

EXHIBIT "B"
TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS

FOR THE
PARKING LOT AND STREET IMPROVEMENTS PROJECT

CLIENT:
McAllen Independent School District

February 4, 2013

I.F.B

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McAllen – Parking Lot and Driveway Resurfacing
DEC NO. 4657-01

TECHNICAL SPECIFICATIONS

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Section 02221

REMOVING EXISTING PAVEMENTS AND STRUCTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Removing concrete pavement, asphaltic concrete pavement, and base courses.
- B. Removing concrete curbs, concrete curbs and gutters, sidewalks and driveways.
- C. Removing pipe culverts and storm sewers.
- D. Removing existing inlets and manholes.
- E. Removing miscellaneous structures of concrete or masonry.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. No Separate payment will be made for work performed under this Section. Include cost of work performed under this Section in pay items for which this work is a component.
- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 REGULATORY REQUIREMENTS

- A. Conform to Section 01 74 19 – Construction Waste Management and Disposal, applicable codes, and local laws for disposal of debris.
- B. Coordinate clearing work with utility companies.

1.04 SUBMITTALS

- A. Conform to the requirements of Section 01 33 00 – Submittal Procedures.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 PREPARATION

- A. Obtain advance approval from Resident Project Representative for dimensions and limits of removal work. Submit preconstruction photographs in accordance with the applicable portions of Section 01 32 33 –Photographic Documentation.
- B. Locate and identify buried utilities. Identification shall be by flagging and offset staking.

REMOVING EXISTING PAVEMENTS AND STRUCTURES

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3.02 PROTECTION

- A. Protect the following from damage or displacement:
 - 1. Adjacent public and private property.
 - 2. Trees, plants, and other landscape features designated to remain.
 - 3. Utilities designated to remain.
 - 4. Benchmarks, monuments, and existing structures designated to remain.

3.03 REMOVALS

- A. Remove pavement and structures by methods that will not damage underground utilities. Do not use a drop hammer near existing underground utilities.
- C. Minimize amount of earth loaded during removal operations.
- D. Where existing pavement is to remain, make straight saw cuts in existing pavement to provide clean breaks prior to removal. Do not break concrete pavement or base with drop hammer unless concrete or base has been saw cut to a minimum depth of 2-inches.
- E. Where street and driveway saw cut locations coincide or fall within 3-feet of existing construction or expansion joints, break out to existing joints.
- F. Remove sidewalks and curbs to nearest existing dummy, expansion, or construction joint.
- G. Where existing end of pipe culvert or end of sewer is to remain, install and 8-in-thick masonry plug in pipe end prior to backfill.

3.04 BACKFILL

- A. Backfill of removal areas shall be in accordance with requirements of Section 02316 – Excavation and Backfill of Structures.

3.05 DISPOSAL

- A. Disposal shall in accordance with requirements of Section 01 74 19 – Construction Waste Management and Disposal.
- B. Remove debris, rubbish, and extracted plant material from the site in accordance with requirements of Section 01 74 19 – Construction Waste Management and Disposal.

END OF SECTION

REMOVING EXISTING PAVEMENTS AND STRUCTURES

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Section 02555

TRAFFIC CONTROL AND REGULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Traffic Control and Regulation

1.02 METHODS OF PAYMENT

- A. No separate payment will be made for traffic control and regulation. Include the cost of traffic control and regulation in unit price for work requiring such control.

1.03 REFERENCES

- A. Texas Manual of Uniform Traffic Control Devices (TMUTCD)
- B. Texas Department of Transportation (TxDOT) permit (if applicable)
- C. Railroad company permit(s) (if applicable)

1.04 PERFORMANCE REQUIREMENTS

- A. Provide all necessary signs, barricades, marking, lighting, and other equipment and supplies required to comply with the TMUTCD (and TxDOT permit, and/or Railroad Company permit, if applicable)
- B. Provide all necessary certified flagmen required to comply with the TMUTCD (and TxDOT permit, if applicable)

PART 2 PRODUCTS

- A. Equipment and materials must be furnished, installed and operated by an experienced contractor regularly engaged in traffic control system design, installation and operation.
- B. All equipment must be in good repair and operating order.
- C. Sufficient standby equipment and materials shall be kept available to ensure continuous operation, where required.

PART 3 EXECUTION

- A. Provide labor, material, equipment, techniques and methods required to provide safe traffic control and regulation. Monitor effectiveness of the installed system and its effect on adjacent property.
- B. Notify, TxDOT and/or Railroad Company as required by the permit(s) (if applicable).
- C. Provide continuous system operation, including nights, weekends and holidays. Arrange for appropriate backup if electrical power is primary energy source for traffic control system.

TRAFFIC CONTROL AND REGULATION

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- D. Remove system(s) upon completion of construction or when traffic control is no longer required.

END OF SECTION

Section 02570

TEXAS POLLUTANT DISCHARGE ELIMINATION SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Section describes the requirements for the documents to be prepared by the Contractor for the Texas Pollutant Discharge Elimination System program for construction storm water. These documents are to be prepared, reviewed, and submitted to the Texas Commission on Environmental Quality (TCEQ) prior to commencing construction operations.

1.02 UNIT PRICES

- A. No separate payment will be made for work performed under this Section. Include the cost of work performed under this Section in pay items of which this work is a component.

1.03 REFERENCES

- A. Texas Commission on Environmental Quality – TPDES General Permit Number TXR150000 (attached)
- B. Texas Department of Transportation – Storm Water Management Guidelines for Construction Activities

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION

3.01 TEXAS POLLUTANT DISCHARGE ELIMINATION SYSTEM

- A. The Contractor shall prepare the necessary forms, Storm Water Pollution Prevention Plan (SWPPP), and comply with the TPDES General Permit Number TXR150000 referenced in item 1.03 A of this specification.
- B. Copies of the Notice of Intent (NOI) with instructions, Notice of Termination (NOT) with instructions, and TPDES General Permit TXR150000 are attached for the Contractor's use.
- C. The Contractor must pay any required application fees and water quality fees as outlined in the TPDES General Permit TXR150000.

3.02 PRECONSTRUCTION REVIEW AND SUBMITTALS

- A. The Contractor shall submit to the Resident Project Representative a copy of the NOI prior to commencing construction.

3.03 CONSTRUCTION REQUIREMENTS

- A. The Contractor shall be responsible for preparation of applicable forms, payment of fees, and retaining records as outlined in the TPDES General Permit TXR150000.

END OF SECTION

Section 02571

STORM WATER POLLUTION PREVENTION PLAN

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Section describes the requirements for the documents to be prepared by the Contractor for the Storm Water Pollution Prevention Plan (SWPPP). These documents are to be prepared and reviewed prior to commencing construction operations.

1.02 UNIT PRICES

- A. No separate payment will be made for work performed under this Section. Include the cost of work performed under this Section in pay items of which this work is a component.

1.03 REFERENCES

- A. Texas Commission on Environmental Quality – TPDES General Permit Number TXR150000
- B. Texas Department of Transportation – Storm Water Management Guidelines for Construction Activities

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION

3.01 STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

- A. The Contractor shall prepare the SWPPP in accordance with the TPDES General Permit Number TXR15000 referenced in item 1.03 A of this specification.
- B. The Contractor shall prepare the SWPPP using structural and nonstructural control measures included in the Plans and Specifications throughout the construction and post construction periods. These control measures shall not be used as a substitute for the permanent pollution control measures unless otherwise directed by the Resident Project Representative in writing. The control measures may include silt fences, straw bales, stabilized construction exits, or other structural or nonstructural storm water pollution controls. Additional information regarding these controls can be found in the Texas Department of Transportation Manual referenced in item 1.03 B of this specification.
- B. The SWPPP shall include at a minimum:
 - 1. A site map showing the areas of soil disturbance, areas not to be disturbed, drainage patterns, approximate slopes anticipated after major grading activities, locations where storm water discharges to surface waters (including wetlands) and/or leaves the project site, locations of structural and nonstructural controls for regulating the discharge of storm water pollutants, locations of waste, borrow, and equipment storage areas, and location where stabilization practices are expected to occur.

STORM WATER POLLUTION PREVENTION PLAN

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2. A description including the nature of the construction activity, a description of the intended sequence of major activities which disturb soils for major portions of the site (grubbing, excavation, grading, utilities and infrastructure installation), estimates of the total area of the site, and the total area of the site that is to be disturbed
3. A description of the control measures that will be implemented as part of the construction activity to control pollutants in storm water discharges, and the general timing during the construction process that these measures will be implemented.
4. A description of construction and waste materials expected to be stored on site with updates as appropriate. The SWPPP shall also include a description of controls to reduce pollutants from these materials including storage practices to minimize exposure of the materials to storm water, and spill prevention and response.
5. A description of pollutant sources from areas other than the construction site over which the Contractor has control for the project (including but not limited to dedicated asphalt plants, dedicated concrete plants, haul roads, and field offices), and the control measures implemented to reduce pollutants.

3.02 PRECONSTRUCTION REVIEW AND SUBMITTALS

- A. The Contractor shall review implementation of the SWPPP in a meeting with the Engineer and the Resident Project Representative prior to the start of construction.
- B. The Contractor shall submit to the Resident Project Representative for acceptance schedules for accomplishment of the storm water pollution control measures in accordance with the SWPPP. Work on the project shall not begin until the schedules for implementation of the controls and methods of operation have been reviewed and accepted in writing by the Resident Project Representative.

3.03 CONSTRUCTION REQUIREMENTS

- A. The Contractor shall be responsible for implementation, maintenance, and inspection of storm water pollution prevention control measures and other practices shown on the SWPPP, the Plan Drawings, or specified elsewhere in this or other Specifications.
- B. The contractor shall effectively prevent and control erosion and sedimentation on the site at the earliest practicable time as outlined in the approved schedule and SWPPP. Control measures, where applicable, will be implemented prior to the commencement of each construction operation or immediately after the area has been disturbed.

END OF SECTION

SECTION 02610

PRIME COAT

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION:

- A. Prime coat shall consist of the application of asphaltic materials on a newly completed base course and/or other approved area, which shall be applied in accordance with these specifications, as shown on the plans, and as directed by the ENGINEER.

1.02 QUALITY ASSURANCE:

A. Test and Certification of Bituminous Materials.

1. Bituminous materials to be tested in accordance with the requirements of AASHTO M-82 and sampled in conformance with AASHTO T-40.
2. Supply, at the time of delivery of each shipment of asphalt, two certified copies of test reports from the supplying vendor to the ENGINEER.
3. Test reports shall indicate name of vendor, type and grade of asphalt delivered, date and point of delivery, quantity delivered, delivery ticket number, purchase order number, and result of specified tests.
4. The test report shall be signed by an authorized representative of the vendor and certify that the product delivered conforms to the specifications for type and grade indicated.
5. Certified test reports and the testing required in the preparation of such report shall be at no cost to the City.
6. Final acceptance of bituminous materials shall be dependent on the determination by the ENGINEER that the material meets prescribed standards.

PART 2- PRODUCTS

2.01 MEDIUM CURING CUTBACK ASPHALT:

- A. Medium-curing liquid asphalt, designated by the letters MC, shall consist of an uncracked petroleum base stock, produced by the processing of asphaltic or semi-asphaltic base crude petroleum, blended with a kerosene-type solvent. The base stock for all MC materials shall be straight run asphalt produced within the penetration range of 100 to 300, and the end point of the kerosene type solvent shall not exceed 525° F. Medium curing liquid cutback asphalt shall be free from water and show no separation.
- B. Medium curing cutback asphalt shall consist of materials specified above and shall conform to the requirements set forth in Table 2610-1.

TABLE 2610-1

Specification Designation	AASHTO Test Method	ASTM Test Method	MC 30	MC 70	MC 250	MC 800	MC 3000
Flash Point (Open Cleave) °F, Min.	T 48	D 92	100	100	150	150	150
Viscosity, 140°F, Kinematic, CS	T 201	D 2170	30 - 60	70 - 140	250 - 500	800 - 1600	3000 - 6000
Furol Viscosity at: 77° F (Sec.) 122° F (Sec.) 140° F (Sec.) 180° F (Sec.)	T 72	D 88	75-150	60-120	125-250	100-200	300-600
Distillation Distillate (% of Total Distillate to 680° F)	T 78	D 402					
437° F			0-25	0-20	0-10	0	0
500° F			40-70	25-60	20-55	10-35	0-15
600° F			75-93	75-90	70-85	65-80	50-75
Residue from Distillation to 680° F Volume % by Difference Min.			50	55	67	75	80
Tests on Residue from Distillation Penetration at 77° F	T 49	D 5	120 - 250	120 - 250	120 - 250	120 - 250	120 - 250
* Ductility 77° F, cm, Min.	T 51	D 113	100	100	100	100	100
Solubility in CCl ₄ , % Min.	T 44		99.5	99.5	99.5	99.5	99.5
Water, % Max.	T 55	D 95	0.2	0.2	0.2	0.2	0.2
Reaction to Spot Test	T 102**		0	0	0	0	0

* If penetration of residue is more than 200 and its ductility at 77° F is less than 100, the material will be acceptable if the ductility at 60° F is greater than 100.

** Using 85% Standard Naptha and 15% Xylene.

NOTE: Viscosity tests may be made by either Kinematic or Furol test methods.

C. Unless otherwise noted on the plans or directed by the ENGINEER, cutback asphalt Grade MC-30 shall be used.

2.02 BLOTTER MATERIAL:

- A. Supply blotter material consisting of native sand and/or sweepings from base course.
- B. Native sand shall be local material obtained from approved sources as approved by the ENGINEER.

PART 3 - EXECUTION

3.01 CONSTRUCTION METHODS:

- A. Unless otherwise specified on the plans or required by the ENGINEER, only asphaltic material shall be used. Where required, a combination of asphaltic and blotter material shall be used.
- B. Application of Asphaltic Materials Only.
 - 1. Apply prime coat to prepared surface when ambient air temperature is above 40° F and rising and shall not be applied when the ambient air temperature is below 50° F and falling.
 - 2. Apply prime coat to surfaces that have been cleaned by sweeping or other approved methods and where base is thoroughly dry and satisfactory for receiving prime coat.
 - 3. Apply prime coat to cleaned base, at a rate of 0.2 to 0.5 gallons per square yard of surface area, using an approved type of self-propelled pressure distributor so constructed and operated to distribute the material evenly and smoothly.
 - 4. Provide necessary facilities for the determination of temperature of asphaltic material in all heating equipment and distributors; and for determination of rate at which it is applied; and for securing uniformity at the junction of two distributor loads.
 - 5. Keep in clean and good working condition all storage tanks, piping, reports, booster tanks and distributors used in the storage and handling of asphaltic materials.
 - 6. Operate all associated equipment in a manner such that there is no contamination of asphaltic material with foreign material.
 - 7. Calibrate distributor and furnish ENGINEER with an accurate and satisfactory record of such calibrations.
 - 8. Recalibrate distributor, in a manner satisfactory to the ENGINEER, after the beginning of work, should the yield on the asphaltic material applied appear to be in error.
 - 9. No traffic, hauling or placing of subsequent courses shall be permitted over freshly applied prime coat until authorized by the ENGINEER.
 - 10. Apply asphaltic material at a temperature within 15° F of temperature of application selected by the ENGINEER based on temperature viscosity relationship noted in Table 2610-1.
 - 11. Maintain surface until work is Blotter Material.
- C. Application of Asphaltic and Blotter Material

1. Haul blotter material in vehicles of uniform capacity and placed on shoulders at a spacing designated by the ENGINEER.
2. After application of asphaltic material as specified above, cover surface with blotter material as directed by the ENGINEER.
3. After application of blotter material, drag surface with approved drag broom, evenly and smoothly distributing the blotter material. Brooming or dragging operation shall continue, as directed by the ENGINEER, until the course has properly cured under traffic.

PART 4 - MEASUREMENT AND PAYMENT

4.01 PRIME COAT:

- A. When listed as a separate contract pay item "Prime Coat", asphaltic material for prime coat will be measured for payment at point of delivery on the project in gallons at applied temperature. Payment will be paid at the unit bid price for "Prime Coat".
- B. When not listed as a separate contract pay item, prime coat shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.
- C. Compensation, whether by contract pay item or incidental work will be for furnishing all material, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

4.02 BLOTTER MATERIALS:

- A. Blotter material will be considered incidental to asphaltic material for prime coat with no direct payment.

END OF SECTION

SECTION 02612

HOT MIX ASPHALT CONCRETE PAVEMENT

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Hot mix asphalt concrete (HMAC) pavement shall consist of a binder course, a leveling up course, a surface course or a combination of the courses as shown on the plans, or as directed by the ENGINEER.
- B. HMAC pavement shall be composed of a compacted mixture of mineral aggregate and asphaltic material, constructed on previously completed and approved subgrade, subbase course, base course, or existing pavement.
- C. HMAC pavement shall be in accordance with the specifications herein and in conformity with the lines, grades, quantities and typical sections in the contract and/or as directed by the ENGINEER.

1.02 QUALITY CONTROL:

- A. HMAC pavement and its constituent part shall conform to the ASTM, AASHTO and/or TxDOT test methods noted below.

PART 2 - PRODUCTS

2.01 ASPHALTIC MATERIALS:

- A. Asphalt cement binders shall be uncracked petroleum asphalt and shall be carefully refined, by steam, vacuum, or solvent, from asphaltic or semi-asphaltic base crude petroleum at a temperature not to exceed 700° F. Asphalt cements shall be free from thermal decomposition products and shall not be blended with any materials which have been subjected to cracking or produced from a crude petroleum source other than that of the original material. The asphalt cement shall not contain residues from non-asphaltic sources. Asphalt cement shall be homogeneous, free from water, and shall not foam when heated to 347° F.
- B. Paving asphalt shall be classified by penetration or viscosity and shall conform to the requirements set forth in one of the following tables as designated by the ENGINEER. The CONTRACTOR may supply asphalt meeting the requirements of one of the following tables provided that the CONTRACTOR obtains prior approval of the ENGINEER and with the provision that once approval has been obtained, that the CONTRACTOR will remain with that grade throughout the project.

SPECIFICATIONS – SITE WORK
PAVEMENT

HOT MIX ASPHALT CONCRETE

TABLE 2612-1

Specification	AASHTO Test	ASTM Test						
Designation	Method	Method	40 to 50	60 to 70	85 to 100	120 to 150	150 to 200	200 to 250
Flash Point (Open Cup) Min	T48	D92	--	450	450	450	450	350
Penetration of Orig. Sample at 77° F	T49	D5	40 to 50	60 to 70	85 to 100	120 to 150	150 to 200	200 to 250
Thin-Film Oven Loss, Hours at 325°F, % Max	T179	D1754	0.75	0.75	0.75	0.75	1.00	1.00
Test of Residue from Thin-Film Oven Test; % of Orig. Pen., Min.	T49	D5	52	50	50	50	50	50
Ductility at 77° F cm. after los at 325° F, Min.	T51	D113	50	50	100	100	100	100
Solubility in CCl ₄ Min.	T44*	None	99.5	99.5	99.5	99.5	99.5	99.5
Reaction to Spot Test	T102**	None	0	0	0	0	0	0

* Procedure No. 1 with CCl₄ substituted for CS₂.

** Using 85% Standard Naphtha Solvent and 15% Xylene.

TABLE 2612-2

TYPE-GRADE	OA-30		OA-175*8		OA-400	
	Min	Max	Min	Max	Min	Max
Penetration at 32° F, 200 g, 60 sec	15	--	--	--	--	--
Penetration at 77° F, 100 g, 5 sec	25	35	150	200	--	--
Penetration at 115° F, 50 g, 5 sec	--	65	--	--	--	--
Ductility at 77° F, 5 cm/min, cms; Original OA	2	--	70	--	--	--
Flash Point COC, °F	450	--	425	--	425	--
Softening Point, R&B, °F	185	--	95	130	--	--
Thin Film Oven Test, 1/8 in. Film 50 g, 5 hrs, 325° F, % Loss by wt.	--	0.4	--	1.4	--	20
Penetration of Residue, at 77° F, 100 g, 5 sec % of Original Pen	--	--	40	--	--	--
Ductility of Residue at 77°F, 5 cm/min, cms	--	--	--	100	--	--
Solubility in Trichloroethylene, %	99	--	99	--	99	--
Spot Test on Original OA	Neg		Neg		Neg	
Float Test at 122° F, sec	--	--	--	--	120	150
Test on 85 to 115 Pen. Residue* Residue by Wt., %	--	--	--	--	75	--
Ductility, 77° F, 5 cm/min: Original Res, cms	--	--	--	--	100	--
Subjected to Thin Film Test, cms	--	--	--	--	100	--

*Determined by Vacuum Distillation (by evaporation if unable to reduce by vacuum).

** For use with Latex Additive only.

TABLE 2612-3

PROPERTIES	AC-1.5		AC-3		AC-5		AC-10		AC-20		AC-40	
	MIN	MA X	MIN	MA X	MIN	MA X	MIN	MA X	MIN	MA X	MIN	MAX
Viscosity, 140° F stokes ...	150	50	300	100	500	100	100 0	200	200 0	400	400 0	800
Viscosity, 275° F stokes ...	0.7	--	1.1	--	1.4	--	1.9	--	2.5	--	3.5	--
Penetration, 77° F 100 g, 5 sec	250	--	210	--	135	--	85	--	55	--	35	--
Flash Point, COC, ° F	425	--	425	--	425	--	450	--	450	--	450	--
Solubility in trichloroethylene, percent ...	99	--	99	--	99	--	99	--	99	--	99	--
Test on residues from thin film oven test: Viscosity, 140° F stokes ...	--	450	--	900	150 0	--	300 0	--	600 0	--	--	1200 0
Ductility, 77° F, 5 cms per min, cms	100	--	100	--	100	--	70	--	50	--	30	--
Spot Test	Negative for all grades											

- C. A minimum of two percent, by weight, latex additive (solids basis) shall be added to the OA-175 Asphalt or to AC-5 Asphalt when specified in the contract. The latex additive shall be governed by the following specifications:

The latex is to be an anionic emulsion of butadiene-styrene low-temperature copolymer in water, stabilized with fatty-acid soap so as to have good storage stability, and possessing the following properties:

Monomer ratio, B/S	70/30
Minimum solids content	67%
Solids content per gal.@ 67%	5.3 lbs.
Coagulum on 80-mesh screen	0.01% max.
Type Anti-oxidant	staining
Mooney viscosity of Polymer (M/L 4@212° F)	100 min.
pH of Latex	9.4 - 10.5
Surface tension	28-42 dynes/cm ²

The finished latex-asphalt blend shall meet the following requirements:

Viscosity at 140° F, stokes 1500 max.

HOT MIX ASPHALT CONCRETE PAVEMENT

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Ductility at 39.2° F, 1 cm. per min., cm. 100 min.

D. Asphalt content shall be within the limits noted below:

Table 2612-4

HMAC Type	Percent of Mixture by Weight	Percent of Mixture by Volume
"A"	3.5 - 7.0	8.0 - 16.0
"B"	3.5 - 7.0	8.0 - 16.0
"C"	3.5 - 7.0	8.0 - 16.0
"D"	4.0 - 8.0	9.0 - 19.0
"F"	3.5 - 6.5	8.0 - 16.0

- E. At the time of delivery of each shipment of asphalt, the vendor supplying the material shall deliver to the purchaser certified copies of the test report which shall indicate the name of the vendor, type and grade of asphalt delivered, date and point of delivery, quantity delivered, delivery ticket number, and results of the above-specified tests. The test report shall be certified and signed by an authorized representative of the vendor that the product delivered conforms to the specifications for the type and grade indicated.
- F. Until the certified test reports and samples of the material have been checked by the ENGINEER to determine their conformity with the prescribed requirements, the material to which such report relates and any work in which it may have been incorporated as an integral component will be only tentatively accepted by the City. Final acceptance will be dependent upon the determination of the ENGINEER that the material involved fulfills the requirements prescribed therefor. The certified test reports and the testing required in connection with the reports will be at the expense to the City.
- G. Unless otherwise specified in these specifications or in the Supplementary Specifications, the various grades of paving asphalt shall be applied at a temperature range of from 210° F to 325° F, the exact temperature to be determined by the ENGINEER.
- H. Paving asphalt shall be heated in such a manner that steam or hot oils will not be introduced directly into the paving asphalt during heating. The CONTRACTOR shall furnish and keep on the site, at all times, an accurate thermometer suitable for determining the temperature of the paving asphalt.
- I. HMAC asphalt shall be the grade having the highest penetration, within specified limits, to produce a mix having a maximum stability of the compacted mixtures.
- J. Only one (1) grade of asphalt shall be required unless otherwise shown on the plans or as required by the ENGINEER.

2.02 AGGREGATES:

A. HMAC aggregate will be tested in accordance with the following test standards:

- AASHTO T-30 Mechanic Testing
- AASHTO T-27 Passing No. 200 Sieve
- AASHTO T-89 Liquid Limit
- AASHTO T-96 Los Angeles Abrasion
- AASHTO T-104 Soundness (Magnesium Sulfate)
- ASTM C – 131 Resistance to Degradation
- ASTM C – 136 Sieve Analysis
- ASTM C – 2419 Sand Equivalence Value
- TxDOT Tex -106-E Method of Calculating Plasticity Index of Solids
- TxDOT Tex-217 – F (I & II) Determination of Deleterious Materials and Decantation Test
- TxDOT Tex-203 – F Quality Tests for Mineral Aggregates

- B. Aggregates shall have an abrasion of not more than 40 for all courses except the non-skid surface course, which shall have an abrasion of not more than 35.
- C. When properly proportioned, HMAC aggregate shall produce a gradation which will conform to the limitations for classification for HMAC type shown below, or as directed by the ENGINEER.
- D. Course aggregate to be crushed limestone rock or crushed gravel with hydrated lime or limestone filler. (Crushed gravel shall be per TxDOT Specifications.)
- E. Binder aggregate to be composed of 15% crushed limestone screening or as directed by the engineer.

1. Type "A" - Course Graded Base Course

	Percent Aggregate by Weight or Volume
Passing 2" sieve.....	100
Passing 1-3/4" sieve.....	95 to 100
Passing 1-3/4" sieve, retained on 7/8" sieve.....	16 to 42
Passing 7/8" sieve, retained on 3/8" sieve.....	16 to 42
Passing 3/8" sieve, retained on No. 4 sieve	10 to 26
Passing No. 4 sieve, retained on No. 10 sieve.....	5 to 21
Total retained on No. 10 sieve.....	68 to 84
Passing No. 10 sieve, retained on No. 40 sieve.....	5 to 21
Passing No. 40 sieve, retained on No. 80 sieve.....	3 to 16
Passing No. 80 sieve, retained on No. 200 sieve	2 to 16
Passing No. 200 sieve.....	1 to 8

2. Type "B" - Fine Graded or Leveling-Up Course

	Percent Aggregate by Weight or Volume
Passing 1" sieve.....	100
Passing 7/8" sieve.....	95 to 100
Passing 7/8" sieve, retained on 3/8" sieve	21 to 53
Passing 3/8" sieve, retained on No. 4 sieve.....	11 to 42
Passing No. 4 sieve, retained on No. 10 sieve.....	5 to 26
Total retained on No. 10 sieve.....	58 to 74
Passing No. 10 sieve, retained on No. 40 sieve.....	6 to 32

Passing No. 40 sieve, retained on No. 80 sieve.....	4 to 21
Passing No. 80 sieve, retained on No. 200 sieve.....	3 to 21
Passing No. 200 sieve.....	1 to 8

3. Type "C" - Course Graded Surface Course

	Percent Aggregate by Weight or Volume
Passing 7/8" sieve.....	100
Passing 5/8" sieve.....	95 to 100
Passing 5/8" sieve, retained on 3/8" sieve	16 to 42
Passing 3/8" sieve, retained on No. 4 sieve.....	11 to 37
Passing No. 4 sieve, retained on No. 10 sieve.....	11 to 32
Total retained on No. 10 sieve.....	54 to 74
Passing No. 10 sieve, retained on No. 40 sieve.....	6 to 32
Passing No. 40 sieve, retained on No. 80 sieve.....	4 to 27
Passing No. 80 sieve, retained on No. 200 sieve.....	3 to 27
Passing No. 200 sieve.....	1 to 8

4. Type "D" - Fine Graded Surface Course

	Percent Aggregate by Weight or Volume
Passing 1/2" sieve.....	100
Passing 3/8" sieve.....	85 to 100
Passing 3/8" sieve, retained on No. 4 sieve.....	21 to 53
Passing No. 4 sieve, retained on No. 10 sieve.....	11 to 32
Total retained on No. 10 sieve.....	54 to 74
Passing No. 10 sieve, retained on No. 40 sieve.....	6 to 32
Passing No. 40 sieve, retained on No. 80 sieve.....	4 to 27
Passing No. 80 sieve, retained on No. 200 sieve.....	3 to 27
Passing No. 200 sieve.....	1 to 8

5. Type "F" - Fine Graded Surface Course

	Percent Aggregate by Weight or Volume
Passing 3/8" sieve.....	100
Passing No. 4 sieve.....	95 to 100
Passing No. 4 sieve, retained on No. 10 sieve.....	58 to 73
Passing No. 10 sieve, retained on No. 40 sieve.....	6 to 26
Passing No. 40 sieve, retained on No. 80 sieve.....	3 to 13
Passing No. 80 sieve, retained on No. 200 sieve.....	2 to 11
Passing No. 200 sieve.....	1 to 8

6. RAP (Reclaimed Asphalt Pavement)

1. RAP is salvaged, milled, pulverized, broken, or crushed asphalt pavement. Crush or break RAP so that 100% of the particles pass the 2 in. sieve. The reclamation of the asphalt shall include the application of an asphalt rejuvenation agent.

RAP from either Contractor- or Department-owned sources, including RAP generated during the project, is permitted only when shown on the plans. Department-owned RAP, if allowed for use, will be available at the location shown on the plans. When RAP is used, determine asphalt content and gradation for mixture design purposes. Perform other tests on RAP when shown on the plans.

When RAP is allowed by plan note, use no more than 30% RAP in Type A or B mixtures unless otherwise shown on the plans. For all other mixtures, use no more than 20% RAP unless otherwise shown on the plans.

Do not use RAP contaminated with dirt or other objectionable materials. Do not use the RAP if the decantation value exceeds 5% and the plasticity index is greater than 8. Test the stockpiled RAP for decantation in accordance with the laboratory method given in Tex 406 A, Part I. Determine the plasticity index using 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.

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.

2.03 PRIME COAT:

- A. Prime coat, when specified on the plans, or directed by the ENGINEER, shall be in accordance with Section 02610 - Prime Coat, and as specified herein.
- B. Prime coat shall be applied to the surfaces of bases at least 12 hours prior to placing the HMAC unless otherwise directed by the ENGINEER.
- C. Asphalt prime shall be applied uniformly at the rate in accordance with Section 02610 - Prime Coat.
- D. In order to prevent lapping at the junction of two applications, the distributor shall be promptly shut off. A hand spray shall be used to touch up all spots unavoidably missed by the distributor.
- E. Immediately prior to application of the asphalt prime, an inspection will be made by the ENGINEER to verify that the base course has been constructed as specified. Also, all loose and foreign material shall be removed by light sweeping. Material so removed shall not be mixed with cover aggregate.
- F. The surface to be primed shall be in a smooth and well-compacted condition, true to grade and cross section, and free from ruts and inequalities.
- G. The pressure distributor used for applying prime coat material shall be equipped with pneumatic tires and shall be so designed and operated as to distribute the prime material in a uniform spray without atomization, in the amount and between the limits of temperature specified. It shall be equipped with a speed tachometer registering feet per minute and so located as to be visible to the truck driver to enable him to maintain the constant speed required for application at the specified rate.
- H. The pressure distributor shall be equipped with a tachometer registering the pump speed, pressure gauge, and a volume gauge. The rates of application shall not vary from the rates specified by the ENGINEER by more than 10%. Suitable means for accuracy indicating at all

times the temperature of the prime material shall be provided. The thermometer well shall be so placed as not to be in contact with a heating tube.

- I. The distributor shall be so designed that the normal width of application shall be not less than 6 feet, with provisions for the application of lesser width when necessary. If provided with heating attachments, the distributor shall be so equipped and operated that the prime material shall be circulated or agitated through the entire heating process.
- J. The asphalt prime coat should preferably be entirely absorbed by the base course and, therefore, require no sand cover. If, however, it has not been completely absorbed prior to the start of placing the asphalt concrete mixture and in the meantime it is necessary to permit traffic thereon, sufficient sand shall be spread over the surface to blot up the excess liquid asphalt and prevent it from being picked up by traffic. Also, sand shall be used in areas where traffic may pass over the prime coat. Prior to placing the asphalt concrete, loose or excess sand shall be swept from the base. If a sand cover is specified in the Supplementary Specifications or noted on the plans to cover asphalt prime, it shall be applied within 4 hours after the application of said prime coat, unless otherwise ordered by the ENGINEER.
- K. Liquid asphalt shall be prevented from being sprayed upon adjacent pavements, structures, guard rails, guide posts, culvert markers, trees, and shrubbery that are not to be removed; adjacent property and improvements; other facilities or that portion of the traveled way being used by traffic.
- L. The CONTRACTOR shall protect the prime coat against all damage and markings, both from foot and vehicle traffic. Barricades shall be placed where necessary to protect the prime coat. If, after the prime coat has been applied to the satisfaction of the ENGINEER and has been accepted, if it is disturbed by negligence on the part of the CONTRACTOR, it shall be restored at his expense to its condition at the time of acceptance. No material shall be placed until the prime coat is in a condition satisfactory to the ENGINEER.

2.04 TACK COAT:

- A. If the asphalt concrete pavement is being constructed directly upon an existing hard-surfaced pavement, a tack coat shall be evenly and uniformly applied to the existing pavement prior to the placing of the new asphalt concrete. The surface shall be free of water, all-foreign material, or dust when the tack coat is applied. No area shall be treated in any one day greater than will be covered by the asphalt concrete during the same day. Traffic will not be permitted over tack coating.
- B. Tack coat for HMAC shall consist of either rapid curing cut-back asphalt RC-2 diluted by addition of (not to exceed 15 percent by volume) an approved grade of gasoline and/or kerosene; emulsified asphalt, EA-11M diluted with 50 percent water, or a cut-back asphalt made by combining 50 to 70 percent of the asphaltic materials specified for the paving mixture with 30 to 50 percent gasoline and/or kerosene by volume.
- C. Tack coat shall conform to the requirements of Section 02620 - Tack Coat, or as specified herein.
- D. Application of tack coat shall be 0.10 to 0.15 gallons per square yard, or as directed by the ENGINEER.
- E. A similar tack coat shall be applied to the surface of any course if, in the opinion of the ENGINEER, the surface is such that a satisfactory bond cannot be obtained between it and the succeeding course.

- F. When required, the contact surfaces of all cold pavement joints, curbs, gutters, manholes, and the like shall be painted with a tack coat immediately before the adjoining asphalt concrete is placed. Asphalt tack coat shall be applied in controlled amounts as shown on the plans or determined by the ENGINEER. Surfaces where a tack coat is required shall be cleaned to the satisfaction of the ENGINEER before the tack coat is applied.

2.05 MINERAL FILLER:

- A. Mineral filler, other than hydrated lime, shall consist of a thoroughly dry stone dust, portland cement or other mineral dust approved by the ENGINEER.
- B. The mineral filler shall be free from foreign or other deleterious matter.
- C. When tested by the method outlined in TxDOT Test Method Tex-200-F (Part 1 or 3), mineral filler shall meet the following gradations by weight:

Passing No. 30 Sieve	95-100%
Passing No. 80 Sieve	75%
Passing No. 200 Sieve	55%

2.06 ANTI-STRIPPING COMPOUND

- A. Anti-Stripping compound, as required in the job mix formula, shall be furnished in the amounts calculated therein.

2.07 JOB MIX FORMULA:

- A. A job mix formula based on representative samples, including filler if required, shall be determined submitted by the CONTRACTOR for approval of the ENGINEER.
- B. The resultant job mix formula shall be within the master range for the specified type of HMAC.
- C. The job mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size and a single percentage of bituminous material to be added to the aggregate and shall provide for 3 to 5% air voids in the resultant design mix. During the mix design process the following factors will be considered: air voids, Marshall stability, durability, water resistance, and asphalt film thickness.
- D. After the job mix formula is established, mixtures for the project shall conform to the following tolerances which may fall outside of the specified master range:

Percent by Weight or
Volume as Applicable

Passing 1-3/4" sieve, retained on 7/8" sieve	± 5
Passing 7/8" sieve, retained on 5/8" sieve	± 5
Passing 5/8" sieve, retained on 3/8" sieve	± 5
Passing 3/8" sieve, retained on No.4 sieve	± 5
Passing No.4 sieve, retained on No.10 sieve	± 5
Total retained on No.10 sieve	± 5
Passing No.10 sieve, retained on No.40 sieve	± 3
Passing No.40 sieve, retained on No.80 sieve	± 3
Passing No.80 sieve, retained on No.200 sieve	± 3
Passing No.200 sieve	± 3

Asphaltic Material	± 0.05 by wt or 1.2 by vol.
Mixing Temperature	± 20° F

- E. Asphaltic mixture shall be tested in accordance with TxDOT Test Method Tex-200-4 (Part I or Part III) and shall have the following laboratory values:

	Surface Course	Base Course
Density:	Minimum	95%
	Maximum	98%
	Optimum	96.5%
Stability (Hveem)	Minimum	30%
	Maximum	45%
	Stability (Marshall – 75 Blow Briquette)	1500 lbs
Voids	3 - 7%	4 - 7%
Voids Filled With Asphalt	75 - 85%	65 - 80%
Sand Equivalent	40	40

2.08 EQUIPMENT:

- A. All equipment for the handling of all material, mixing, and placing of HMAC shall be in accordance with the provisions of TxDOT Item 340.

2.09 STOCKPILING, STORAGE, PROPORTIONING AND MIXING:

- A. Stockpiling, storage proportioning and mixing operations shall be in accordance with the Provisions of TxDOT Item 340.

PART 3 - EXECUTION

3.01 WEATHER AND TEMPERATURE LIMITATIONS:

- A. Asphaltic mixture, when placed with a spreading and finishing machine, or the tack coat shall not be placed when the air temperature is 50° F and falling, but may be placed when the air temperature is 40° F and rising.
- B. Asphaltic mixture, when placed with a motor grader, shall not be placed when the air temperature is less than or equal to 60° F and falling, but may be placed when the air temperature is greater than or equal to 50° F and rising.

- C. Mat thicknesses of 1 inch or less shall not be placed when the temperature on which the mat is to be laid is below 50° F.
- D. No tack coat or asphaltic mixture shall be placed when the humidity, general weather conditions and temperature and moisture condition of the base, in the opinion of the ENGINEER, are unsuitable.
- E. If, after being discharged from the mixer and prior to placing, the temperature of the asphaltic mixture is 50° F or more below the temperature established by the ENGINEER, all or any part of the load may be rejected and payment will not be made for the rejected material.

3.02 EQUIPMENT:

A. Hauling Equipment:

- 1. Trucks used for hauling asphaltic mixtures shall have tight, clean, smooth metal beds that have been thinly coated with a minimal amount of paraffin oil, lime slurry, tine solution or other approved material to prevent mixture adhesion to the bed.
- 2. The dispatching of hauling equipment shall be arranged so that all material delivered may be placed and all rolling completed during daylight hours, unless otherwise directed by the ENGINEER.
- 3. All trucks shall be equipped with a cover of canvas, or other suitable material to protect the mixture from weather or on hauls where the temperature of the mixture will fall below specified level. Use of covers will be as directed by the ENGINEER.

B. Rollers:

- 1. Pneumatic Tire Roller. This roller shall consist of not less than seven pneumatic tire wheels, running on axles in such manner that the rear group of tires shall cover the entire gap between adjacent tires of the forward group; mounted in a rigid frame; and provided with a loading platform or body suitable for ballast loading. The front axle shall be attached to the frame in such manner that the roller may be turned within a minimum circle. The tire shall provide surface contact pressures up to 90 pounds per square inch or more. The roller shall be so constructed as to operate in both a forward and a reverse direction with suitable provisions for moistening the surface of the tires while operating; and shall be approved by the ENGINEER. It shall be operated in accordance with the manufacturer's recommendations.
- 2. Two Axle Tandem Roller. This roller shall be an acceptable power-driven, steel-wheel, tandem roller weighing not less than eight tons. It must operate in forward and reverse directions; contain provision for moistening the surface of the wheels while in motion; and shall be approved by the ENGINEER. It shall be operated in accordance with the manufacturer's recommendations.
- 3. Three Wheel Roller. This roller shall be an acceptable power-driven, all steel, three wheel roller weighing not less than 10 tons. It must operate in forward and reverse directions; contain provisions for moistening the surface of the wheel while in motion; and shall be approved by the ENGINEER. It shall be operated in accordance with the manufacturer's recommendations.
- 4. Vibratory Steel Wheel Roller. If approved for use by the OWNER, this roller shall have a minimum weight of six tons. The compactor shall be equipped with amplitude and

frequency controls and shall be specifically designed to compact the material on which it is used. It shall be operated in accordance with the manufacturer's recommendations.

C. Straight Edges:

1. The CONTRACTOR shall provide an acceptable 16-foot straight-edge for surface testing. Satisfactory templates shall be provided as required by the ENGINEER.

D. Spreading and Finishing Machine:

1. Bituminous pavers shall be self-contained, power-propelled units, provided with an activated screed or a strike-off assembly, heated if necessary, and capable of spreading and finishing courses of bituminous plant mix material in lane widths applicable to the specified typical section and thickness shown on the plans.
2. The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed. Design will be such that no part of the truck weight will be supported by the paver.
3. The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture. When laying mixtures, the paver shall be capable of being operated at forward speeds consistent with satisfactory laying of the mixture. The screed shall be adjustable for both height and crown and shall be equipped with a controlled heating device.
4. The bituminous paver shall be equipped with an automatic leveling device controlled from an external guide. The initial pass for each course shall be made using a paver equipped with a 40-foot minimum external reference, except that these requirements will not apply when asphalt concrete is placed adjacent to portland cement concrete pavement. Subsequent passes may utilize the matching device of one foot minimum length riding on the adjacent lay.

3.03 CONSTRUCTION METHODS:

A. Spreading and Finishing:

1. The asphalt concrete mixture shall be laid on the approved surface, spread and struck off to the grade and elevation established. It shall be spread and compacted in layers as shown on the plans or as directed by the ENGINEER. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable.
2. The ENGINEER will determine a minimum placement temperature within a range from 220° F to 300° F which will produce the required density. The established placement temperature, which is measured immediately behind the laydown machine, shall not vary more than 20° F.
3. A conventional paver or suitable equipment approved by the ENGINEER may be used to place asphalt concrete material on shoulders depressed from the traveled lanes in order to establish a uniform typical section. Approval of the equipment used will be based upon the results obtained.

4. The asphalt concrete may be dumped from the hauling vehicles directly into the paving machine or it may be dumped upon the surface being paved and subsequently loaded into the paving machine; however, no asphaltic concrete shall be dumped from the hauling vehicles at a distance greater than 250 feet in front of the paving machine. When asphaltic concrete is dumped first upon the surface being paved, the loading equipment shall be self-supporting and shall not exert any vertical load on the paving machine. Substantially all of the asphaltic concrete dumped shall be picked up and loaded into the paving machine.
 5. To achieve, as far as practicable, a continuous operation, the speed of the paving machine shall be coordinated with the production of the plant. Sufficient hauling equipment shall be available to insure continuous operation.
 6. The control system shall control the elevation of the screed at each end by controlling the elevation of one end directly and the other indirectly either through controlling the transverse slope or alternately when directed, by controlling the elevation of each end independently, including any screed attachment used for widening, etc. Failure of the control system to function properly shall be cause for the suspension of the asphaltic concrete operations.
 7. When dumping directly into the paving machine from trucks, care shall be taken to avoid jarring the machine or moving it out of alignment.
 8. All courses of asphaltic concrete shall be placed and finished by means of self-propelled paving machines except under certain conditions or at certain locations where the ENGINEER deems the use of self-propelled, paving machines impracticable.
 9. Self-propelled paving machines shall spread the asphaltic concrete without segregation or tearing within the specified tolerances, true to the line, grade, and crown indicated on the plans. Pavers shall be equipped with hoppers and augers which will place the asphaltic concrete evenly in front of adjustable screeds without segregation. Screeds shall include any strike-off device operated by tamping or vibrating action which is effective without tearing, shoving or gouging the asphaltic concrete and which produces a finished surface of an even and uniform texture for the full width being paved. Screeds shall be adjustable as to height and crown and shall be equipped with a controlled heating device for use when required.
 10. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be spread, raked, fluted and compacted with hand tools. For such areas the mixture shall be dumped, spread and screed to give the required compacted thickness.
- B. Compaction:
1. Rolling with the 3-wheel and tandem roller shall start longitudinally at the sides and proceed toward the center of the surface course, overlapping on successive trips by at least half the width of the rear wheels.
 2. Alternate trips of the roller shall be slightly different in length.
 3. Rolling with a pneumatic tired roller shall be as directed by the ENGINEER.
 4. Rolling shall continue with no further compression can be obtained and all roller marks are eliminated.

5. The motion of the roller shall be slow enough at all times to avoid displacement of asphaltic materials. If displacement occurs, it shall be corrected immediately by use of rakes and fresh asphaltic mixtures, where required.
 6. The roller shall not be allowed to stand on the surface course when it has not been fully compacted and allowed to cool.
 7. To prevent adhesion of the surface course to the roller, the wheels shall be kept thoroughly moistened with water; however, excess water shall not be allowed.
 8. All precautions shall be taken to prevent dripping of gasoline, oil, grease, or other foreign substances on the surface or base courses during rolling operations or while rollers are standing.
 9. With the approval of the ENGINEER, a vibratory steel wheeled roller may be substituted for the 3-wheel roller and tandem roller.
 10. Along forms, curbs, headers, walls and other places not accessible to the rollers, the mixture shall be thoroughly compacted with hot hand tampers, smoothing irons, or with mechanical tampers. On depressed areas, a trench roller may be used or cleated compression strips may be used under the roller to transmit compression to the depressed area.
 11. Any mixture that becomes loose, broken, mixed with dirt, segregated, or is in any way defective shall be removed and replaced with fresh hot bituminous mixture, which shall be compacted to conform with the surrounding area. Any area showing excess or deficiency of bituminous material shall be corrected immediately as directed by the ENGINEER.
- C. In-Place Density:
1. In-place density shall be required for all mixtures except thin irregular depth leveling courses.
 2. Each course, after final compaction, shall have a density of not less than 95 percent of the density developed in the laboratory test method outlined in TxDOT Bulletin C-14.
 3. Density shall be determined with a portable nuclear test device in conformity with ASTM D-2950.76.
 4. Calibration of the portable nuclear device will be established by the ENGINEER from cut pavement samples tested in accordance with AASHTO T-166 (weight, volume method). The density readings of the cut pavement samples determined in accordance with AASHTO T-166 (weight, volume method), and the density readings of the pavement samples determined by the portable nuclear test device in conformity with ASTM D 2950 will be correlated by the ENGINEER.
 5. Other methods of determining in-place density may be used as deemed necessary by the ENGINEER.
 6. It is intended that acceptance density testing will be done while the bituminous mixture is hot enough to permit further compaction if necessary. If the density of an acceptance section does not meet the specified requirements, the CONTRACTOR shall continue the compaction effort until the optimum density is obtained. Rolling for any compactive effort will not be

allowed when the temperature of the mix is below 175° F unless authorized in writing by the ENGINEER. Rerolling the paved surface after it has initially cooled will not be allowed.

7. If in-place density tests of the mixture produce a value lower than specified and in the opinion of the ENGINEER is not due to a change in the quality of the material, production may proceed with subsequent changes in the mix and/or construction procedures until in-place density equals or exceeds the specified density.
8. In-place density tests will be provided by the ENGINEER unless otherwise specified.

D. Joints:

1. Placing of the asphalt concrete shall be as continuous as possible. Rollers shall not pass over the unprotected end of a freshly laid mixture unless authorized by the ENGINEER.
2. When plant mix bituminous pavement is placed over plant mix bituminous treated base or when plant mixed seal coat is placed over plant mix bituminous pavement, longitudinal joints shall be staggered at least 6 inches with relation to the longitudinal joints of the underlying course.
3. Transverse joints shall have a two foot or 12:1 minimum taper. Longitudinal joints shall have a one foot or 6:1 minimum taper. All transverse tapers shall be cut and squared off prior to commencing new work. Tapered longitudinal joints from previous operations shall be cleaned and tack coated if directed by the ENGINEER. All joints shall be completely bonded. The surface of each course at all joints shall be smooth and shall not show any deviations in excess of 3/16 of an inch when tested with a 10-foot straightedge in any direction.
4. When paving under traffic, the CONTRACTOR shall plan his daily surfacing operations on a schedule which will result in not more than one (1) day's operation of exposed longitudinal joints. The longitudinal joints shall not have a height greater than two (2) inches and shall not be left exposed longer than 24 hours.

E. Surface Tolerance:

1. Upon completion, the pavement shall be true to grade and cross section. Except at intersections or any changes of grade, when a 16 foot straight edge is laid on the finished surface parallel to the centerline of the roadway, the surface shall not vary from the edge of the straight edge more than 1/16-inch per foot. Areas that are not within this tolerance shall be brought to grade immediately following the initial rolling. After the completion of final rolling, the smoothness of the course shall be checked, and the irregularities that exceed the specified tolerances or that retain any water on the surface shall be corrected by removing the defective work and replacing with new material as directed by the ENGINEER at the expense of the CONTRACTOR.

F. Manholes and Valve Covers:

1. Manhole frames and valve covers shall be adjusted prior to placing the surface course.

G. Compacted Thickness of HMAC Surface and Base Courses:

1. Surface Courses. The compacted thickness or depth of the asphaltic concrete surface course shall be as shown on the plans. Where the plans require a depth or thickness of the

surface course greater than two inches compacted depth, same shall be placed in multiple courses of equal depth, each of which shall not exceed two inches compacted depth. If, in the opinion of the ENGINEER, an additional tack coat is considered necessary between any of the multiple courses, it shall be applied at the rate as directed.

2. Base Courses. The compacted thickness or depth of each base course shall be as shown on the plans. Where the plans require a depth or thickness of the course greater than 4 inches, same shall be accomplished by constructing multiple lifts of approximately equal depth, each of which shall not exceed these maximum compacted depths. If, in the opinion of the ENGINEER, an additional tack coat is considered necessary between any of the multiple lifts, it shall be applied as hereinbefore specified and at the rate as directed.

H. Pavement Thickness Tests:

1. Pavement Thickness Test. Upon completion of the work and before final acceptance and final payment shall be made, pavement thickness test shall be made by the ENGINEER or his authorized representative unless otherwise specified in the special provisions or in the plans. The number and location of tests shall be at the discretion of the OWNER. The cost for the initial pavement thickness test shall be at the expense of the ENGINEER. In the event a deficiency in the thickness of pavement is revealed during normal testing operations, subsequent tests necessary to isolate the deficiency shall be at the CONTRACTOR's expense.

I. Price Adjustment for Roadway Density

1. The payment of the unit price will be adjusted for roadway density as outlined in the following table. The adjustment will be applied on a lot by lot basis for each lift. The adjustment will be based on the average of five density tests. The price adjustment will be applied to the entire asphalt concrete mix which includes the HMAC aggregate, the asphalt cement and anti-stripping compound, if used.

Average Density % of Lab Density	Percent of Contract Price To Be Paid
Above 95%	100%
94.0 to 94.99	96%
93.0 to 93.99	91%
92.0 to 92.99	85%
Less than 92.00	*

* This lot shall be removed and replaced to meet specification requirements as ordered by the ENGINEER. In lieu thereof, the CONTRACTOR and the ENGINEER may agree in writing that for practical purposes, the lot shall not be removed and will be paid for at 50% of the contract price.

PART 4 - MEASUREMENT AND PAYMENT

4.01 INCIDENTAL WORK:

- A. Prime coat, anti-stripping compound, where used, and tack coat shall not be measured for direct payment, but shall be considered as subsidiary work pertaining to the placing of asphaltic mixtures of the contract price.

4.02 MEASUREMENT:

- A. Hot-mix asphalt concrete material shall be measured by the ton of 2,000 pounds or by the square yard of the type or types used in the completed and accepted work, as shown on the Bid Proposal.
- B. Weight shall be determined by a certified scale approved by the OWNER and recorded serially numbered weight tickets, identifying the vehicle and presented to the ENGINEER's representative on the job.

4.03 PAYMENT:

- A. Work performed and materials furnished, as prescribed by this item, measured as provided herein, shall be paid at the unit bid price per ton or square yard for the type or types of hot mix asphalt concrete pavement shown on the proposal.
- B. Unit bid price shall be payment in full for quarrying; furnishing all materials; for all heating; mixing; hauling; cleaning existing base course or pavement; placing asphaltic mixtures; rolling and finishing; and for all labor, tools, equipment and incidentals necessary to complete the work, including the work and materials involved in the application of prime coat and tack coat.

END OF SECTION

SECTION 02670

MILLING

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION OF WORK

- A. The item shall consist of milling the existing pavement to a depth of 1" at the lip of gutter and transition it to match the existing pavement at a minimum width of 5 feet. The existing pavement to be milled will either be asphalt, concrete, or brick pavement.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. The equipment for removing the pavement surface shall be a self propelled milling machine or other approved equal that is capable of mechanically removing, in either one pass or two passes, the necessary pavement thickness in minimum width of 5 feet. The equipment shall be self-propelled with sufficient power, traction, and stability to maintain accurate depth of cut and slope. The machine shall be equipped with an integral loading and reclaiming process that immediately removes the material being cut from the surface of the roadway and discharges the cuttings into a truck in a single application or pass. The machine shall be equipped with a means to control dust created by the cutting action and shall have a manual system that allows for the depth of cut to be uniformly varied while the machine is in motion, allowing for cuts to be made flush to all inlets, manholes, or other obstructions within the paved area.
- B. Adequate back-up equipment such as mechanical street sweepers, loaders, water, truck, etc., and personnel shall be readily available to keep the flying dust produced by the milling operations down to a minimum and to insure that all cuttings are removed from street surface daily.
- C. Stockpiling of planned material will not be permitted on the project site unless designated by the Engineer.

PART 3 - EXECUTION

3.01 CONSTRUCTION METHODS

- A. Milling should be conducted along all areas as outlined in the plans and as directed by the Engineer.
- B. Milling of the pavement along any curb and gutter section should extend to a depth of 1 inch along the gutter face and taper to match the existing pavement at a minimum width of 5 feet.
- C. In all situations where the existing HMAC surface contacts the curb face, the wedge milling shall include the removal of the existing asphalt covering the gutter up to and along the face of curb.
- D. The wedge milling operations shall be performed in a continuous manner.

- E. The machine shall be equipped with a manual system that allows for the depth of cut to be uniformly varied while the machine is in motion, allowing for cuts to be made flush to all inlets, manholes, or other obstructions within the paved area.
- F. The milled surface shall provide a smooth surface, free from gouges, ridges, oil film, and other imperfections of workmanship and shall have a uniform textured appearance.
- G. The material being cut from the surface of the roadway shall be immediately removed and discharged into a truck after a single pass.
- H. Provision should be made to keep any dust caused as a result of the cutting operations down to a minimal.

PART 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT

- A. Unless otherwise noted on the bid request, no additional compensation will be made for materials, equipment, or labor required by this item and shall be considered incidental to the other items included in this contract.

END OF SECTION

SECTION 02680

FLAT WHEEL ROLLING

PART 1- GENERAL

1.01 GENERAL DESCRIPTION OF WORK:

- A. This work shall consist of the compaction of subgrade, embankment, flexible base, surface treatments and asphalt surfaces by the operation of an approved power roller as herein specified and as directed by the ENGINEER.

PART 2 - PRODUCTS

2.01 EQUIPMENT:

A. Embankments and Flexible Bases

1. Power rollers shall be of the 3-wheel, self-propelled type, weighing not less than 10 tons and shall provide a compression on the rear wheels of not less than 325 pounds per linear foot of wheel width. All wheels shall be flat.
2. The rear wheels shall have a diameter of not less than 48 inches and each shall have a wheel width of not less than 20 inches.

B. Surface Treatments and Pavements

1. Power rollers shall be the 3-wheel or tandem, self-propelled type, weighing not less than 3 tons nor more than 6 tons. All wheels shall be flat.
2. Rollers shall be equipped with an adequate scraping or cleaning device on each wheel.
3. Rollers used to compact asphalt mixture shall be equipped with a water system which will keep all tires uniformly wet.
4. In lieu of the rolling equipment specified, the CONTRACTOR may operate other compacting equipment that will produce equivalent relative compaction in the same period of time as the specified equipment. If the substituted compaction equipment fails to produce the desired compaction within the same period of time, its use shall be discontinued.
5. Rollers shall be maintained in good repair and operating condition and shall be approved by the ENGINEER.

PART 3 - EXECUTION

3.01 CONSTRUCTION METHODS:

A. Subgrades, Embankments and Flexible Base

1. The subgrade, embankment layer, or the base course shall be sprinkled if directed. Rolling with a power roller shall start longitudinally at the sides and proceed towards the center, overlapping on successive trips by at least 1/2 the width of the rear wheel of the power roller.

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2. On super-elevated curves, rolling shall begin at the low sides and progress toward the high sides. Alternate trips of the roller shall be slightly different in length.
3. The rollers, unless otherwise directed, shall be operated at a speed between 2 and 3 miles per hour.

B. Surface Treatments and Pavements

1. Rolling shall be done to produce a satisfactory surface as called for in surface treatment and pavement items.
2. The sequence of work shall be as indicated for embankment layer or base course.
3. The operating speed shall be determined by the CONTRACTOR.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT:

- A. No additional compensation will be made for materials, equipment or labor required by this item, and shall be considered incidental to the other items included in the contract.

END OF SECTION

SECTION 02682

PNEUMATIC TIRE ROLLING

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION OF WORK:

- A. This work shall consist of the compaction of embankment, flexible base, surface treatments, or pavements by the operation of approved pneumatic tire rollers.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS:

- A. When used on seal coats, asphaltic surface treatments, and bituminous mixture pavements, the roller shall be self propelled and equipped with smooth tread tires with a tire pressure of 45 psi.
- B. The roller shall be so constructed as to be capable of being operated in both a forward and a reverse direction.
- C. When used on bituminous mixture pavements, the roller shall have suitable provision for moistening the surface of the tires while operating.
- D. When turning is impractical or detrimental to the work and when specifically directed by the ENGINEER, the roller shall be of the self-propelled type.
- E. In lieu of the rolling equipment specified, the CONTRACTOR may operate other compacting equipment that will produce equivalent relative compaction in the same period of time as the specified equipment. If the substituted compaction equipment fails to produce the desired compaction within the same period of time, its use shall be discontinued.
- F. Rollers shall be maintained in good repair and operating condition and shall be subject to approval of the ENGINEER.

2.02 LIGHT PNEUMATIC TIRE ROLLER:

- A. The light pneumatic tire roller shall consist of not less than 9 pneumatic tire wheels, running on axles in such manner that the rear group of tires will cover the entire gap between adjacent tires of the forward group, mounted in a rigid frame, and provided with a loading platform or body suitable for ballast loading.
- B. The front axle shall be attached to the frame in such manner that the roller may be turned within a minimum circle.
- C. Under working conditions the pneumatic tire roller shall have an effective rolling width of approximately 60 inches and shall be so designed that by ballast loading the total load can be varied uniformly from 9,000 pounds to 18,000 pounds.
- D. The roller shall be equipped with tires that will afford ground contact pressures to 45 pounds per square inch or more. The operating load and tire air pressure shall be within the range of the manufacturer's chart. The roller under working conditions shall provide a uniform compression under all wheels.

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- E. Individuals tire inflation pressures shall be within +5 psi of each other.
- F. The pneumatic tire roller shall be drawn by a suitable crawler type tractor, a pneumatic tired tractor, a truck of adequate tractive effort or may be of the self-propelled type and the roller, when drawn or propelled by either type of equipment, shall be considered a light pneumatic tire roller unit.

2.03 MEDIUM PNEUMATIC TIRE ROLLER (TYPE A):

- A. The medium pneumatic tire roller (Type A) shall consist of not less than 7 pneumatic tired wheels, running on axles in such manner that the rear group of tires will cover the entire gap between adjacent tires of the forward group and mounted in a rigid frame and provided with a loading platform or body suitable for ballast loading.
- B. The front axles shall be attached to the frame in such a manner that the roller may be turned within a minimum circle. The pneumatic tire roller, under working conditions, shall have an effective rolling width of approximately 84 inches and shall be so designed that, by ballast loading, the total load may be varied uniformly from 23,500 pounds to 50,000 pounds.
- C. The roller shall be equipped with tires that will afford ground contact pressures to 80 pounds per square inch or more. Individual tire inflation pressures shall be within +5 psi of each other.
- D. The operating load and tire air pressure shall be within the range of the manufacturer's chart.
- E. The pneumatic tire roller shall be drawn by a suitable crawler type tractor, a pneumatic tired tractor, a truck of adequate tractive effort or may be of the self-propelled type.
- F. The roller, when drawn or propelled by any type of equipment, shall be considered a medium pneumatic tire roller unit.
- G. The power unit shall have adequate tractive effort to properly move the operating roller at variable uniform speeds up to approximately 5 miles per hour.

2.04 MEDIUM PNEUMATIC TIRE ROLLER (Type B):

- A. The medium pneumatic tire roller (Type B) shall conform to the requirements for Medium Pneumatic Tire Roller (Type A) as specified above, except that the roller shall be equipped with tires that will afford ground contact pressures to 90 psi or more.

PART 3 -EXECUTION

3.01 CONSTRUCTION METHODS:

- A. The embankment layer or the base course be sprinkled if directed and rolling with a pneumatic tire roller shall start longitudinally at the sides and proceed towards the center, overlapping on successive trips by at least 1/2 of width of the pneumatic tire roller.
- B. On super-elevated curves, rolling shall begin at the low sides and progress towards the high sides.
- C. Alternative trips of the roller shall be slightly different in length.
- D. The light pneumatic tire roller shall be operated at speeds between 2 and 6 miles per hour for asphalt surfacing work and all other work.

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- E. The medium pneumatic tire roller shall be operated at speeds which produce a satisfactory product.
- F. Sufficient rollers shall be provided to compact the material in a satisfactory manner. When operations are so isolated from one another that 1 roller unit cannot perform the required compaction satisfactorily, additional roller units shall be provided.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT:

- A. No additional compensation will be made for materials, equipment or labor required by this item, but shall be considered subsidiary to the various items of the contract.

END OF SECTION

SECTION 02686

PROOF ROLLING

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION WORK:

- A. This work shall consist of furnishing and operating heavy, pneumatic-tired, compaction equipment for testing the compaction of embankment, subgrade or flexible base.
- B. Proof roll is to be used to locate unstable areas.

PART 2 - PRODUCTS

2.01 EQUIPMENT:

- A. The proof rolling equipment shall consist of not less than 4 pneumatic tired wheels, running on axles carrying not more than 2 wheels, mounted in a rigid frame, and provided with a loading platform or a body suitable for ballast loading.
- B. All wheels shall be arranged so that they will carry approximately equal loads when operating on uneven surfaces.
- C. Under working conditions the proof roller shall have a rolling width of 8 feet to 10 feet and shall be so designed that by ballast loading the gross load may be varied uniformly from 25 tons to 50 tons.
- D. The tires shall be capable of operating under the various loads with variable air pressure up to 150 pounds per square inch. The operating load and tire pressure shall be within the range of the manufacturer's chart and as directed by the ENGINEER.
- E. The proof roller may be of the self-propelled type or shall be drawn by a suitable crawler-type tractor or a rubber tired tractor of adequate tractive effort. There shall be a sufficient quantity of ballast available to load the equipment to a maximum gross weight of 50 tons.
- F. Rubber tired tractive equipment shall be used on base courses.
- G. Other type tractive equipment may be used on embankment subgrade.
- H. The heavy pneumatic tired roller unit shall be capable of turning 180 degrees in the crown width.

In lieu of the rolling equipment specified, the CONTRACTOR may, upon written permission from the ENGINEER, operate other equipment that will produce equivalent results as the specified equipment. If the substituted equipment fails to produce the desired results as would be expected of the specified equipment as determined by the ENGINEER, its use shall be discontinued.

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PART 3 - EXECUTION**3.01 CONSTRUCTION METHODS:**

- A. This work shall be done to proof all prepared subgrade and flexible base courses or as directed by the ENGINEER.
- B. On embankment compaction, each layer will be placed to specified thickness at optimum moisture and compacted with conventional equipment to comply with the requirements of the governing embankment item.
- C. Prior to placing the overlaying course, the layer shall be proof rolled as directed by the ENGINEER.
- D. When the operation of the proof rolling unit shows an area to be unstable or nonuniform, such area shall be brought to satisfactory stability and uniformity by additional compaction or by removal of unsuitable materials and replacement with suitable materials and re-compacted.
- E. The surface tested shall then be checked for conformity with line and grade and any irregularities corrected.
- F. Roller shall be operated at speeds between 2 and 6 miles per hour or as directed by the ENGINEER.

PART 4 - MEASUREMENT AND PAYMENT**4.01 MEASUREMENT AND PAYMENT:**

- A. No additional payment will be made for the materials, equipment or labor required by this item and shall be considered subsidiary to the various items included in the contract.

END OF SECTION

Section 02743

TACK COAT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tack coat for asphaltic concrete paving.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.

- 1. No separate payment will be made for tack coat under this Section. Include payment in unit price for asphaltic pavements.

- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 REFERENCES

- A. ASTM D 244 - Standard Test Methods for Emulsified Asphalts.

1.04 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01 33 00 - Submittal Procedures.
- B. Submit product data for proposed tack coat.
- C. Submit report of recent calibration of distributor.

PART 2 PRODUCTS

2.01 CUTBACK ASPHALT

- A. Provide moisture-free homogeneous material which will not foam when heated to 347 degrees F and which meets following requirements:

- 1. Asphalt material for tack coat: RC-250 and meet following:

PROPERTIES	RC – 250	
	MIN.	MAX.
Water, Percent	---	0.2
Flash Point, T.O.C., °F	80	---
Kinematic Viscosity at 140°F, cst	250	400

2. Distillate: Expressed as percent by volume of total distillate to 680 F:

TEMPERATURE	RC – 250	
	MIN.	MAX.
to 437°F	40	75
to 500°F	65	90
to 600°F	85	---
Residue from 680°F Distillation, Volume, Percent	70	---

3. Tests on Distillation Residue:

PROPERTIES	RC – 250	
	MIN.	MAX.
Penetration at 77°F, 100g, 5 sec.	100	150
Ductility at 77°F, 5 cm/min. cms	100	---
Solubility in Trichloroethylene, %	99	---
Spot Test	All Negative	

2.02 EMULSION

- A. Provide homogeneous material which shall show no separation of asphalt after mixing and shall meet the viscosity requirements at any time within 30 days after delivery.

1. Emulsion material for tack coat: SS-1 and meet following:

PROPERTIES	SS – 1	
	MIN.	MAX.
Furol Viscosity at 77°F, sec.	30	100
Residue by Distillation, %	60	---
Oil Portion of Distillate, %	---	2
Sieve Test, %	---	0.1
Miscibility (Standard Test)	Passing	Passing
Cement Mixing, %	---	2.0
Storage Stability, 1 Day, %	---	1
Test on Residue:		
Penetration at 77°F, 100g, 5 sec.	120	160
Solubility in Trichloroethylene, %	97.5	---
Ductility at 77°F, 5 cm/min., cms	100	---

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted base is ready to support imposed loads.
- B. Verify lines and grades are correct.

3.02 PREPARATION

- A. Thoroughly clean base course or concrete surface of loose material by brooming prior to application of tack coat.

3.03 APPLICATION

- A. Apply tack coat uniformly by use of approved distributor at rate not to exceed 0.05 gallons per square yard of surface.
- B. Paint contact surfaces of curbs and structures, and joints with thin uniform coat of tack coat.
- C. Cutback Asphalt:
 - 1. Do not place tack coat when air temperature is below 50 degrees F and falling. Materials may be placed when air temperature taken in shade and away from artificial heat is above 40 degrees F and rising.
 - 2. Temperature of tack coat shall be between 125 degrees F and 180 degrees F when applied.
 - 3. Do not heat tack coat above 200 degrees F at any time.

3.04 PROTECTION

- A. Prevent traffic or placement of subsequent courses over freshly applied tack coat until authorized by Resident Project Representative.

END OF SECTION

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Section 02751

CONCRETE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Portland cement concrete paving.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.

- 1. Payment for concrete paving is on square yard basis. Separate pay items are used for each different required thickness of pavement.

- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 REFERENCES

- A. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- B. ASTM A 185 - Standard Specifications for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- C. ASTM A 615 - Standard Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement.
- D. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- E. ASTM C 33 - Standard Specifications for Concrete Aggregates.
- F. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- G. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- H. ASTM C 42 - Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- I. ASTM C 78 - Standard Test Method for Flexural Strength of Concrete.
- J. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
- K. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

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- L. ASTM C 136 - Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- M. ASTM C 138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
- N. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
- O. ASTM C 150 - Standard Specification for Portland Cement.
- P. ASTM C 174 - Standard Test Method for Measuring Length of Drilled Concrete Cores.
- Q. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- R. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
- S. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.
- T. ASTM C 618 - Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
- U. TxDOT Tex-203-F - Sand Equivalent Test for Fine Aggregate.
- V. TxDOT Tex-406-A - Loss by Decantation Test for Coarse Aggregate.

1.04 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01 33 00 - Submittal Procedures.
- B. Submit proposed mix design and test data for each type and strength of concrete in the Work. Include proportions and actual flexural strength obtained from design mixes at required test ages.
- C. Submit for approval manufacturer's description and characteristics for mixing equipment, and for traveling form paver, if proposed for use.
- D. Submit manufacturer's certificates giving properties of reinforcing steel. Include certificate of compliance with ASTM A 82.

1.05 HANDLING AND STORAGE

- A. Do not mix different classes of aggregate without written permission of Engineer.
- B. Class of aggregate being used may be changed before or during Work with written permission of Engineer. New class shall comply with specifications.
- C. Segregated aggregate will be rejected. Before using aggregate whose particles are separated by size, mix them uniformly to grading requirements.
- D. Aggregates mixed with dirt, weeds, or foreign matter will be rejected.
- E. Do not dump or store aggregate in roadbed.

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PART 2 PRODUCTS

2.01 MATERIALS

A. Portland Cement:

1. Unless otherwise shown on the Drawings or in the specifications, the cement shall be either Type I, II, or III Portland cement.
2. Type III cement shall not be used without prior approval of Engineer.
3. Type III cement may be used, regardless of air temperature, in all precast concrete.
4. All cement used in a monolithic placement shall be of the same type.
5. Type I/II cement may be considered as either Type I or Type II cement except as otherwise noted.
6. Type IP cement may be used in lieu of Type I or Type II cement except when otherwise required by the Drawings or specifications. When Type IP cement is used, additional fly ash will not be permitted.
7. Bulk cement which meets referenced standards may be used if the method of handling is approved by the Resident Project Representative. When using bulk cement, provide satisfactory weighing devices.
8. Fly ash which meets standards of ASTM C 618 may be used as mineral fill.

B. Water: Conform to requirements for water in ASTM C 94.

C. Coarse Aggregate: Crushed stone or gravel, or combination thereof, which is clean, hard, durable, conforms to requirements of ASTM C 33, and has abrasion loss not more than 45 percent by weight when subjected to Los Angeles Abrasion Test (ASTM C 131).

1. Maximum percentage by weight of deleterious substances shall not exceed following values:

Item	Percent by Weight of Total Sample Maximum
Clay lumps and friable particles	3.0
Material finer than 75- μ m (No. 200) sieve:	
Concrete subject to abrasion	3.0*
All Other concrete	5.0*
Coal and lignite:	
Where surface appearance of concrete is of importance	0.5
All other concrete	1.0

* In case of manufactured sand, if material finer than 75- μ m (No. 200) sieve consists of dust of fracture, essentially free from clay or shale, these limits may be increased to 5 and 7 percent, respectively.

2. Coarse aggregate (size 1-1/2 inch to No. 4 sieve) shall conform to requirements of ASTM C 33. Gradation shall be within following limits when graded in accordance with ASTM C 136:

<u>Sieve Designation (Square Openings)</u>	<u>Percentage by Weight</u>
Retained on 1-3/4" sieve	0
Retained on 1-1/2" sieve	0 to 5
Retained on 3/4" sieve	30 to 65
Retained on 3/8" sieve	70 to 90
Retained on No. 4 sieve	95 to 100
Loss by Decantation Test *Method Tex-406-A	1.0 maximum

- * In case of aggregates made primarily from crushing of stone, if material finer than 200 sieve is dust of fracture essentially free from clay or shale as established by Part III of Tex-406-A, percent may be increased to 1.5.

- D. Fine Aggregate: Sand, manufactured sand, or combination thereof, composed of clean, hard, durable, uncoated grains, free from loams or other injurious foreign matter. Fine aggregate for concrete shall conform to requirements of ASTM C 33. Gradation shall be within following limits when graded in accordance with ASTM C 136:

<u>Sieve Designation (Square Openings)</u>	<u>Percentage by Weight</u>
Retained on 3/8" sieve	0
Retained on No. 4 sieve	0 to 5
Retained on No. 8 sieve	0 to 20
Retained on No. 16 sieve	15 to 50
Retained on No. 30 sieve	35 to 75
Retained on No. 50 sieve	65 to 90
Retained on No. 100 sieve	90 to 100
Retained on No. 200 sieve	97 to 100

1. When subjected to color test for organic impurities (ASTM C 40), fine aggregate shall not show color darker than standard color. Fine aggregate shall be subjected to Sand Equivalent Test (Tex-203-F). Sand equivalent value shall not be less than 80, unless higher value is shown on Drawings.
- E. Mineral Filler: Class C fly ash of acceptable quality and meeting requirements of ASTM C 618 may be used as mineral admixture in concrete mixture. When fly ash mineral filler is used, it shall be stored and inspected in accordance with ASTM C 618. Fly ash shall not be used in amounts to exceed 30 percent by absolute volume of cementitious material in mix design. Cement content may be reduced if strength requirements can be met. Note: When fly ash is used, the term "cement" is defined as cement plus fly ash.
- F. Air Entraining Agent: Furnish an air entraining agent conforming to requirements of ASTM C 260.
- G. Water Reducer: Water reducing admixture conforming to requirements of ASTM C 494 may be used if required to improve the workability of concrete. Amount and type of such admixture shall be subject to approval by Engineer.

H. Reinforcing Steel:

1. Provide new billet steel manufactured by open hearth process and conforming to ASTM A 615, Grade 60. Store steel to protect it from mechanical injury and rust. At time of placement, steel shall be free from dirt, scale, rust, paint, oil, or other injurious materials.
2. Cold bend reinforcing steel to shapes shown. Once steel has been bent, it may not be rebent.
3. Provide wire fabric conforming to ASTM A 82. Use fabric in which longitudinal and transverse wires have been electrically welded at points of intersection. Welds shall have sufficient strength not to be broken during handling or placing. Welding and fabrication of fabric sheets shall conform to ASTM A 185.

2.02 EQUIPMENT

- A. Equipment shall conform to requirements of ASTM C 94.

2.03 MIXING

- A. Flexural strength shall be as specified using test specimens prepared in accordance with ASTM C 31 and tested in accordance with ASTM C 78 (using simple beam with third-point loading). Compressive strength shall be as specified using test specimens prepared in accordance with ASTM C 31 and tested in accordance with ASTM C 39. Contractor shall determine and measure batch quantity of each ingredient, including water for batch designs and all concrete produced for Work. Mix shall conform to these specifications and other requirements indicated on Drawings.
- B. Concrete pavement, including curb, curb and gutter, and saw-tooth curb shall be Class A concrete. Materials shall be as detailed previously.
- C. Concrete sidewalk and slope paving shall be Class A concrete. Materials shall be as detailed previously.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted base is ready to support imposed loads and meets compaction requirements.
- B. Verify lines and grades are correct.

3.02 PREPARATION

- A. Properly prepare, shape and compact each section of subgrade before placing forms, reinforcing steel or concrete. After forms have been set to proper grade and alignment, use subgrade planer to shape subgrade to its final cross section. Check contour of subgrade with template.
- B. Remove subgrade that will not support loaded form. Replace and compact subgrade to required density.

3.03 EQUIPMENT

- A. Alternate equipment and methods, other than those required by this Section, may be used provided the Contractor demonstrates that equal or better results will be obtained. Maintain equipment for preparing subgrade and for finishing and compacting concrete in good working order.
- B. Subgrade Planer and Template:
1. Use subgrade planer with adjustable cutting blades to trim subgrade to exact section shown on Drawings. Select planer mounted on visible rollers which ride on forms. Planer frame must have sufficient weight so that it will remain on form, and have such strength and rigidity that, under tests made by changing support from wheels to center, planer will not develop deflection of more than 1/8 inch. Tractors used to pull planer shall not produce ruts or indentations in subgrade. When slip form method of paving is used, operate subgrade planer on prepared track grade or have it controlled by electronic sensor system operated from string line to establish horizontal alignment and elevation of subbase.
 2. Provide template for checking contour of subgrade. Template shall be long enough to rest upon side forms and have such strength and rigidity that, when supported at center, maximum deflection shall not exceed 1/8 inch. Fit template with accurately adjustable rods projecting downward at 1-foot intervals. Adjust these rods to gauge cross sections of slab bottom when template is resting on side forms.
- C. Machine Finisher: Provide a power-driven, transverse finishing machine designed and operated to strike off and consolidate concrete. Machine shall have two screeds accurately adjusted to crown of pavement and with frame equipped to ride on forms. Use finishing machine with rubber tires if it operates on concrete pavement.
- D. Hand Finishing:
1. Provide mechanical strike and tamping template 2 feet longer than width of pavement to be finished. Shape template to pavement section.
 2. Provide two bridges to ride on forms and span pavement for finishing expansion and dummy joints. Provide floats and necessary edging and finishing tools.
- E. Burlap Drag for Finishing Slab: Furnish four plies of 10-ounce burlap material fastened to bridge to form continuous strip of burlap full width of pavement. The 3-foot width of burlap material shall be in contact with pavement surface. Keep burlap drags clean and free of encrusted mortar.
- F. Vibrators: Furnish mechanically-operated, synchronized vibrators mounted on tamping bar which rides on forms and hand-manipulated mechanical vibrators. Furnish vibrators with frequency of vibration to provide maximum consolidation of concrete without segregation.
- G. Traveling Form Paver: Approved traveling form paver may be used in lieu of construction methods employing forms, consolidating, finishing and floating equipment. Requirements of this specification for subgrade, pavement tolerances, pavement depth, alignments, consolidation, finishing and workmanship shall be met. If traveling form paver does not provide concrete paving that meets the compaction, finish, and tolerance requirements of this Specification, its use shall be immediately discontinued and conventional methods shall be used.
1. Equip traveling paver with longitudinal transangular finishing float adjustable to crown and grade. Float shall be long enough to extend across pavement to side forms or edge of slab.

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2. Ensure that continuous deposit of concrete can be made at paver to minimize starting and stopping. Use conventional means of paving locations inaccessible to traveling paver, or having horizontal or vertical curvature that traveling paver cannot negotiate.
3. Where Drawings require tie bars for adjacent paving, securely tie and support bars to prevent displacement. Tie bars may be installed with approved mechanical bar inserter mounted on traveling-form paver. Replace any pavement in which tie bars assume final position other than that shown on Drawings.

3.04 FORMS

- A. Side Forms: Use metal forms of approved shape and section. Preferred depth of form shall be equal to required edge thickness of pavement. Forms with depths greater or less than required edge thickness of pavement will be permitted, provided difference between form depth and edge thickness is not greater than 1 inch, and further provided that forms of depth less than pavement edge are brought to required edge thickness by securely attaching wood or metal strips to bottom of form, or by grouting under form. Bottom flange of form shall be same size as thickness of pavement. Aluminum forms are not allowed. Forms shall be approved by Resident Project Representative. Length of form sections shall be not less than 10 feet and each section shall provide for staking in position with not less than 3 pins. Flexible or curved forms of wood or metal of proper radius shall be used for curves of 200-foot radius or less. Forms shall have ample strength and shall be provided with adequate devices for secure setting so that when in-place they will withstand, without visible springing or settlement, impact and vibration of finishing machine. In no case shall base width be less than 8 inches for form 8 inches or more in height. Forms shall be free from warp, bends or kinks and shall be sufficiently true to provide straight edge on concrete. Top of each form section, when tested with straight edge, shall conform to requirements specified for surface of completed pavement. Provide sufficient forms for satisfactory placement of concrete. For short radius curves, forms less than 10 feet in length or curved forms may be used. For curb returns at street intersections and driveways, wood forms of good grade and quality may be used.
- B. Form Setting:
 1. Rest forms directly on subgrade. Do not shim with pebbles or dirt. Accurately set forms to required grade and alignment and, during entire operation of placing, compacting and finishing of concrete, do not deviate from this grade and alignment more than 1/8 inch in 10 feet of length. Do not remove forms for at least 8 hours after completion of finishing operations. Provide supply of forms that will be adequate for orderly and continuous placing of concrete. Set forms and check grade for at least 300 feet ahead of mixer or as approved by Resident Project Representative.
 2. Adjacent slabs may be used instead of forms, provided that concrete is well protected from possible damage by finishing equipment. These adjacent slabs shall not be used for forms until concrete has aged at least 7 days.

3.05 REINFORCING STEEL AND JOINT ASSEMBLIES

- A. Place reinforcing steel and joint assemblies and position securely as indicated on Drawings. Wire reinforcing bars securely together at intersections and splices. Bars and coatings shall be free of rust, dirt or other foreign matter when concrete is placed. Secure reinforcing steel to chairs.
- B. Position pavement joint assemblies at required locations and elevations, and rigidly secure in position. Install dowel bars in joint assemblies, each parallel to pavement surface and to center line of pavement, as shown.
- C. Cut header boards, joint filler, and other material used for forming joints to receive each dowel bar.

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- D. Secure in required position to prevent displacement during placing and finishing of concrete.
- E. Drill dowels into existing pavement, secure with epoxy, and provide paving headers as required to provide rigid pavement sections.
- F. Chairs for steel reinforcement bars shall be of sufficient number to maintain position of bars within allowable tolerances. Reinforcement shall be placed as shown on Drawings. In plane of steel parallel to nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of spacing between bars. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch.

3.06 PLACEMENT

- A. Place concrete only when air temperature taken in shade and away from artificial heat is above 35 degrees F and rising. Concrete shall not be placed when temperature is below 40 degrees F and falling.
- B. Place concrete within 90 minutes after initial water had been added. Remove and dispose of concrete not placed within this period.
- C. Concrete slump during placement shall be 1 to 4 inches, except when using traveling-form paver, slump shall be maximum of 2 inches.
- D. Deposit concrete continuously in successive batches. Distribute concrete in manner that will require as little rehandling as possible. Where hand spreading is necessary, distribute concrete with shovels or by other approved methods. Use only concrete rakes in handling concrete. At placement interruption of more than 30 minutes, place transverse construction joint at stopping point. Remove and replace sections less than 10 feet long.
- E. Take special care in placing and spading concrete against forms and at longitudinal and transverse joints to prevent honeycombing. Voids in edge of finished pavement will be cause for rejection.
- F. Retempering of concrete is prohibited.

3.07 COMPACTION

- A. Consolidate the concrete using mechanical vibrators as specified herein. Extend a vibratory unit across the pavement, not quite touching side forms. Space individual vibrators at close enough intervals to vibrate and consolidate entire width of pavement uniformly. Mount mechanical vibrators to avoid contact with forms, reinforcement, transverse or longitudinal joints.
- B. Furnish enough hand-manipulated mechanical vibrators for proper consolidation of concrete along forms, at joints and in areas not covered by mechanically controlled vibrators.

3.08 FINISHING

- A. Finish concrete pavement with power-driven transverse finishing machines or by hand finishing methods.
 - 1. Use transverse finishing machine to make at least two trips over each area. Make last trip continuous run of not less than 40 feet. After transverse screeding, use hand-operated longitudinal float to test and level surface to required grade.
 - 2. Hand finish with mechanical strike and tamping template in same width as pavement to be finished. Shape template to pavement section shown on Drawings. Move strike template forward in direction of placement, maintaining slight excess of material in front of cutting edge. Make minimum of two trips over each area. Screed pavement surface to required section.

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Work screed with combined transverse and longitudinal motion in direction work is progressing. Maintain screed in contact with forms. Use longitudinal float to level surface.

- B. On narrow strips and transitions, finish concrete pavement by hand. Thoroughly work concrete around reinforcement and embedded fixtures. Strike off concrete with strike-off screed. Move strike-off screed forward with combined transverse and longitudinal motion in direction work is progressing, maintaining screed in contact with forms, and maintaining slight excess of materials in front of cutting edge. Tamp concrete with tamping template. Use longitudinal float to level surface.
- C. After completion of straightedge operation, make first pass of burlap drag as soon as construction operations permit and before water sheen has disappeared from surface. Follow with as many passes as required to produce desired texture depth. Permit no unnecessary delays between passes. Keep drag wet, clean and free from encrusted mortar during use.

3.09 JOINTS AND JOINT SEALING

- A. Conform to requirements of Section 02752 - Concrete Pavement Joints.

3.10 CONCRETE CURING

- A. Conform to requirements of Section 02753 - Concrete Pavement Curing.

3.11 TOLERANCES

- A. Test entire surface before initial set and correct irregularities or undulations. Bring surface within requirements of following test and then finish. Place 10-foot straightedge parallel to center of roadway to bridge any depressions and touch all high spots. Do not permit ordinates measured from face of straight edge to surface of pavement to exceed 1/16 inch per foot from nearest point of contact. Maximum ordinate with 10-foot straightedge shall not exceed 1/8 inch. Grind spots in excess of required tolerances to meet surface test requirements. Restore texture by grooving concrete to meet surface finishing specifications.

3.12 FIELD QUALITY CONTROL

- A. Testing will be performed under provisions of Section 01454 - Testing Laboratory Services.
- B. Compressive Strength Test Specimens: Four test specimens for compressive strength test will be made in accordance with ASTM C 31 for each 150 cubic yards or less of pavement that is placed in one day. Two specimens will be tested at 7 days. The remaining two specimens will be tested at 28 days. Specimens will be tested in accordance with ASTM C 39. Minimum flexural strength at 7 days shall be 425 psi. Minimum compressive strength at 28 days shall be 3000 psi.
- C. When compressive test indicates failure, yield test will be made in accordance with ASTM C 138 for cement content per cubic yard of concrete. If such cement content is found to be less than that specified per cubic yard, increase batch weights until amount of cement per cubic yard of concrete conforms to requirements.
- D. Minimum of one 4-inch core will be taken at random locations per 1000 feet per lane or 500 square yards of pavement to measure in-place depth. Depth shall be measured in accordance with ASTM C 174. Each core may be tested for 28-day compressive strength according to methods of ASTM C 42. The 28-day compressive strength of each core tested shall be a minimum of 3000 pounds per square inch.

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- E. Contractor may, at his own expense, request three additional cores in vicinity of cores indicating nonconforming in-place depths. In-place depth at these locations shall be average depth of four cores.
 - F. Fill cores and density test sections with new concrete paving or non shrink grout.
- 3.13 NONCONFORMING PAVEMENT
- A. Remove and replace areas of pavement found deficient in thickness by more than 10 percent, or that fail compressive strength tests, with concrete of thickness shown on Drawings.
 - B. Nonconforming pavement sections shall be replaced at no additional cost to Owner.
- 3.14 UNIT PRICE ADJUSTMENT
- A. Unit price adjustments shall be made for in-place depth determined by cores as follows:
 - 1. Adjusted Unit Price shall be ratio of average thickness as determined by cores to thickness bid upon, times unit price.
 - 2. Adjustment shall only apply to lower limit of 90 percent and an upper limit of 100 percent of unit price.
- 3.15 PAVEMENT MARKINGS
- A. Restore pavement markings to match those existing or those shown on the Drawings.
- 3.16 PROTECTION
- A. Barricade pavement section to prevent use until concrete has attained minimum design strength. Cure barricade pavement section for minimum 72 hours before use. Do not open pavement to traffic until concrete is at least 10 days old.
 - B. On those sections of pavement to be opened to traffic, seal joints, clean pavement, and place earth against pavement edges before permitting use by traffic. Such opening of pavement to traffic shall not relieve Contractor from his responsibility for the Work.
 - C. Maintain concrete paving in good condition until completion of Work.
 - D. Repair defects by replacing concrete to full depth.

END OF SECTION

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Section 02752

CONCRETE PAVEMENT JOINTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Joints for concrete paving; concrete sidewalks; concrete driveways, curbs, and curb and gutters.
- B. Saw-cutting existing concrete or asphalt pavements for new joints.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

- 1. Payment for saw-cutting existing concrete or asphalt pavement for new joints is on linear foot basis. Saw-cutting existing standard concrete curb will be measured as 1-1/2 linear feet and existing standard concrete curb and gutter will be measured as 3 linear feet.
- 2. No separate payment will be made for expansion joints, formed or sawed street pavement contraction joints and longitudinal weakened plane joints. Include payment in unit price for Concrete Paving.
- 3. No separate payment will be made for joints for Curb, Curb and Gutter, Saw-tooth Curb, Concrete Sidewalks, and Concrete Driveways. Include payment in unit price for Curb and Gutter, Concrete Sidewalks, and Concrete Driveways.

- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 REFERENCES

- A. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- B. ASTM D 994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- C. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- D. ASTM D 3405 - Standard Specification for Joint Sealants, Hot-Poured, for Concrete and Asphalt Pavements.

1.04 SUBMITTALS

- A. Submit product data and samples in accordance with requirements of Section 01 33 00 - Submittal Procedures.

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- B. Submit product data for joint sealing compound and proposed sealing equipment for approval.
- C. Submit samples of dowel cup, metal supports, and deformed metal strip for approval.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Board Expansion Joint Material: Filler board of selected stock. Use wood of density and type as follows:
 - 1. Clear, all-heart cypress weighing no more than 40 pounds per cubic foot, after being oven dried to constant weight.
 - 2. Clear, all-heart redwood weighing no more than 30 pounds per cubic foot, after being oven dried to constant weight.
- B. Preformed Expansion Joint Material: Bituminous fiber and bituminous mastic composition material conforming to ASTM D 994 and ASTM D 1751.
- C. Joint Sealing Compound: Hot-poured rubber-asphalt compound conforming to ASTM D 3405.
- D. Load Transmission Devices:
 - 1. Smooth, steel dowel bars conforming to ASTM A 615, Grade 60. When indicated on Drawings, encase one end of dowel bar in approved cap having inside diameter 1/16 inch greater than diameter of dowel bar.
 - 2. Deformed steel tie bars conforming to ASTM A 615, Grade 60.
- E. Metal Supports for Reinforcing Steel and Joint Assembly: Employ metal supports of approved shape and size that will secure reinforcing steel and joint assembly in correct position during placing and finishing of concrete.

PART 3 EXECUTION

3.01 PLACEMENT

- A. When new work is adjacent to existing concrete, place joints at same location as existing joints in adjacent pavement.
- B. If the limit of removal of existing concrete or asphaltic pavement does not fall on existing joint, saw cut existing pavement minimum of 2 inches deep to provide straight, smooth joint surface without chipping, spalling or cracks.

3.02 CONSTRUCTION JOINTS

- A. Place transverse construction joint wherever concrete placement must be stopped for more than 30 minutes. Place longitudinal construction joints at interior edges of pavement lanes using No. 6 deformed tie bars, 30 inches long and spaced 18 inches on centers.

3.03 EXPANSION JOINTS

- A. Place 3/4-inch expansion joints at radius points of curb returns for cross street intersections, or as located in adjacent pavement but no further than 80 feet apart. Use no boards shorter than 6 feet. When pavement is 24 feet or narrower, use not more than 2 lengths of board. Secure pieces to form straight joint. Shape board filler accurately to cross section of concrete slab. Use load transmission devices of type and size shown on Drawings unless otherwise specified or shown as "No Load Transfer Device". Seal with joint sealing compound.

3.04 CONTRACTION JOINTS

- A. Place contraction joints at same locations as in adjacent pavement or at spaces indicated on Drawings. Place smoothed, painted and oiled dowels accurately and normal to joint. Seal groove with joint sealing compound.

3.05 LONGITUDINAL WEAKENED PLANE JOINTS

- A. Place longitudinal weakened plane joints at spaces indicated on Drawings. Seal groove with joint sealing compound.

3.06 SAWED JOINTS

- A. Use sawed joints as an alternate to contraction and weakened plane joints. Circular cutter shall be capable of cutting straight line groove minimum of 1/2 inch wide. Depth shall be one quarter of pavement thickness plus 1/2 inch. Commence sawing as soon as concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and prior to initiation of cracks. Once sawing has commenced, it shall be continued until completed. Make saw cut with one pass. Complete sawing within 24 hours of concrete placement. Saw joints at required spacing consecutively in sequence of concrete placement.
- B. Concrete Saw: Provide sawing equipment adequate in power to complete sawing to required dimensions and within required time. Provide at least one standby saw in good working order. Maintain an ample supply of saw blades at work site at all times during sawing operations. Sawing equipment shall be on job at all times during concrete placement.

3.07 JOINTS FOR CURB, CURB AND GUTTER

- A. Place 3/4-inch preformed expansion joints through curb and gutters at locations of expansion and contraction joints in pavement; at end of radius returns at street intersections and driveways; and at curb inlets. Maximum spacing shall be 120-foot centers.

3.08 JOINTS FOR CONCRETE SIDEWALKS

- A. Provide 3/4-inch expansion joints conforming to ASTM A 1751 along and across sidewalk at back of curbs, at intersections with driveways, steps, and walls; and across walk at intervals not to exceed 36 feet. Provide expansion joint material conforming to ASTM D 994 for small radius curves and around fire hydrants and utility poles. Extend the expansion joint material full depth of the slab.

3.09 JOINTS FOR CONCRETE DRIVEWAYS

- A. Provide 3/4-inch expansion joints conforming to ASTM D 1751 across driveway in line with street face of sidewalks, at existing concrete driveways, and along intersections with sidewalks and other structures. Extend expansion joint material full depth of slab.

3.10 JOINT SEALING

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- A. Seal joints only when surface and joints are dry, ambient temperature is above 50 degrees F and less than 85 degrees F, and weather is not foggy or rainy.
- B. Joint sealing equipment shall be in like new working condition throughout the joint sealing operation, and be approved by Resident Project Representative. Use concrete grooving machine or power-operated wire brush and other equipment such as plow, brooms, brushes, blowers or hydro or abrasive cleaning as required to produce satisfactory joints.
- C. Clean joints of loose scale, dirt, dust and curing compound. The term joint includes wide joint spaces, expansion joints, dummy groove joints or cracks, either preformed or natural. Remove loose material from concrete surfaces adjacent to joints.
- D. Fill joints neatly with joint sealer to depth shown. Pour sufficient joint sealer into joints so that, upon completion, surface of sealer within joint will be 1/4 inch above level of adjacent surface or at elevation as directed.

3.11 PROTECTION

- A. Maintain joints in good condition until completion of Work.
- B. Replace damaged joints material with new material as required by this Section.

END OF SECTION

Section 02753

CONCRETE PAVEMENT CURING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Curing of Portland cement concrete paving.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.

- 1. No separate payment will be made for concrete curing under this Section. Include payment in unit price for Concrete Paving, Concrete Sidewalks, Curbs, and Curb and Gutters.

- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 REFERENCES

- A. ASTM C 171 - Standard Specifications for Sheet Materials for Curing Concrete.
- B. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.

1.04 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01 33 00 - Submittal Procedures.
- B. Submit manufacturer's product data for cover materials and liquid membrane-forming compounds.

PART 2 PRODUCTS

2.01 COVER MATERIALS FOR CURING

- A. Curing materials shall conform to one of the following:
 - 1. Polyethylene Film: Opaque pigmented white film conforming to requirements of ASTM C 171.
 - 2. Waterproofed Paper: Paper conforming to requirements of ASTM C 171.
 - 3. Cotton Mats: Single layer of cotton filler completely enclosed in cover of cotton cloth. Mats shall contain not less than 3/4 of a pound of uniformly distributed cotton filler per square yard of mat. Cotton cloth used for covering materials shall weigh not less than 6 ounces per square yard. Mats shall be stitched so that mat will contact surface of pavement at all points when saturated with water.

2.02 LIQUID MEMBRANE-FORMING COMPOUNDS

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- A. Liquid membrane-forming compounds shall conform to ASTM C 309. Membrane shall restrict loss of water to not more than 0.55 kg/m² of surface in 72 hours.

PART 3 EXECUTION

3.01 CURING REQUIREMENT

- A. Concrete pavement shall be cured by protecting it against loss of moisture for period of not less than 72 hours immediately upon completion of finishing operations. Do not use membrane curing for concrete pavement to be overlaid by asphaltic concrete.
- B. Failure to provide sufficient cover material shall be cause for immediate suspension of concreting operations.

3.02 POLYETHYLENE FILM CURING

- A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in the form of a fine spray. Cover surface with polyethylene film so film will remain in direct contact with surface during specified curing period.
- B. Cover entire surface and both edges of pavement slab. Joints in film sheets shall overlap minimum of 12 inches. Immediately repair tears or holes occurring during curing period by placing acceptable moisture-proof patches or by replacing.

3.03 WATERPROOFED PAPER CURING

- A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in form of fine spray. Cover surface with waterproofed paper so paper will remain in direct contact with surface during specified curing period.
- B. Prepare waterproofed paper to form blankets of sufficient width to cover entire surface and both edges of pavement slab, and not be more than 60 feet in length. Joints in blankets caused by joining paper sheets shall lap not less than 5 inches and shall be securely sealed with asphalt cement having melting point of approximately 180 degrees F. Place blankets to secure an overlap of at least 12 inches. Tears or holes appearing in paper during curing period shall be immediately repaired by cementing patches over defects.

3.04 COTTON MAT CURING

- A. Immediately after finishing surface, and after concrete has taken its initial set, completely cover surface with cotton mats, thoroughly saturated before application, in such manner that they will contact surface of pavement equally at all points.
- B. Mats shall remain on pavement for specified curing period. Keep mats saturated so that, when lightly compressed, water will drip freely from them. Keep banked earth or cotton mat covering edges saturated.

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3.05 LIQUID MEMBRANE-FORMING COMPOUNDS

- A. Immediately after finishing surface, and after concrete has taken its initial set, apply liquid membrane-forming compound in accordance with manufacturer's instructions.

END OF SECTION

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Section 02754

CONCRETE DRIVEWAYS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Portland cement concrete driveways.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.

- 1. Payment for concrete driveways is on square yard basis.

- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Concrete: Conform to material and proportion requirements for concrete of Section 02751 - Concrete Paving.
- B. Reinforcing Steel: Conform to material requirements for welded wire fabric of Section 02751 - Concrete Paving.
- C. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Section 02752 - Concrete Pavement Joints.
- D. Expansion Joint Filler: Conform to material requirements for expansion joint material of Section 02752 - Concrete Pavement Joints.
- E. Subgrade Materials: Conform to subgrade material requirements of Section 02336 - Lime Stabilized Subgrade, Section 02337 - Lime/Fly-Ash Stabilized Subgrade, or Section 02338 - Portland Cement Stabilized Subgrade.

PART 3 EXECUTION

3.01 PREPARATION

- A. Prepare subgrade in accordance with applicable portions of Section 02336 - Lime Stabilized Subgrade, Section 02337 - Lime/Fly-Ash Stabilized Subgrade, and Section 02338 - Portland Cement Stabilized Subgrade.

3.02 PLACEMENT

- A. Place and finish concrete in accordance with applicable portions of Section 02751 - Concrete Paving.

3.03 JOINTS

- A. Install joints in concrete driveway in accordance with Section 02752 - Concrete Pavement Joints.

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3.04 CONCRETE CURING

- A. Cure concrete driveway in accordance with Section 02753 - Concrete Pavement Curing.

3.05 PROTECTION

- A. Conform to applicable requirements of Section 02753 - Concrete Pavement Curing.

END OF SECTION

Section 02776

PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Centerline, Left Turning Lane and Channelization Markings.
- B. Edge Line Pavement Markings.
- C. Crosswalks Markings at the intersections between sidewalks / driveways.
- D. Stop Line Markings.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. Payment for Centerline, Left Turning Lane and Channelization Markings shall be on per linear feet.
 - 2. Payment for Edge Line Pavement Markings shall be on per linear feet.
 - 3. Payment for Crosswalks Markings at the intersections shall be on per linear feet.
 - 4. Payment for Stop Line Markings shall be on per linear feet.
 - 5. Refer to Section 01270 - Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 REFERENCES

- A. Texas Manual on Uniform Traffic Control Devices (TMUTCD) and Texas Department of Transportation (TxDOT).

1.04 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01 33 00 - Submittal Procedures and Item 7 of General Conditions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. For Centerline, Left Turning Lane and Channelization Markings materials shall be in accordance with Section 02777: ReflectORIZED Pavement Markings.
- B. For Edge Line Pavement Markings materials shall be in accordance with Section 02777: ReflectORIZED Pavement Markings.

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- C. For Crosswalks Markings materials shall be in accordance with Section 02777: Reflectorized Pavement Markings.
- D. For Stop Line Markings materials shall be in accordance with Section 02777: Reflectorized Pavement Markings.

PART 3 EXECUTION

3.01 CENTERLINE, LEFT TURNING LANE AND CHANNELIZATIONS

- A. Centerline pavement markings, when used, shall be the pavement markings used to delineate the separation of traffic lanes that have opposite directions of travel on a roadway and shall be yellow.
- B. Centerline pavement markings may be placed at a location that is not the geometric center of the roadway.
- C. The centerline markings on two-lane, two-way roadways shall be one of the following:
 - a. Two-direction passing zone markings consisting of a normal broken yellow line where crossing the centerline markings for passing with care is permitted for traffic traveling in either direction;
 - b. One-direction no-passing zone markings consisting of a normal broken yellow line and a normal solid yellow line where crossing the centerline markings for passing with care is permitted for the traffic traveling adjacent to the broken line, but is prohibited for traffic traveling adjacent to the solid line; and
 - c. Two-direction no-passing zone markings consisting of two normal solid yellow lines where crossing the centerline markings for passing is prohibited for traffic traveling in either direction.
- D. Centerline markings shall be placed on all paved urban arterials and collectors that have a traveled width of 20ft or more and an ADT of 6,000 vehicles per day or greater. Centerline markings shall also be placed on all paved two-way streets or highways that have three or more traffic lanes.
- E. Centerline, left turning lane and Channelization markings shall be placed as shown on the detail drawings.

3.02 EDGE LINE PAVEMENT

- A. The right edge line pavement markings shall consist of a normal solid white line to delineate the right edge of the roadway.
- B. Edge line marking shall not be continued through intersections; however, edge line extensions may be placed through intersections.
- C. Edge line markings should not be broken for driveways.
- D. Edge line markings shall be placed on paved streets or highways with the following characteristics:
 - a. Freeways;
 - b. Expressways; and

- c. Rural arterials with a traveled way of 20ft or more in width and an ADT of 6,000 vehicles per day or greater.
 - d. Rural arterials and collectors with a traveled way of 20ft or more in width and an ADT of 3,000 vehicles per day or greater,
 - e. At other paved streets and highways where an engineering study indicates a need for edge line markings.
- E. Edge line markings have unique value as visual references to guide road users during adverse weather and visibility conditions.

3.03 CROSSWALKS OR CROSSWALKS MARKINGS

- A. Crosswalks lines shall be solid white lines, marking both edges of the crosswalk.
- B. Lines shall not be less than 6 inches in width and shall not be spaced less than 6 feet apart.
- C. Crosswalk lines on both sides of the crosswalk shall be extended across the full width of driveways or pavements.
- D. Crosswalk markings shall not be used discriminately.
- E. Crosswalk shall be marked with white diagonal lines at a 45° angle or with white longitudinal lines at a 90 angle to the line of the crosswalk. These lines shall be approximately 12 inch wide and spaced 12 inch apart.
- F. Crosswalk markings shall be in accordance with Texas Manual on Uniform Traffic Control Devices (TMUTCD) –Section 3B-18.

3.04 STOP LINE

- A. Stop line shall consist of solid white lines extending across approach lanes to indicate the point at which the stop is intended or required to be made.
- B. Stop line should be 12 to 24 inch wide.
- C. Stop line should be used to indicate the point behind which vehicles are required to stop, in compliance with a STOP sign, traffic control signal, or some other traffic control device.
- D. Stop line should be placed 4 ft in advance of and parallel to the nearest crosswalk line. In the absence of a marked crosswalk, the stop line should be placed at the desired stopping point, but should be placed no more that 30 ft nor less than 4 ft from the nearest edge of the intersecting traveled way.
- E. Stop lines at midblock signalized locations should be placed at least 40 ft in advance of the nearest signal indication.

3.03 PLACEMENT

- A. Placement of all types of markings shall be in compliance with Section 02777: ReflectORIZED Pavement Markings.

END OF SECTION

Section 02777

REFLECTORIZED PAVEMENT MARKING

PART 1 GENERAL

1.01 DESCRIPTION

- A. This item shall govern for furnishing and placing reflectORIZED pavement markings of the types, colors, shapes, sizes, widths, and thickness shown on the plans.

2.01 MATERIALS

- A. All pavement markings shall be Sherwin Williams Setfast Acrylic Waterborne Traffic Marking Paint (TM226, TM227) and Setfast Latex Traffic Marking Paint (TM2132, TM2133, TM2135).

2.02 EQUIPMENT REQUIREMENTS. Equipment used to place pavement markings shall:

- A. Be maintained in satisfactory operating condition.
- B. Be considered in satisfactory operation condition if it has an average placement rate of 5,000 linear feet per hour of acceptable four-inch solid or broken lines over any five (5) consecutive working days.
- C. Meet or exceed the material handling at elevated temperatures requirements of the National Fire Underwriters and the Texas Railroad Commission.
- D. Be capable of placing a minimum of 40,000 linear feet of four-inch solid or broken markings per working day.
- E. Have production capabilities similar to four-inch marking equipment and shall be capable of placing linear markings up to eight (8) inches in width in a single pass when used for placing markings in widths other than four (4) inches.
- F. Have production capabilities considered satisfactory by the Engineer when used to place markings other than solid or broken lines.
- G. Be capable of placing a center-line and no-passing barrier-line configuration consisting of one (1) broken line with two (2) solid liens at the same time to the alignment and spacing shown on the plans.
- H. Be capable of placing broken and/or continuous white line from both sides.
- I. Be capable of placing lines with clean edges and of uniform cross-section. All lines shall have a tolerance of plus or minus 1/8 inch per four (4) inch width.
- J. Have an automatic cut-off device with manual operating capabilities to provide clean, reasonably square marking ends to the satisfaction of the Engineer, and to provide a method of applying broken line in an approximate stripe-to-gap ratio of 10 to 30. The length of the stripe shall not be less than 10 feet or more than 10.5 feet. The total length of any stripe-gap cycle shall not be less than 39.5 feet or more than 40.5 feet.
- K. Provide continuous mixing and agitation of the pavement marking material. The use of pans,

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aprons or similar appliances which the die overruns will not be permitted for longitudinal striping applications.

- L. Apply beads by an automatic bead dispenser attached to the pavement marking equipment in such a manner that the beads are dispensed uniformly and almost instantly upon the marking as the marking is being applied to the road surface. The bead dispenser shall have an automatic cut-off control, synchronized with the cut-off of the pavement marking equipment.
- M. When Type I markings are to be placed, the Contractor shall have a hand-held thermometer on the project. The thermometer shall be capable of measuring the temperature of the pavement marking material to be placed.

3.01 CONSTRUCTION METHODS

When required by the Engineer, the Contractor and the Engineer shall review the sequence of work to be followed and the estimated progress schedule.

Markings may be placed on roadways either free of traffic or open to traffic. On roadways already open to traffic, the markings shall be placed under traffic conditions that exist with a minimum of interference to the operation of the facility. Traffic control shall be as shown on the plans or as approved by the Engineer in writing. All markings placed under open-traffic conditions shall be protected from traffic damage and disfigurement. On roadways open to traffic, with three (3) lanes of travel in one direction, all markings shall be placed from the outside lanes only, unless otherwise approved in writing by the engineer.

Guides to mark the lateral location of pavement markings shall be established as shown on the plans or as directed by the Engineer. The Contractor shall establish the pavement marking guides and the Engineer will verify the location of the guides.

Markings shall be placed in proper alignment with the guides. The deviation rate in alignment shall not exceed one (1) inch per 200 feet of roadway. The maximum deviation shall not exceed two (2) nor shall any deviation be abrupt.

Markings shall essentially have a uniform cross-section. The density and quality of markings shall be uniform throughout their thickness. The applied markings shall have not more than five (5) percent, by area, of holes or voids and shall be free of blisters.

Markings, in place on the roadway, shall be reflectorized both internally and externally. Glass beads shall be applied to the materials at a uniform rate sufficient to achieve uniform and distinctive retroreflective characteristics when observed in accordance with Test Method Tex-828-B.

The Contractor's personnel shall be sufficiently skilled in the work of installing pavement markings.

Markings placed that are not in alignment or sequence, as shown on the plans or as stated in this specification, shall be removed and replaced by the Contractor at the Contractor's expense. Removal shall be in accordance with Item 677, "Eliminating Existing Pavement Markings and Markers" on the TxDOT Standards and Specifications for Construction and Maintenance of Highways, Streets, and Bridges, except for measurement and payment. Guides placed on the roadway for alignment purposes shall not establish a permanent marking on the roadway.

3.02 SURFACE PREPARATION

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Shall be in accordance with manufacturers recommendations.

3.03 PERFORMANCE PERIOD

All pavement markings shall meet all requirements of this specification for a minimum of 15 calendar days after installation. Pavement markings that fail to meet all requirements of this specification shall be removed and replaced by the Contractor at the Contractor's expense. The Contractor shall replace all pavement markings failing the requirements of this specification within 30 calendar days following notification by the Engineer of such failing. All replacement markings shall also meet all requirements of this specification for a minimum of 15 calendar days after installation.

4.01 MEASUREMENT AND PAYMENT

- A. This Item will be measured by the linear foot, by each of the various words, symbols or shapes, or by any other unit as shown on the plans. Where double stripes are placed, each stripe will be measured separately.

All pavement markings requiring two (2) applications however will be measured as one (1) marking.

- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

END OF SECTION

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Section 02778

PAVEMENT SURFACE PREPARATION FOR MARKINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation of pavement surface areas prior to placement of pavement markings or raised pavement markers.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. No Separate payment will be made for work performed under this Section. Include cost of work performed under this Section in pay items for which this work is a component.
- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Abrasive blasting medium shall be a quality commercial product capable of producing the specified surface cleanliness without the deposition of deleterious materials on the cleaned surface. Water used in blasting operations shall be potable.

PART 3 EXECUTION

3.01 CONSTRUCTION

- A. Prepare pavement surface of sufficient area for the pavement markings or raised pavement markers shown on the plans.
- B. Remove all contamination and loose material.
- C. Avoid damaging the pavement surface.
- D. When existing pavement markings are present, remove loose and flaking material.
- E. Approved pavement surface preparation methods are sweeping, air blasting, flail milling, and blast cleaning unless otherwise specified on the plans.
- F. For concrete pavement surfaces, in addition to the above, air blast after the removal of contamination or existing material and just prior to placing the stripe.
- G. Perform the air blasting with a compressor that is capable of generating compressed air at a minimum of 150 cfm and 100 psi using 5/16-in. or larger hosing for the air blast.

PAVEMENT SURFACE PREPARATION FOR MARKINGS

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- H. Contaminants up to 0.5 sq. in. may remain if they are not removed by the following test, performed just before application of markings:

Step 1: Air-blast the surface to be tested, to simulate blasting during application of markings.

Step 2: Firmly press a 10-in.-long, 2-in.-wide strip of monofilament tape onto the surface, leaving approximately 2 in. free.

Step 3: Grasp the free end and remove the tape with a sharp pull.

- I. Portland cement concrete surfaces shall not be cleaned by grinding.

END OF SECTION

Section 03100

CONCRETE FORMWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Design, construction, erection and removal of structural concrete formwork.

1.02 UNIT PRICES

- A. No separate payment will be made for concrete formwork under this Section. Include payment in unit price for structural concrete.
- B. Refer to Section 01025 - Measurement and Payment for unit price procedures.

1.03 REFERENCE STANDARDS

- A. ACI 117 - Standard Tolerances for Concrete Construction and Materials.
- B. ACI 347 - Recommended Practice for Concrete Formwork.
- C. U.S. Product Standard PS 1 Construction and Industrial Plywood.
- D. U.S. Product Standard PS 20 American Softwood Lumber Standard.

1.04 SUBMITTALS

- A. Conform to Section 01 30 00 - Submittals.
- B. Shop Drawings: Show location, member size and loading of shoring. When reshoring is permitted, submit plans showing locations and member size of reshoring.
- C. Product Data and Samples:
 - 1. Corrugated Fiberboard Carton Forms: Submit certification of compliance with design criteria, description of forms, and one-foot-long sample.
 - 2. Form-coating Materials: Submit trade or brand names of manufacturers and complete description of products.
 - 3. Form ties and related accessories, including taper tie plugs, if taper ties are used. Form gaskets.
- D. Detailed Layout for Slip-forming: Submit detailed layout of proposed slipforming, including description of equipment, rate of progress, and other data to show suitability of method. Show provisions for ensuring attainment of required concrete surface finish.

CONCRETE FORMWORK

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PART 2 PRODUCTS

2.01 MATERIAL

- A. Smooth Forms: New plywood, metal, plastic, tempered concrete-form hardboard, dressed lumber faced with plywood or fiberboard lining, or metal-framed plywood-faced panel material, to provide continuous, straight, smooth surfaces. Form material shall be free of raised grain, torn surfaces, worn edges, patches, dents or other defects. Furnish material in largest practical sizes to minimize number of joints and, when indicated on Drawings, conform to joint system indicated. Form material shall have sufficient strength and thickness to withstand pressure of newly placed concrete without bow or deflection.
- B. Rough Forms: Plywood, metal, dressed or undressed lumber free of knots, splits or other defects, or other material acceptable to Engineer of sufficient strength and thickness to withstand pressure of newly placed concrete without bow or deflection.
- C. Plywood: Conform to PS 1, Class 1.
- D. Lumber: Conform to PS 20.
- E. Edge Forms and Intermediate Screed Strips: Type and strength compatible with the screed equipment and methods used.
- F. Plastic Forms: One-piece forms for domes, beams and pan joists. Single lengths for columns not exceeding height of 7 feet 6 inches. For columns over 7 feet 6 inches, use 7-foot 6-inch sections and filler sections as needed. To facilitate removal of pan joist forms, taper sides one inch per foot.
- G. Metal Pan Joist Forms: Removable type; fabricated of minimum 14-gauge steel; one piece between end closures. Adjustable forms not allowed. Taper sides one inch per foot to facilitate removal.
- H. Earth Cuts for Forms:
 - 1. Use earth cuts for forming unexposed sides of grade beams cast monolithically with slabs on grade.
 - 2. Where sides of excavations are stable enough to prevent caving or sloughing, following surfaces may be cast against neat-cut excavations
 - a. Sides of footings.
 - b. Inside face of perimeter grade beams not monolithic with slab on grade. When inside face is cast against earth, increase beam width indicated on Drawings by one inch.
 - c. Both faces of interior grade beams not monolithic with slab on grade. When grade beam is cast against earth, increase beam width indicated on Drawings by 2 inches.

- I. Corrugated Fiberboard Carton Forms:
1. Corrugated fiberboard carton forms, when called for, are intended to form a void space beneath pile-supported and pier-supported slabs and other structural elements as shown.
 2. Provide products of a reputable manufacturer regularly engaged in commercial production of double-faced corrugated fiberboard carton forms, constructed of waterproof paper and laminated with waterproof adhesive.
 3. Fiberboard forms: Capable of supporting required dead load plus construction loads, and designed to lose their strength upon prolonged contact with moisture and soil bacteria.
 4. Seal cuts and ends of each form section by dipping in waterproof wax, unless liners and flutes are completely impregnated with waterproofing.
 5. Size forms as indicated on Drawings. Assemble as recommended by manufacturer, either with steel banding at 4 feet 0 inches maximum on centers, or, where liners and flutes are impregnated with waterproofing, with adequate stapling.
- J. Circular Forms:
1. Form round-section members with paper or fiber tubes, constructed of laminated plies using water-resistant adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation. Provide manufacturer's seamless units to minimize spiral gaps and seams.
 2. Fiberglass or steel forms may be used for round-section members.
- K. Shores: Wood or adjustable metal, with bearing plates; with double wedges at lower end.
- L. Form Ties:
1. Use commercially-manufactured ties, hangers and other accessories for embedding in concrete. Do not use wire not commercially fabricated for use as a form accessory.
 2. Fabricate ties so ends or end fasteners can be removed without causing spalling of concrete faces. Depth from formed concrete face to the embedded portion: At least 1 inch, or twice the minimum dimension of tie, whichever is greater.
 3. Provide waterstop feature for form ties used on liquid-containing structures and on concrete walls which will have earth backfill on one side.
 4. Removable ties: Taper ties may be used when approved by the Engineer. In the hole left by the removal of the taper tie, insert a preformed neoprene or polyurethane plug sized to seat at the center of the wall.
- M. Form Coating: Commercial formulation of form oil or form-release agent having proven satisfactory performance. Coating shall not bond with, stain or otherwise adversely affect

concrete surfaces, or impair their subsequent treatment, including application of bonding agents, curing compounds, paint, protective liners and membrane waterproofing.

- N. Coating for Plastic Forms: Alkali-resistant gel-coat.
- O. Chamfer Strips: Unless otherwise indicated on Drawings, provide 3/4-inch chamfer strips in corners of forms to produce beveled edges where required by Part 3, Execution.
- P. Form Gaskets: Polyethylene rod, closed cell, one-inch diameter.

2.02 DESIGN OF FORMWORK

- A. Conform to ACI 117, ACI 347 and building codes, unless more restrictive requirements are specified or shown on Drawings. Contractor shall design and engineer concrete formwork, including shoring and bracing. Design formwork for applicable gravity loads, lateral pressure, wind loads and allowable stresses. Camber formwork to compensate for anticipated deflection during placement of concrete when required to maintain specified tolerances. Design formwork to be readily removed without impact, shock or damage to concrete surfaces and adjacent materials.
- B. Slip Forming: Permitted on written approval of Engineer. Contractor shall demonstrate suitability of method proposed.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Formwork Construction
 - 1. Construct and maintain formwork so that it will maintain correct sizes of members, shape, alignment, elevation and position during concrete placement and until concrete has gained sufficient strength. Provide for required openings, offsets, sinkages, keyways, recesses, moldings, anchorages and inserts.
 - 2. Construct forms for easy removal without damage to concrete surfaces.
 - 3. Make formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins. Provide gaskets for wall forms to prevent concrete paste leakage at their base.
 - 4. Place chamfer strips in forms to bevel edges and corners permanently exposed to view, except top edges of walls, and slabs which are indicated on Drawings to be tooled. Do not bevel edges of formed joints and interior corners unless indicated on Drawings. Form beveled edges for vertical and horizontal corners of equipment bases. Unless otherwise indicated on Drawings, make bevels 3/4 inch wide.
 - 5. Provide temporary openings at bases of column and wall forms and other points as required for observation and cleaning immediately before concrete is placed.
 - 6. Where runways are required for moving equipment, support runways directly on the formwork or structural members. Do not allow runways or supports to rest on reinforcing steel.

7. Use smooth forms on formed concrete surfaces required to have smooth form finish or rubbed finish as specified in Section 03350 - Concrete Finishing.
 8. Rough forms may be used on formed concrete surfaces indicated to have rough form finish as specified in Section 03350 - Concrete Finishing.
- B. Forms for Surfaces Requiring Smooth Form Finish:
1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Uniformly space form ties and align in horizontal and vertical rows. Install taper ties, if used, with the large end on the wet face of the wall.
 2. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back up joints with extra studs or girts to maintain true, square intersections.
 3. Form molding shapes, recesses and projections with smooth-finish materials and install in forms with sealed joints to prevent displacement.
 4. Form exposed corners of beams and columns to produce square, smooth, solid, unbroken lines.
 5. Provide exterior exposed edges with 3/4-inch chamfer or 3/4-inch radius.
 6. Arrange facing material in orderly and symmetrical fashion. Keep number of joints to practical minimum. Support facing material adequately to prevent deflection in excess of allowable tolerances.
 7. For flush surfaces exposed to view in completed structure, overlap previously- placed hardened concrete with form sheathing by approximately 1 inch. Hold forms against hardened concrete to maintain true surfaces, preventing offsets or loss of mortar.
- C. Forms for Surfaces Requiring Rubbed Finish: Provide forms as specified in Paragraph 3.01B, Smooth Form Finish. Use smooth plywood or fiberboard linings or forms, in as large sheets as practicable, and with smooth, even edges and close joints.
- D. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure supports for types of screeds required.
- E. Circular Forms: Set forms in one piece for full height of member.
- F. Surfaces to Receive Membrane Waterproofing: Coordinate surface finish, anchors, reglets and similar requirements with membrane waterproofing applicator.
- G. Fireproofing Steel Member: Construct forms to provide not less than the concrete thickness necessary, measured from face of steel member, to provide the required fire rating. Forms for concealed surfaces may be unlined.

H. Tolerances:

1. Unless noted otherwise on Drawings, construct formwork so concrete surfaces will conform to tolerance limits listed in Tables 03100A and 03100B at end of this Section.
2. Establish sufficient control points and bench marks as references for tolerance checks. Maintain these references in undisturbed condition until final completion and acceptance of the Work.

I. Adjustment of Formwork:

1. Use wedges or jacks to provide positive adjustment of shores and struts. After final inspection and before concrete placement, fasten in position wedges used for final adjustment of forms.
2. Brace forms securely against lateral deflections. Prepare to compensate for settling during concrete placement.
3. For wall openings, construct wood forms that facilitate necessary loosening to counteract swelling of forms.

J. Corrugated Fiberboard Carton Forms:

1. Place on smooth firm bed of suitable material to prevent vertical displacement; set tight to prevent horizontal displacement. Exercise care to avoid buckling of forms. Install in accordance with manufacturer's directions and recommendations.
2. Fit carton forms tightly around piles and piers; completely fill the space between subgrade and concrete placement with carton forms to form a void space.
3. Protect carton forms from moisture and maintain in a dry condition until concrete is placed on them. If they become wet before placement of concrete, allow them to dry and carefully inspect for strength before concrete is placed.
4. Before concrete placement, replace damaged or deteriorated forms which are incapable of supporting concrete dead load plus construction live loads.

3.02 PREPARATION OF FORM SURFACES

- A. Clean surfaces of forms and embedded materials before placing concrete. Remove accumulated mortar, grout, rust and other foreign matter.
- B. Coat forms for exposed or painted concrete surfaces with form oil or form-release agent before placing reinforcement. Cover form surfaces with coating material in accordance with manufacturer's printed instructions. Do not allow excess coating material to accumulate in forms or to contact hardened concrete against which fresh concrete will be placed. Remove coating material from reinforcement before placing concrete.
- C. Forms for unexposed surfaces, other than retained-in-place metal forms, may be wet with water immediately before concrete placement in lieu of coating. When possibility of freezing temperatures exists, however, the use of coating is mandatory.

3.03 REMOVAL OF FORMS

A. Time Limits:

1. When repair of surface defects or finishing is required before concrete is aged, forms on vertical surfaces may be removed as soon as concrete has hardened sufficiently to resist damage from removal operations.
2. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete. Leave formwork for water-retaining structures in place for at least 2 days. Formwork for non-water-retaining columns, walls, sides of beams and other formwork components not supporting weight of concrete may be removed after 12 hours, provided concrete has hardened sufficiently to resist damage from removal operations, and provided removal of forms will not disturb members supporting weight of concrete.
3. Forms and shoring supporting weight of concrete or construction loads: Leave in place until concrete has reached minimum strength specified for removal of forms and shoring. Do not remove such forms in less than 4 days.

B. Circular Paper or Spiral Tube Forms: Follow manufacturer's directions for form removal. Take necessary precautions to prevent damage to concrete surface. When removal is done before completion of curing time, replace form, tie in place and seal to retard escape of moisture.

C. Removal Strength:

1. Control Tests: Suitable strength-control tests will be required as evidence that concrete has attained specified strength for removal of formwork or shoring supporting weight of concrete in beams, slabs and other structural members. Furnish test cylinders and data to verify strength for early form removal.
 - a. Field-cured Test Cylinders: When field-cured test cylinders reach specified removal strength, formwork or shoring may be removed from respective concrete placements.
 - b. Laboratory-cured Test Cylinders: When concrete has been cured as specified for structural concrete for same time period required by laboratory-cured cylinders to reach specified strength, formwork or shoring may be removed from respective concrete placements. Determine length of time that concrete has been cured by totaling the days or fractions of days, not necessarily consecutive, during which air temperature surrounding concrete is above 50 degrees F and concrete has been damp or thoroughly sealed against evaporation and loss of moisture.
2. Compressive Strengths: The minimum concrete compressive strength for removal of formwork supporting weight of concrete is 75 percent of specified minimum 28-day strength for class of concrete involved.

3.04 RESHORING

- A. When reshoring is permitted, plan operations in advance and obtain Engineer's approval of such operations. While reshoring is under way, keep live load off new construction. Do not permit concrete in any beam, slab, column or other structural member to be subjected to combined dead and construction loads in excess of loads permitted for developed concrete strength at time of reshoring.
- B. Place reshores as soon as practicable after form-stripping operations are complete but in no case later than end of day on which stripping occurs. Tighten reshores to carry required loads without over stressing construction. Leave reshores in place until tests representative of concrete being supported have reached specified strength at time of removal of formwork supporting weight of concrete.
- C. Floors supporting shores under newly-placed concrete: Leave original supporting shores in place, or re-shore. Locate reshores directly under shore position above. Extend reshoring over a sufficient number of stories to distribute weight of newly-placed concrete, forms and construction live loads in such manner that design superimposed loads of floors supporting shores are not exceeded.

3.05 FORM REUSE

- A. Do not reuse forms that are worn or damaged beyond repair. Thoroughly clean and recoat forms before reuse. For wood and plywood forms to be used for exposed smooth finish, sand or otherwise dress concrete contact surface to original condition or provide form liner facing material. For metal forms, straighten, remove dents and clean to return forms to original condition.

Table 03100A

TOLERANCES FOR FORMED SURFACES CONCRETE IN BUILDINGS**			
FROM	VARIATION IN	FOR ANY	MAXIMUM FOR
VARIATION	VARIATION IN	10-FOOT	ENTIRE
PLUMB OR		LENGTH	DIMENSION
SPECIFIED		FOR ANY	
BATTER		20-FOOT	
LINES AND SURFACES OF		LENGTH OR	
COLUMNS, PIERS, WALLS AND		ANY BAY	
ARRISES			
EXPOSED CORNER COLUMNS,			
CONTROL JOINT GROOVES, AND			
OTHER CONSPICUOUS LINES			
SLAB SOFFITS, CEILINGS, BEAM			
SOFFITS, AND ARISES			
(MEASURED BEFORE REMOVAL OF			
SHORES)			
EXPOSED LINTELS, SILLS,			
PARAPETS, HORIZONTAL			
GROOVES AND OTHER			
CONSPICUOUS LINES			
POSITION OF LINEAR BUILDING			
LINES, COLUMNS, WALLS, AND			
PARTITIONS			
SIZE AND LOCATION OF SLEEVES,			
FLOOR OPENINGS AND WALL			
OPENINGS			
CROSS SECTION OF COLUMNS,			
BEAMS, SLABS, AND WALLS			
FOOTINGS* IN PLAN			
FOOTING MISPLACEMENT OR			
ECCENTRICITY IN DIRECTION OF			
ERROR (THE LESSER OF)			
FOOTING THICKNESS DECREASE			
FOOTING THICKNESS INCREASE			
STEP RISE IN FLIGHT OF STAIRS			
STEP TREAD IN FLIGHT OF STAIRS			
CONSECUTIVE STEP RISE			
CONSECUTIVE STEP TREAD			
1"		1/4"	1"
PLUMB OR			
SPECIFIED			
BATTER			
LINES AND SURFACES OF			
COLUMNS, PIERS, WALLS AND			
ARRISES			
EXPOSED CORNER COLUMNS,			
CONTROL JOINT GROOVES, AND			
OTHER CONSPICUOUS LINES			
SLAB SOFFITS, CEILINGS, BEAM			
SOFFITS, AND ARISES			
(MEASURED BEFORE REMOVAL OF			
SHORES)			
EXPOSED LINTELS, SILLS,			
PARAPETS, HORIZONTAL			
GROOVES AND OTHER			
CONSPICUOUS LINES			
POSITION OF LINEAR BUILDING			
LINES, COLUMNS, WALLS, AND			
PARTITIONS			
SIZE AND LOCATION OF SLEEVES,			
FLOOR OPENINGS AND WALL			
OPENINGS			
CROSS SECTION OF COLUMNS,			
BEAMS, SLABS, AND WALLS			
FOOTINGS* IN PLAN			
FOOTING MISPLACEMENT OR			
ECCENTRICITY IN DIRECTION OF			
ERROR (THE LESSER OF)			
FOOTING THICKNESS DECREASE			
FOOTING THICKNESS INCREASE			
STEP RISE IN FLIGHT OF STAIRS			
STEP TREAD IN FLIGHT OF STAIRS			
CONSECUTIVE STEP RISE			
CONSECUTIVE STEP TREAD			
FOOTING tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel,			
dowels, or embedded items.			
** Includes water and wastewater process structures.			

TABLE 03100B

TOLERANCES FOR FORMED SURFACES CONCRETE IN BRIDGES, WHARVES AND MARINE STRUCTURES		
VARIATION FROM	VARIATION IN	MAXIMUM
PLUMB OR SPECIFIED BATTER	SURFACES OF COLUMNS, PIERS AND WALLS	1/2" in 10'
LEVEL OR SPECIFIED GRADE	TOP SURFACES OF SLABS	See Section 03345
	TOP SURFACES OF CURBS AND RAILINGS	3/16" in 10'
DRAWING DIMENSIONS	CROSS SECTION OF COLUMNS, CAPS, WALLS, BEAMS AND SIMILAR MEMBERS	+1/2", -1/4"
	THICKNESS OF DECK SLABS	+1/4", - 1/8"
	SIZE AND LOCATION OF SLAB AND WALL OPENINGS	± 1/2"
	FOOTINGS IN PLAN	+2", -1/2"
	FOOTING MISPLACEMENT OR ECCENTRICITY IN DIRECTION OF ERROR (THE LESSER OF)	2% of WIDTH OR 2"
	FOOTING THICKNESS DECREASE	5%
	FOOTING THICKNESS INCREASE	NO LIMIT
	STEP RISE IN FLIGHT OF STAIRS	±1/8"
	STEP TREAD IN FLIGHT OF STAIRS	±1/4"
	CONSECUTIVE STEP RISE	±1/16"
	CONSECUTIVE STEP TREAD	±1/8"

END OF SECTION

Section 03151

JOINTS IN CONCRETE STRUCTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Waterstops and similar joints in concrete structures intended to retain water or withstand hydrostatic pressure.

1.02 UNIT PRICES

- A. No separate payment will be made for joints under this Section. Include payment in unit price for structural concrete.
- B. Refer to Section 01270 - Measurement and Payment for unit price procedures.

1.03 REFERENCES

- A. ASTM A 775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- B. ASTM C 920 - Specification for Elastomeric Joint Sealants.
- C. ASTM D 412 - Test Methods for Rubber Properties in Tension.
- D. ASTM D 624 - Test Method for Rubber Property - Tear Resistance.
- E. ASTM D 638 - Test Method for Tensile Properties of Plastics.
- F. ASTM D 746 - Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
- G. ASTM D 747 - Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
- H. ASTM D 1056 - Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- I. ASTM D 1752 - Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- J. ASTM D 2000 - Specification for Rubber Products in Automotive Applications.
- K. ASTM D 2240 - Test Method for Rubber Property - Durometer Hardness.
- L. ASTM D 2241 - Specification for PVC Tubing.
- M. Federal Specification SS-S-210A - Sealing Compound, Preformed Plastic for Expansion Joints and Pipe Joints.

JOINTS IN CONCRETE STRUCTURES

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- N. Federal Specification TT-S-0227E(3) Sealing Compound, Elastomeric Type, Multi-Component, for Caulking, Sealing, and Glazing Buildings and Other Structures.
- O. U.S. Army Corps of Engineers Specification CRD-C 572 PVC Waterstop.

1.04 DEFINITIONS

- A. The following definitions refer to concrete joints in water-retaining structures. Unless otherwise indicated, all such joints shall have a waterstop or sealant groove to prevent water penetration at the joint.
- B. Construction Joint: The joint or surface between two concrete pours, produced by placing fresh concrete in contact with a hardened concrete surface.
 - 1. A bond breaker may or may not be used, as indicated.
 - 2. Reinforcing steel is continuous through the joint, unless otherwise indicated.
- C. Contraction Joint: A joint similar to a construction joint, but intended to accommodate concrete shrinkage and similar movement.
 - 1. A bond breaker is always used.
 - 2. Reinforcing steel is held back 4-1/2 inches from the joint surface, and sleeved dowels are used so pours can move apart, unless otherwise indicated.
- D. Expansion Joint: A joint similar to a construction or contraction joint, but intended to accommodate both expansion and contraction.
 - 1. Compressible joint filler is placed against the hardened concrete, to form and separate the second pour so pours can move together or apart.
 - 2. A centerbulb waterstop and joint sealant are used to fill the gap, unless otherwise indicated.
 - 3. Reinforcing steel is held back, and sleeved dowels are used to allow and control movement, unless otherwise indicated.
- E. Control Joint: A groove cut or formed in the face of a single pour, producing a weaker plane more likely to crack; used in an attempt to control locations of normal shrinkage cracks.
 - 1. Joint sealant is used to fill the groove.
 - 2. Reinforcing steel is continuous, since the pour is monolithic.

1.05 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 - Submittals.
- B. Product Data: Information sufficient to indicate compliance with Contract Documents, including manufacturer's descriptive literature and specifications.

- C. Shop Drawings: Indicate type, size, and location of each joint in each structure, and installation details.
 - D. Samples: For extrusions, submit 6-inch lengths. For molded or fabricated items, submit whole items. Submit 6-inch beads for sealants and 6-inch square samples for coatings, on appropriate substrates.
 - E. Quality Control Submittals: Submit manufacturer's instructions and recommendations for storage, handling and installation including material safety data sheets, and, where specified, test reports certified by an independent testing laboratory or the manufacturer, and manufacturer's certification that products furnished comply with Contract Documents.
- 1.06 QUALITY ASSURANCE
- A. Waterstop Inspection: Notify Resident Project Representative to schedule inspection at least 24 hours prior to work involving waterstop installation or fabrication of waterstop field joints.
 - B. Defects include but are not limited to the following:
 - 1. Offsets at joints greater at any point than 1/16 inch or 15 percent of material thickness, whichever is less.
 - 2. Exterior cracks at joints due to incomplete bond, which are deeper at any point than 1/16 inch or 15 percent of material thickness, whichever is less.
 - 3. At any point, any combination of offsets or exterior cracks resulting in a net reduction in the cross-sectional area of the waterstop greater than 1/16 inch or 15 percent of material thickness at any point, whichever is less.
 - 4. Misalignment of joint resulting in misalignment of the waterstop in excess of 1/2 inch in 10 feet.
 - 5. Porosity in the welded joint as evidenced by visual inspection.
 - 6. Bubbles or inadequate bond which can be detected with a pen knife. If, while probing the joint with the point of a pen knife, the knife breaks through the outer portion of the weld into a bubble, the joint is defective.
 - C. Field Joint Samples: Prior to use of the waterstop material in the field, fabricate and submit for review a sample of a fabricated mitered cross and a tee constructed of each size or shape of material to be used. Fabricate samples so material and workmanship represent fittings to be furnished. Field samples of fabricated fittings (crosses, tees, etc.) will be selected at random by the Owner for testing by a laboratory at Owner's expense; they shall have a tensile strength across the joints equal to at least 600 psi when tested in accordance with ASTM D 638. Contractor shall pay cost of failed tests and retesting required by failures.
 - D. Construction Joint Sealant: Prepare adhesion and cohesion test specimens, as specified, at intervals of 5 working days while sealants are being installed.
 - E. Sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:

1. Prepare sealant specimen between 2 concrete blocks (1 inch by 2 inches by 3 inches); spacing between the blocks shall be 1 inch. Use coated spacers (2 inches by 1-1/2 inches by 1/2 inch) to ensure sealant cross-sections of 1/2 inch by 2 inches with a width of 1 inch.
2. Cast and cure sealant according to manufacturer's recommendations except that curing period shall be not less than 24 hours.
3. Following curing period, widen the gap between blocks to 1-1/2 inches. Use spacers to maintain this gap for 24 hours prior to inspection for failure.

F. Sealant Installer: A competent waterproofing specialty contractor, approved by sealant manufacturer, having a record of successful performance in similar installations. Before beginning work, sealant manufacturer's representative shall instruct installer's crew in proper method of application.

1.07 WARRANTY

- A. Provide a written warranty covering entire sealant installation against faulty and incompatible materials and workmanship, and agreeing to repair or replace defective work at no additional cost to the Owner, for a period of 5 years.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle materials in accordance with manufacturer's printed instructions.
- B. Store waterstops to permit free circulation of air around waterstop material.

PART 2 PRODUCTS

2.01 EPA POTABLE CLASSIFICATION

- A. All joint materials shall be materials that reach acceptability for use in potable water systems no later than 30 days after installation, as classified by the Environmental Protection Agency.

2.02 PVC WATERSTOPS

- A. Extrude from virgin polyvinyl chloride elastomer. Use no reclaimed or scrap material. Submit waterstop manufacturer's current test reports and manufacturer's written certification that the material furnished meets or exceeds Corps of Engineers Specification CRD-C572 and other specified requirements.
- B. Flat Strip and Center-Bulb Waterstops: As detailed, and as manufactured by: Kirkhill Rubber Co., Brea, California; Water Seals, Inc., Chicago, Illinois; Progress Unlimited, Inc., New York, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or equal acceptable to the Engineer, provided that at no place shall waterstop thickness be less than 3/8 inch.

- C. Multi-Rib Waterstops: As detailed, and as manufactured by Water Seals, Inc., Chicago, Illinois; Progress Unlimited, Inc., New York, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or equal acceptable to the Engineer. Use prefabricated joint fittings at intersections of ribbed-type waterstops.
- D. Other Waterstops: When types of waterstops not listed above are indicated on the Drawings, they are subject to these specifications.
- E. Waterstop Properties: When tested in accordance with specified standards, waterstop material shall meet or exceed the following requirements:

<u>Physical Property, Sheet Material</u>	<u>Value</u>	<u>ASTM Standard</u>
Tensile Strength-min (psi):	1750	D638, Type IV
Ultimate Elongation-min (percent):	350	D638, Type IV
Low Temp Brittleness-max (degrees F):	-35	D746
Stiffness in Flexure-min (psi):	400	D747

Accelerated Extraction (CRD-C572) -

Tensile Strength-min (psi):	1500	D638, Type IV
Ultimate Elongation-min (percent):	300	D638, Type IV

Effect of Alkalies (CRD-C572) -

Change in Weight (percent):	+0.25/-0.10	-----
Change in Durometer, Shore A:	+5	D2240

Finished Waterstop -

Tensile Strength-min (psi):	1400	D638, Type IV
Ultimate Elongation-min (percent):	280	D638, Type IV

2.03 JOINT SEALANT

- A. Material: Polyurethane polymer designed for bonding to concrete which is continuously submerged in water. Use no material with an unsatisfactory history of bond or durability when used in joints of liquid-retaining structures.
- B. Sealant Properties at 73 degrees F, 50 percent relative humidity:
1. Work Life: 45 - 180 minutes
 2. Time to Reach 20 Shore A Hardness
(at 77 degrees F, 200 gr quantity): 24 hours, maximum
 3. Ultimate Hardness (ASTM D 2240): 20 - 45 Shore A
 4. Tensile Strength (ASTM D 412): 200 psi, minimum
 5. Ultimate Elongation (ASTM D 412): 400 percent, minimum
 6. Tear Resistance (Die C ASTM D 624): 75 pounds per inch of thickness, minimum
 7. Color: Light Gray

- C. Polyurethane Sealants for Waterstop Joints in Concrete:
1. Sealant: 2-part polyurethane; when cured, sealant shall meet or exceed ANSI/ASTM C 920 or Federal Specification TT-S-0227 E(3) for 2-part material.
 2. Vertical and overhead horizontal joints: Use only "non-sag" compounds meeting ANSI/ASTM C 920, Class 25, Grade NS, or Federal Specification TT-S-0227 E(3), Type II, Class A.
 3. Plane horizontal joints: Self-leveling compounds meeting ANSI/ASTM C 920, Class 25, Grade P, or Federal Specification TT-S-0227 E(3), Type I. For joints subject to either pedestrian or vehicular traffic, use a compound providing non-tracking characteristics and having a Shore A hardness range of 35 to 45.
 4. Primer: Use only compatible materials manufactured or recommended for the application by the sealant manufacturer, in accordance with the printed instructions and recommendations of the sealant manufacturer.
- D. Acceptable Products: Polymeric Systems Inc. "PSI-270"; Pacific Polymers "Elastothane 227R"; Sika Corporation "Sikaflex 2C", or equal acceptable to the Engineer.
- E. Sealants for non-waterstop joints: Conform to Section 07921 – Caulking and Sealing.

2.04 MISCELLANEOUS MATERIALS

- A. Bearing Pad: ASTM D 2000 neoprene, Grade 2 or 3, Type BC, tensile strength 1450 psi, 60 durometer hardness, unless otherwise indicated.
- B. Neoprene Sponge: ASTM D 1056, Type 2C3-E1 closed-cell expanded neoprene.
- C. Preformed Joint Filler: ASTM D 1752 Type I non-extruding type; neoprene sponge or polyurethane of firm texture, except as otherwise specified. Bituminous fiber type will not be permitted.
- D. Control Joint Former: Continuous plastic insert strips with anchorage ribs located at the bottom and an enlarged upper portion that is readily removable without damage to the concrete, and is sized to form sealant groove. Size to extend to at least 1/4 slab depth.
- E. Backing Rod: Extruded closed-cell polyethylene foam rod, compatible with joint sealant materials used, with a tensile strength not less than 40 psi, and compression deflection approximately 25 percent at 8 psi. Size: 1/8-inch larger in diameter than joint width, except use one-inch diameter rod for 3/4-inch wide joints.
- F. Bond Breaker: "Super Bond Breaker" manufactured by Burke Company, San Mateo, California; "Select Cure CRB", manufactured by Select Products Co., Upland, California, or equal acceptable to the Engineer. Bond breaker shall contain a fugitive dye so areas of application will be readily distinguishable.
- G. Slip Dowels: Smooth epoxy-coated bars conforming to ASTM A 775.
- H. PVC Tubing: ASTM D 2241, Schedule SDR 13.5.