjustments; connections to existing sewers; and all other incidentals necessary to complete the work in accordance with the plans and specifications.

- 11.8.8. **New Sewer Service (Service Laterals).** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid at the unit price bid for each "New Sewer Service Lateral" of the particular size installed. This price is full compensation for furnishing all required materials and labor; excavation and backfill; fittings; cutting; bypassing; coordination; testing; and plugging/capping of abandoned utilities; draining of lines; vertical and horizontal adjustments; connections to existing sewers; and all other incidentals necessary to complete the work in accordance with the plans and specifications.
- 11.8.9. **Abandon and Fill Existing Sanitary Sewer Pipe.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Abandon and Fill Existing Sanitary Sewer Pipe" of the size specified. This price is full compensation for furnishing all required materials, labor, and equipment, including but not limited to the following items: coordination, traffic control, potholing, excavation, complete flushing and draining (dewatering) of pipe, flowable backfill, cutting, capping/plugging, complete filling with approved flowable backfill of sanitary sewer mains to be abandoned, proper abandonment of all manhole structures with flowable backfill as indicated on the plans, and all other items for the project not indicated as being covered under the other specific bid items.
- 11.8.10. **Remove Existing Sanitary Sewer Pipe.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Remove Existing Sanitary Sewer Pipe" of the size specified. This price is full compensation for furnishing all required materials, labor, and equipment, including but not limited to the following items: coordination, traffic control, potholing, excavation and backfill, complete draining (dewatering) of pipe, groundwater dewatering, flowable backfill, cutting, capping, removal of pipe, disposal of materials, and all other items for the project not indicated as being covered under the other specific bid items.
- 11.8.11. **Flowable Backfill.** Flowable Backfill will be paid for in accordance with Item 401, "Flowable Backfill".
- 11.8.12. **Cutting and Restoring Pavement.** Cutting and Restoring Pavement will be paid for in accordance with Item 400, "Excavation and Backfill for Structures".

12. CASINGS

- 12.1. **Description.** Furnish all labor, materials, equipment and incidentals required to construct steel casings and install approved carrier pipes within the casing of various sizes including all necessary field welding, carrier pipes and accessories as shown on the plans and as specified herein.
- 12.2. **Materials.** Furnish new, unused steel casing pipe suitable for the purpose intended with a minimum yield strength of 36,000 psi. Provide casing that meets ASTM A-53 or approved equal requirements. Coat and line pipe with coal tar epoxy (15 mils min.) in accordance with AWWA C-210. Weld pipe joints in accordance with AWWA C-206. After pipe is welded, repair coating and lining. Unless specified otherwise, provide the steel casing pipe with a minimum wall thickness of 5/16 inches. Provide required vent piping, casing insulators (casing insulated spacers), end seals, pipe supports and skids, and other incidental features required to complete work described in this section and as shown on the plans.
- Construct tunnel liner of cold-formed steel plates of the sizes, thickness, and dimensions required, as indicated on the plans, and as manufactured by Commercial Shearing, Contech, or equal.
- Provide reinforced concrete pipe for casing where specified or shown that is straight-wall RCP pipe casing conforming to ASTM C-76 Class IV of the size and length specified.
- Provide welded half coupling grout holes. Provide tapped holes with a pipe plug screwed in place.
- Provide bolts and nuts with liner plates that are not less than 1/2 inch diameter and conform to ASTM A-307 Grade A.

12.2.1. Submittals. Submit complete working drawings that show details of the proposed method of construction and the sequence of operations to be performed during construction. The plan will show the method of jacking, boring, or tunneling, muck removal and disposal, type and method of installation of the primary casing or tunnel liner, access pit size and construction shoring and bracing, and dewatering methods proposed. Drawings should be sufficiently detailed to allow the ENGINEER to judge whether or not proposed materials and procedures will meet the contract requirements.

Include the design criteria used and a certification that the structural design of the casing or tunnel liner meets these design criteria and that the material meets the required ASTM Standards. The tunnel liner must be capable of carrying H-20 vehicle load distributions in accordance with AASHTO as well as the anticipated dead loads and include an appropriate design factor of safety.

Include the layout and design of the access shafts. Provide a certification that the structural design of the shoring and bracing meets the design criteria as submitted. All structural designs must be sealed by a Professional Engineer licensed in the State of Texas and qualified to perform such work.

12.2.2. Standards. Apply all OSHA regulations and all requirements of the specific private and governmental agencies under whose facilities the casings and pipe area to be installed.

Protect the facilities under which the casings and pipe are installed, provide protection at the excavations, and carry out the trench safety procedures in accordance with all required OSHA regulations.

Referenced within this section is the "Standard Specification for Construction of Highways, Streets and Bridges," most current edition of the Texas Department of Transportation (TxDOT).

12.3. **Construction.**

12.3.1. General. Install casings at the locations and to the lines and grades indicated on the plans, of the sizes indicated, using either jacking, boring, tunneling, or approved open-cut methods.

Provide adequate lights, ventilation, signal systems, fire extinguisher, safety equipment, and other equipment required and maintain such equipment in good repair.

Determining soil conditions at the various locations where casings are to be installed, and make such other investigations to obtain that information as deemed necessary subsidiary to this Item.

The methods of construction, whether by tunnel boring machine or by hand digging, is Contractor's option subject to the approval of the governing agencies and Engineer.

Execute work of excavating, lining, grouting and construction of the casing or tunnel so that ground settlement is minimized.

Where casings are installed by open-cut method, all requirements for trenching and backfilling as described in these specifications apply, except as otherwise required by the plans or supplemental specifications.

Locate access shafts or pits at the beginning and end of each casing or tunnel segment to be constructed.

Unless superseded by the requirements of other governing authorities under whose facilities or right-of-way the casing is to be installed, install the face of any shaft at least 20 feet from existing adjacent roadways or structures. Ensure that the size of shafts or pits provide adequate room to meet operational requirements for tunnel construction.

12.3.2. Installation of Casings. Install casings using either jacking, boring, or tunneling methods. Provide equipment of such size and capacity as to allow the placement of the casings to proceed in a safe and expeditious manner.

Install casing pipe from the end which will create a minimum of access and utility relocation problems. Prior to casing installation, pothole utilities and all other permanent structures within the project area in order to identify potential conflicts. In the event a conflict exists, notify Engineer before proceeding with casing installation so a solution can be formulated.

Permissible lateral or vertical variation in the final position of the pipe casing from the established line and grade established is only to the extent of 1 inch in 10 feet, provided that such variation is regular and only in the direction that will not detrimentally affect the function of the carrier pipe. Remove or abandon casing pipe found to be considerably off-grade or alignment and re-install at no additional cost.

Repair any detectable settlement of the roadway overlying the casing or tunnel immediately. Slight settlement of the roadway, should it occur, will result in cessation of casing/tunneling operations, posting of appropriate highway safety signs, and placement of an asphaltic hot-mix overlay to return the roadway to original grade. For over-cutting in excess of 1 inch, pressure grout the entire length of the bore with 7 sack cement per cubic yard of soil mixture. Where applicable, provide hot-mix in accordance with the requirements of TxDOT Specifications. Prime the surface to receive hot-mix as directed. Submit an emergency road repair procedure plan to the Engineer, prior to beginning any casing/tunneling operations. Labor and equipment necessary for this work is the Contractor's responsibility and will be provided at no additional cost.

When installing casing by boring, install casing, excavate and remove material within the casing simultaneously. Ensure the completed casing is free of dents, bends, weld protrusions, or other obstructions to allow the smooth sliding of the carrier pipe through the casing.

12.3.3.

Installation by Tunneling. Excavate tunnel of sufficient size to permit efficient excavation operations, to provide sufficient working space for placing the tunnel lining, and to allow for construction of the carrier pipe as shown on the plans and indicated on the specifications. Determine adequate tunnel size and section to meet these requirements. Dimensions shown on the plans represent the acceptable approximate dimensions and do not necessarily represent the size and/or section suitable for the construction methods or operational procedures as may be proposed and/or conducted by the Contractor.

Use structural steel plates assembled from the inside of the tunnel and field bolted to provide a full round casing pipe when installing casing pipe by tunneling method. Hold tunnel excavation to the minimum possible diameter required for installation of liner plate.

Minimize excavation limits as required to prevent caving. Pressure grout the annular space between the tunnel liner and the tunnel bank by providing 2 inch diameter plugs in the liner plates at spacing of 5'-0" or as directed. Remove any excess groundwater encountered in a manner to allow the tunneling operation to proceed according to schedule.

12.3.4.

Installation of Carrier Pipe in Casing Pipe or Tunnel Liner. Install carrier pipe in the casing in accordance with the recommendations of the pipe manufacturer. After the casing or tunnel liner has been installed and approved, push or pull the carrier pipe through the casing by exerting pressure on the barrel of the pipe in such a manner that the pipe joints are always in compression.

Use insulated spacers when specified for providing cathodic protection consisting of pre-manufactured steel bands with plastic lining and plastic runners. Casing spacers must fit snug over the carrier pipe. Position the carrier pipe approximately in the center of the casing pipe, to provide adequate clearance between the carrier pipe bell and the casing pipe. Use casing spacers that are Model C12G-2, coated for the ultimate in strength, toughness and corrosion resistance, or Model A12G-2, painted for unusually heavy pipe, for long casings or whenever maximum strength and toughness are required for carrier pipes 4" - 56" in diameter and as directed. Casing spacers can be as manufactured by Pipeline Seal and Insulator, Inc. (PSI) or approved equal.

If tunnel liner is used, grout the bottom 120 degrees of the liner to the top of the tunnel liner ribs to aid in the installation of the carrier pipe.

Seal ends of pipe after installation of the carrier pipe inside the casing pipe or tunnel liner to prevent water or other material from entering the casing or liner and causing corrosion by one of the following methods:

- Brick and Mortar Method
- Bulkhead and Grout Method
- Synthetic rubber end seal - type PSI, Inc. Standard Pull-On (Model C), or approved equal, appropriate for the size and type of carrier pipe and casing.

Include a precautionary outlet and bonnet box at each end of the casing as shown on the plans when using steel casings.

- 12.3.5. Grouting. Use ordinary cement-sand grout, as described in Article 5, unless otherwise specified or directed. Fill all excavation outside the casing or tunnel liner with pressure-applied grout or other approved fill unless otherwise directed.

Exercise care in grouting operations to prevent damage to adjacent utilities or other properties. Ensure that pressure used in grouting is not great enough to distort or imperil any portion of the work.

Completely fill with grout all voids outside the limits of the casing or tunnel excavation created by caving or collapse of earth cover over the excavation, or by other cause. All grouting to eliminate voids outside the casing or tunnel limits is subsidiary to this Item.

When hand-tunneling methods are used, place grout behind the tunnel liner at the end of each day or at every 10 feet of tunnel installed whichever spacing is acceptable.

Treat the annular space between the casing and carrier pipe by one of the following methods as directed or specified. Where applicable, fill the annular space according to the regulations specified by the governing agency for the area where the casing is to be installed.

- Leave annular space open for cathodically protected systems where both casing and carrier pipes are metallic material.
- Fill annular space with pneumatically placed sand as the standard method for pipes in all installations other than groundwater.
- Fill annular space with grout. Do not damage or distort pipe using pressure to install grout. Submit method for approval prior to starting work. This method is mandatory for installations in groundwater, optional on all other dry installations.

- 12.4. **Measurement.** Casings will be measured by the linear foot complete in place. Casing for temporary water and/or sanitary sewer by-pass lines will not be measured for payment and are incidental to pertinent pay items.

- 12.5. **Payment.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Casing" of the type, size and installation method specified. This price is full compensation for coordination; excavation; disposal of excess material; grouting; backfilling; compaction; compaction testing for utilities; furnishing and installing the approved carrier pipe, precautionary outlet with bonnet box, and accessories as per specifications and standard details by means of open cut (where indicated), and bore and jacking methods (where indicated), welding, furnishing and installing steel casing insulators, and all appurtenances described herein to include, but not limited to the following items: locating, protecting, supporting, relocating if required, and repairing damage to any utilities or structures encountered in the process of the work, dewatering and disposal for water where required, paving cut, removal and repair as needed, traffic control plan, excavation for bore pits, and all other items of the project not indicated as being covered under the other specific bid items shown on the Proposal. Such payment is complete compensation for the complete performance of the work in accordance with the plans and the provisions of these specifications.

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