

Standard Specifications Manual

SERIES 300 - STREET SURFACE COURSES
--

Item No.

- 301 Asphalts, Oils, and Emulsions
- 302 Aggregates for Surface Treatments
- 306 Prime Coats
- 307 Tack Coats
- 310 Emulsified Asphalt Treatment
- 311 Emulsified Asphalt Repaving
- 312 Seal Coat
- 313 Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)
- 315 Milling Asphaltic Concrete Pavement and Non-Portland Cement Concrete Bases
- 316 Polymerized Asphalt Interlayer Seal
- 320 Two Course Surface Treatment
- 340 Hot Mix Asphaltic Concrete Pavement
- 341 Paving Fabric
- 350 Heating, Scarifying and Repaving
- 351 Recycling Agent
- 360 Concrete pavement

**ITEM NO. 301
ASPHALTS, OILS, AND EMULSIONS**

301.1 Description

This item includes the requirements for cutback asphalts, emulsified asphalts, polymer modified asphalt cements, performance graded asphalt binders and other miscellaneous asphaltic materials and latex additives.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text the inch-pound units are given preference followed by SI units shown within parentheses.

301.2 Submittals

Submittals shall include test results for each of the materials described herein when specifically identified on the drawings and/or referenced in associated standard specification items and standard details.

Submittals may include samples of the base asphalt cement and polymer additives.

301.3 Materials

When tested in accordance with designated TxDOT, AASHTO and/or ASTM test methods, the various materials shall meet the applicable requirements of this specification.

A. Acronyms

The acronyms used in this specification are defined in the following table.

Table 1: Acronyms

Acronym	Definition	Acronym	Definition
Test Method Prefix Tex T D	TxDOT AASHTO ASTM	Polymer Modifier SBR or L SBS TR P	Styrene-Butadiene Rubber (Latex) Styrene-Butadiene-Styrene Block Copolymer Tire Rubber, from ambient temperature grinding of truck and passenger tires Polymer Modified
AC	Asphalt Cement	SS	Slow Setting
RC	Rapid Curing	H-suffix	Harder Residue (Lower Penetration)
MC	Medium Curing	AE	Asphalt Emulsion
SCM	Special Cutback Material	S-suffix	Stockpile Usage
HF	High Float	AE-P	Asphalt Emulsion Prime
C	Cationic	EAP&T	Emulsified Asphalt Prime and Tack
RS	Rapid Setting	PCE	Prime, Cure, and Erosion Control
MS	Medium Setting	PG	Performance Grade

B. Asphalt Cement

The material shall be homogeneous, free from water, shall not foam when heated to 350°F (177°C) and shall meet the requirements in Table 2.

Table 2: Asphalt Cement Requirements

Viscosity Grade		AC-10		AC-20		AC-30	
Property	Test Method	Min	Max	Min	Max	Min	Max
Viscosity: 140°F, poises (60°C, pascals)	T 202	800 (80)	1200 (120)	1600 (160)	2400 (240)	2400 (240)	3600 (360)
Viscosity: 275°F, stokes (135°C, pascals)	T 202	1.9 (.19)	-	2.5 (.25)	-	3.0 (.30)	-
Penetration: 77°F (25°C), 100g, 5s	T 49	85	-	55	-	45	-
Flash Point, C.O.C. °F (°C)	T 48	450 (232)	-	450 (232)	-	450 (232)	-
% Solubility trichloroethylene	T 44	99.0	-	99.0	-	99.0	-
Spot test	Tex 509-C						
Viscosity: 140°F stokes (60°C pascals)	T 202	-	3000 (300)	-	6000 (600)	-	9000 (900)
Ductility 77°F (25°C), 5 cm/min, cm	T 202	100	-	70	-	50	-

C. Polymer Modified Asphalt Cement

Polymer modified asphalt cement must be smooth, homogeneous, and shall comply with the requirements listed in Table 3.

Table 3: Polymer Modified Asphalt Cement Requirements

Polymer Modified Viscosity Grade		AC-5		AC-10		AC-15P		AC-45P*	
Polymer Type		SBR		SBR		SBS		SBS	
Property	Test Method	Min	Max	Min	Max	Min	Max	Min	Max
Polymer in % (solids basis)	Tex-533-C	2.0	-	2.0	-	3.0	-	3.0	-
Viscosity									
140°F, poise (60°C, pascals)	T 202	700 (70)	-	1300 (130)	-	1500 (150)	-	4500 (450)	-
275°F, poise (135°C, pascals)	T 202	-	7.0 (0.7)	-	8.0 (0.8)	-	8.0 (0.8)	14.0 (1.4)	
Penetration, 77°F (25°C), 100 g, 5 s.	T 49	120	-	80	-	100	150	50	74
Ductility, 5cm/min., 39.2°F, cm	T 51	70	-	60	-	-	-	15	-
Elastic Recovery, 50°F (10°C), %	Tex-539-C	-	-	-	-	55	-		-
Polymer Separation, 48 hrs**.	Tex-540-C	None		None		None		None	
Flash Point, C.O.C., °F (°C),	T 48	425 (218)	-	425 (218)	-	425 (218)	-	425 (218)	-
Tests on Residue from Thin Film Oven Test: (T179)									
Retained Penetration Ratio, 77°F (25°C), % original	T 49	-	-	-	-	0.60	1.00	0.60	0.90

* The SBS block copolymer may be pre-blended with a polymer processing oil (up to a 1:1 ratio of polymer to oil) to aid the solution of the polymer in the asphalt.

** A 350-gram (0.77 pound) sample of the asphalt-SBS blend is stored for 48 hours at 325°F (163°C). Upon completion of the storage time, the sample is visually examined for separation of the SBS from the asphalt (smoothness and homogeneity). If a question still exists about the separation of the SBS, samples shall be taken from the top and bottom of the sample for Infrared Spectroscopy analysis. A difference of 0.4% or more in the concentration of the SBS between the top and bottom samples shall constitute separation.

D. Cutback Asphalt

Cutback asphalt shall meet the requirements presented in Tables 4 and 5 for the specified type and grade.

Table 4: Rapid Curing Type Cutback Asphalt Requirements

Type-Grade		RC-250		RC-800		RC-3000	
Properties	Test Method	Min	Max	Min	Max	Min	Max
Water, percent	T55	-	0.2	-	0.2	-	0.2
Flash Point, T.O.C., °F (°C)	T79	80 (27)	-	80 (27)	-	80 (27)	-
Kinematic viscosity @ 140°F, cst (60°C, mm ² /s)	T201	250	400	800	1600	3000	6000
Distillation Test: T78							
Distillate, % by volume of total distillate to 680°F (360°C):							
to 437°F (225°C):		40	75	35	70	20	55
to 500°F (260°C):		65	90	55	85	45	75
to 600°F (316°C):		85	-	80	-	70	-
Residue from Distillation, Volume %		70	-	75	-	82	-
Tests of Distillation Residue:							
Penetration, 100g, 5 sec., 77°F (25°C), cm	T49	80	120	80	120	80	120
Ductility, 5 cm/min., 77°F, 5 cm/min., cm (25°C, 50 mm/min., mm)	T51	100 1000	- -	100 1000	- -	100 1000	- -
Solubility in trichloroethylene, %	T44	99.0	-	99.0	-	99.0	-
Spot Test	Tex 509-C	ALL NEGATIVE					

Table 5: Medium Curing Type Cutback Asphalt Requirements

Type		MC-30		MC-70		MC-250		MC-800		MC-3000	
Properties	Test Method	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Water, %	T55	-	0.2	-	0.2	-	0.2	-	0.2	-	0.2
Flash Point, T.O.C., °F (°C)	T79	100 (38)	-	100 (38)	-	150 (65)	-	150 (65)	-	150 (65)	-
Kinematic viscosity, @ 140°F. cst (60°C, mm ² /s)	T201	30	60	70	140	250	500	800	1600	3000	6000
Distillation Test: T78											
Distillate, as % by volume to total distillate to 680°F(360°C):, shall be as follows:											
to 437°F (225°C):		-	25	-	20	-	10	-	-	-	-
to 500°F (260°C):		40	70	20	60	15	55	-	35	-	15
to 600°F (316°C):		75	93	65	90	60	87	45	80	15	75
Residue from 80°F (225°C) distillation											
Volume Percent		50	-	55	-	67	-	75	-	80	-
Tests on Distillation Residue:											
Penetration @ 77°F (25°C), 100g, s, 01mm:	T49	120	250	120	250	120	250	120	250	120	250
Ductility @ 77°F, 5 cm/min, cms (25°C, 50 mm/min., mm)	T51	100* 1000*	-	100* 1000*	-	100* 1000*	-	100* 1000*	-	100* 1000*	-
% Solubility in trichloroethylene	T44	99.0	-	99.0	-	99.0	-	99.0	-	99.0	-
Spot Test	Tex 509-C	ALL NEGATIVE									

* If penetration of residue is more than 200 and the ductility at 77°F (25°C) is less than 100 cm (1000 mm), the material will be acceptable if its ductility at 60°F (16°C) is more than 100cm (1000 mm).

E. Emulsified Asphalt

The material shall be homogenous. It shall show no separation of asphalt after thorough mixing and shall meet the requirements for the specified type and grade presented in Tables 6, 7 and 8.

Table 6: Anionic Emulsion Requirements

	Type	Medium Setting		Slow Setting			
	Grade	MS-2		SS-1		SS-1h	
Property	Test Method	Min	Max	Min	Max	Min	Max
Furol Viscosity @ 77°F (25°C), sec.	T72	-	-	20	100	30	100
@ 122°F(50°C), sec		100	300	-	-	-	-
Sieve Test, %.	T59	-	0.1	-	0.1	-	0.1
Miscibility (Standard Test)	T59	-	-	Passing		Passing	
Cement Mixing, %	T59	-	-	-	2.0	-	2.0
% Demulsibility: 35 cc 0.02N CaCl ₂	T59	-	30	-	-	-	-
Storage Stability 1 day, %	T59	-	1	-	1	-	1
Freezing Test, 3 Cycles*	T59	Passing		Passing		Passing	
Distillation Test	T59						
Distillation Residue, %		65	-	60	-	60	-
Distillate Oil Portion, %		-	½	-	½	-	½
Tests of Residue from Distillation:							
Penetration @ 77°F (25°C), 100g, 5s	T49	120	160	120	160	70	100
Solubility in Trichloroethylene, %	T44	97.5	-	97.5	-	97.5	-
Ductility @ 77F, 5 cm/min., cm	T51	100	-	100	-	80	-
(@ 25°C, 50 mm/min., mm)		1000	-	1000	-	800	-

* Applies only when Engineer or designated representative specifies the material for winter use.

Table 7: High Float anionic Emulsion Requirements

Property	Type Grade	Rapid Setting		Medium Setting	
		HFRS-2		AES-300	
Property	Test Method	Min	Max	Min	Max
Viscosity, Saybolt Furol	T72				
@ 77°F (25°C), sec.		-	-	75	400
@ 122°F (50°C), sec.		150	400	-	-
Oil Portion of Distillate, %	T59	-	2	-	7
Sieve Test, %	T59	-	0.1	-	0.1
Particle Charge	T59	positive		positive	
Coating Ability and Water Resistance:	T59				
Coating, dry aggregate		-	-	good	
Coating, after spraying		-	-	fair	
Coating, wet aggregate				fair	
Coating, after spraying				fair	
% Demulsibility: 35 ml 0.02 N CaCl ₂	T59	50	-	-	-
Storage Stability Test, 1 day, %	T59	-	1	-	1
Distillation Test	T59				
Residue by Distillation, % by weight		65	-	65	-
Oil Distillate, by volume of emulsion, %		-	1/2	-	5
Tests on Residue from Distillation:					
Penetration at 77°F (25°C), 100 g, 5s	T49	100	140	300	-
Solubility in Trichloroethylene, %	T44	97.5	-	97.5	-
Ductility @ 77°F., 5 cm/min, cms (25°C., 50 mm/min, mm)	T51	100 (1000)	-	-	-
Float Test at 140°F (60°C), sec.	Tex 509-C	1200	-	1200	-

Table 8: Cationic Emulsion Requirements

Property	Test Method	Type		Rapid Setting				Medium Setting				Slow Setting			
		Grade		CRS-2		CRS-2h		CMS-2		CMS-2s		CSS-1		CSS-1h	
		Min	Max	Min	Max	Min.	Max	Min	Max	Min	Max	Min	Max		
Viscosity, Saybolt Furol	T72														
@ 77°F (25°C), sec.		-	-	-	-	-	-	-	-	20	100	20	100		
@ 122°F (50°C), sec.		150	400	150	400	100	300	100	300	-	-	-	-		
Storage stability test, 1 day %	T59	-	1	-	1	-	1	-	1	-	1	-	1		
% Demulsibility: *,**	T59	40	-	40	-	-	-	-	-	-	-	-	-		
Coating, ability & water resistance	T59														
Coating, dry aggregate		-	-	-	-	good	fair	good	fair	-	-	-	-		
Coating, after spraying		-	-	-	-	fair	fair	fair	fair	-	-	-	-		
Coating, wet aggregate		-	-	-	-	fair	fair	fair	fair	-	-	-	-		
Coating, after spraying		-	-	-	-	fair	fair	fair	fair	-	-	-	-		
Particle charge test	T59	Positive		Positive		Positive		Positive		Positive		Positive			
Sieve test, %	T59	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10		
Cement Mixing test, %	T59	-	-	-	-	-	-	-	-	-	2.0	-	2.0		
Distillation Test:	T59														
% Oil distillate, vol. of emulsion		-	1/2	-	1/2	-	7	-	5	-	1/2	-	1/2		
Residue by Distillation, % by wt.		65	-	65	-	65	-	65	-	60	-	60	-		
Tests on Residue from Distillation:															
Penetration, 77°F (25°C), 100g, 5s	T49	120	160	80	110	120	200	300	-	120	160	80	110		
Ductility, 77°F, 5 cm/min, cm (25°C, 50 mm/min, mm)	T51	100	-	80	-	100	-	-	-	100	-	80	-		
		00	-	800	-	1000	-	-	-	1000	-	800	-		
% Solubility in trichloroethylene	T44	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-		

* At a level of 35 ml 0.8% sodium dioctyl sulfosuccinate.

** The demulsibility test shall be made within 30 days from date of shipment.

F. Polymer Modified Emulsions

The material shall be homogenous. It shall show no separation of asphalt after thorough mixing and shall meet the requirements for the specified type and grade presented in Tables 9 and 10.

G. Specialty Emulsions

Specialty emulsions may be either asphaltic-based or resin-based and must meet the requirements included in Table 11.

H. Recycling Agent

Recycling agent and emulsified recycling agent must meet the requirements of Table 12. Additionally, recycling agent and residue from emulsified recycling agent, when added in the specified proportions to the recycled asphalt, must meet the properties specified on the drawings.

Table 9: Polymer Modified Emulsified Asphalt Requirements

Type-Grade	Test Method	Rapid Setting				Medium Setting						Slow Setting	
		RS-1P		HFRS-2P		AES-150P		AES-300P		AES-300S		SS-1P	
Property	Test Method	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72												
77°F, sec.		-	-	-	-	75	400	75	400	75	400	30	100
122°F, sec.		50	200	150	400	-	-	-	-	-	-	-	-
Sieve Test, %	T 59	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1
Miscibility	T 59	-		-		-		-		-		pass	
Coating Ability and Water Resistance:	T 59												
dry aggregate/after spray		-		-		good/fair		good/fair		good/fair		-	
wet aggregate/after spray		-		-		fair/fair		fair/fair		fair/fair		-	
Demulsibility, 35 ml of 0.02 N CaCl ₂ , %	T 59	60	-	50	-	-	-	-	-	-	-	-	-
Storage Stability, 1 day, %	T 59	-	1	-	1	-	1	-	1	-	1	-	1
Breaking Index, g	Tex-542-C	-	80	-	-	-	-	-	-	-	-	-	-
Distillation Test: ¹	T 59												
Residue by Distillation, % by wt.		65	-	65	-	65	-	65	-	65	-	60	-
Oil Distillate, % by vol of emulsion		-	3	-	0.5	-	3	-	5	-	7	-	0.5
Tests: Residue from Distillation:													
Polymer Content, wt. % (solids basis)	Tex-533-C	-	-	3.0	-	-	-	-	-	-	-	3.0	-
Penetration, 77°F, (25°C) 100 g, 5 sec.	T 49	225	300	90	140	150	300	300	-	300	-	100	140
Solubility in Trichloroethylene, %	T 44	97.0	-	97.0	-	97.0	-	97.0	-	97.0	-	97.0	-
Viscosity, 140°F, poise 60°C, Pa-s	T 202	-	-	1500	-	-	-	-	-	-	-	1300	-
Float Test, 140°F, sec.	T 50	-	-	1200	-	1200	-	1200	-	1200	-	-	-
Ductility ² , 39.2°F, 5 cm/min., cm (4°C, 5 cm/min., mm)	T 51	-	-	50 500	-	-	-	-	-	-	-	50 500	-
Elastic Recovery ² , 50°F,(10°C), %	Tex-539-C	55	-	55	-	-	-	-	-	-	-	-	-
Tests on RTFO Curing of Distillation Residue:	Tex-541-C												
Elastic Recovery, 50°F,(10°F) %	Tex-539-C	-	-	-	-	50	-	50	-	30	-	-	-

¹ Exception to AASHTO T 59: Bring the temperature on the lower thermometer slowly to 350°F +/- 10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 +/- 5 min. from the first application of heat.

² HFRS-2P must meet one of either the Ductility or Elastic Recovery.

Table 10: Polymer Modified Cationic Emulsified Asphalt Requirements

Type-Grade	Test Method	CRS-1P		Rapid Setting CRS-2P		Slow Setting CSS-1P	
		Min	Max	Min	Max	Min	Max
Property	Test Method	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72						
77°F (25°C), sec.		-	-	-	-	20	100
122°F (50°C), sec.		50	150	150	400	-	-
Sieve Test, %	T 59	-	0.1	-	0.1	-	0.1
Demulsibility, 35 ml of 0.8% sodium dioctyl sulfosuccinate, %	T 59	60	-	70	-	-	-
Storage Stability, 1 day, %	T 59	-	1	-	1	-	1
Breaking Index, g	Tex-542-C	-	80	-	-	-	-
Particle Charge	T 59	positive		positive		positive	
Distillation Test: ¹	T 59						
Residue by Distillation, % by wt.		65	-	65	-	62	-
Oil Distillate, % by volume of emulsion		-	3	-	0.5	-	0.5
Tests on Residue from Distillation:							
Polymer Content, wt. % (solids basis)	Tex-533-C	-	-	3.0	-	3.0	-
Penetration, 77°F (25°C), 100 g, 5 sec.	T 49	225	300	90	150	55	90
Viscosity, 140°F, poise (60°C, Pa-s)	T 202	-	-	1300	-	-	-
Solubility in Trichloroethylene, %	T 44	97.0	-	97.0	-	97.0	-
Softening Point, °F	T 53	-	-	-	-	135	-
Ductility, 77°F, 5 cm/min., cm (25°C, 5 cm/min., mm)	T 51	-	-	-	-	70 700	-
Ductility ² , 39.2°F, 5 cm/min., cm (4°C, 5 cm/min., mm)	T 51	-	-	50	-	-	-
Elastic Recovery ² , 50°F (10°C), %	Tex-539-C	45	-	55	-	-	-

¹ Exception to AASHTO T 59: Bring the temperature on the lower thermometer slowly to 350°F +/- 10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 +/- 5 min. from the first application of heat.

² CRS-2P must meet one of either the Ductility or Elastic Recovery.

Table 11: Specialty Emulsion Requirements

Type-Grade	Test Method	Medium Setting				Slow Setting	
		AE-P		EAP&T		PCE ¹	
Property		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72						
77°F (25°C), sec.		-	-	-	-	10	100
122°F (50°C), sec.		15	150	-	-	-	-
Sieve Test, %	T 59	-	0.1	-	0.1	-	0.1
Miscibility ²	T 59	-		pass		pass	
Demulsibility, 35 ml of 0.10 N CaCl ₂ , %	T 59	-	70	-	-	-	-
Storage Stability, 1 day, %	T 59	-	1	-	1	-	-
Particle Size ³ , % by volume < 2.5 m	Tex-238-F	-	-	90	-	-	-
Asphalt Emulsion Distillation to 500°F (260°C) followed by Cutback Asphalt Distillation of Residue to 680°F (360°C):	T 59 & T 78						
Residue after both Distillations, % by wt.		40	-	-	-	-	-
Total Oil Distillate from both distillations, % by volume of emulsion		25	40	-	-	-	-
Distillation:	T 59						
Residue by Distillation, % by wt.		-	-	60	-	-	-
Evaporation: ⁴	T 59						
Residue by Evaporation, % by wt.		-	-	-	-	60	-
Tests on Residue after all Distillation(s):							
Viscosity, 140°F, poise (60°C, Pa-s)	T 202	-	-	800	-	-	-
Kinematic Viscosity, 140°F, cSt (60°C, mm ² /s)	T 201	-	-	-	-	100	350
Flash Point, C.O.C., °F (°C)	T 48	-	-	-	-	400 204	-
Solubility in Trichloroethylene, %	T 44	97.5	-	-	-	-	-
Float Test, 122°F (50°C), sec.	T 50	50	200	-	-	-	-

¹ Supply with each shipment of PCE:

- a) a copy of a lab report from an approved analytical lab, signed by a lab official, indicating the PCE formulation does not meet any characteristics of a Resource Conservation Recovery Act (RCRA) hazardous waste;
- b) a certification from the producer that the formulation supplied does not differ from the one tested and that no listed RCRA hazardous wastes or PCB's have been mixed with the product; and
- c) a Materials Safety Data Sheet.

² Exception to AASHTO T 59: In dilution, use 350 ml of distilled or deionized water and a 1000-ml beaker.

³ Tex-238-F, beginning at "Particle Size Analysis by Laser Diffraction," "Procedure" (using - medium: distilled or deionized water and dispersant: none), or other approved method.

⁴ Exception to AASHTO T 59: Leave sample in the oven until foaming ceases, then cool and weigh.

Table 12: Recycling Agent and Emulsified Recycling Agent Requirements

Property	Test Method	Recycling Agent		Emulsified Recycling Agent	
		Min	Max	Min	Max
Viscosity, Saybolt Furol, 77?, sec.	T 72	-	-	15	100
Sieve Test, %	T 59	-	-	-	0.1
Miscibility ¹	T 59	-		No Coagulation	
Evaporation Test: ²	T 59				
Residue by Evaporation, % by wt.		-	-	60	-
Tests on Recycling Agent or Residue from Evaporation:					
Flash Point, C.O.C., °F	T 48	400	-	400	
Kinematic Viscosity,	T 201				
140°F, cSt		75	200	75	200
275°F, cSt		-	10.0	-	10.0

¹ Exception to AASHTO T 59: Use 0.02 N CaCl₂ solution in place of water.

² Exception to AASHTO T 59: Maintain sample at 300°F until foaming ceases, then cool and weigh.

I. Crack Sealer

This section sets forth the requirements for a polymer modified emulsion suitable for sealing fine cracks, and a rubber asphalt compound suitable for sealing cracks of 1/8 inch (3 mm) or greater width.

1. Polymer Modified Asphalt Emulsion Crack Sealer

For cracks on the order of 1/8 inch (3 mm) width, HFRS-2P polymer modified emulsion as described in the table included in Section F, Polymer Modified Emulsions of this item may be used. Requirements for the polymer modified emulsion and rubber-asphalt crack-sealing compound are presented in Table 13.

Table 13: Polymer Modified Asphalt Emulsion Crack Sealer Requirements

Property	Test Methods	Min	Max
Rotational Viscosity, 77°	ASTM D 2196, Method A	10,000	25,000
Sieve Test, %	T 59	-	0.1
Storage Stability, 1 day, %	T 59	-	1
Evaporation	Tex-543-C		
Residue by Evaporation, % by wt.		65	-
Tests on Residue from Evaporation:			
Penetration, 77°F, 100 g, 5 sec,	T 49	35	75
Softening Point, °F	T 53	140	-
Ductility, 39.2°F, 5 cm/min., cm	T 51	100	-

2. Rubber-Asphalt Crack Sealing Compound

This specification item may be a proprietary product. The compound shall be capable of being melted and applied at a temperature of 400°F (200°C) or less by a suitable oil jacketed kettle equipped with a pressure pump, a hose and a nozzle. It shall contain no water or highly-volatile matter. It shall not be tracked by vehicular traffic once it cools to road pavement temperature.

The rubber-asphalt crack sealing compound shall meet requirements in Table 14.

Table 14: Rubber-Asphalt Crack Sealer Requirements

Property	Test Methods	Class A		Class B	
		Min	Max	Min	Max
CRM Content, Grade A or B, % by wt.	Tex-544-C	22	26	-	-
CRM Content, Grade B, % by wt.	Tex-544-C	-	-	13	17
Virgin Rubber Content ¹ , % by wt.		-	-	2	-
Flash Point ² , COC, °F	T 48	400	-	400	-
Penetration ³ , 77°F, 150g, 5 sec.	T 49	30	50	30	50
Penetration ³ , 32°F, 200g, 60 sec.	T 49	12	-	12	-
Softening Point, °F	T 53	-	-	170	-
Bond ⁴ , 3 cycles, 20°F	Tex-525-C	-		Pass	

1 Provide certification that the min. % virgin-rubber was added.

2 Before passing the test flame over the cup, agitate the sealing compound with a 3/8 to 1/2 in. (9.5 to 12.7 mm) wide, square-end metal spatula in a manner so as to bring the material on the bottom of the cup to the surface, i.e., turn the material over. Start at one side of the thermometer, move around to the other, and then return to the starting point using 8 to 10 rapid circular strokes. Accomplish

agitation in 3 to 4 sec. Pass the test flame over the cup immediately after stirring is completed.

- 3 Exception to AASHTO T 49: Substitute the cone specified in ASTM D 217 for the penetration needle.
- 4 No crack in the crack sealing materials or break in the bond between the sealer and the mortar blocks over 1/4 in. deep for any specimen after completion of the test.
 - a. Properties of Rubber Used in Sealer. The rubber shall be one of the following types;
 - 1) Type I - Ground tire rubber.
 - 2) Type II - A mixture of ground tire rubber and high natural reclaimed scrap rubber. The natural rubber content, determined by ASTM D 297, shall be a minimum of 25 percent.
 - b. Ground Rubber. The ground rubber shall comply with the following gradation requirements when tested by TxDOT Test Method Tex-200-F, Part I.

Table 15: Ground Rubber Gradation Requirements

Sieve Size		Percent Retained	
U.S.	SI	Type I	Type II
No. 8	2.36 mm	0	-
No. 10	2.00 mm	0-5	0
No. 30	600mm	90-100	50-70
No. 50	300mm	95-100	70-95
No. 100	150mm	-	95-100

The ground rubber shall be free from fabric, wire, cord or other contaminating materials.

- c. Packaging. The rubber-asphalt crack sealing compound shall be packaged in boxes, which contain two 30-35 pound (14-16 kilogram) blocks that are individually packaged in a liner made of polyethylene, or other packaging approved by the Engineer or designated representative.
- J. Performance Graded Binders

Performance graded binders must be smooth, homogeneous, show no separation when tested in accordance with Test Method Tex-540-C, and must meet the requirements in the following table.

Separation testing is not required if:

- a modifier is introduced separately at the mix plant either by injection in the asphalt line or mixer, or
- the binder is blended on site in continuously agitated tanks, or
- binder acceptance is based on field samples taken from an in-line sampling port at the hot mix plant after the addition of modifiers.

Table 16: Performance Graded Binder Requirements

Performance Grade	PG 58			PG 64			PG 70			PG 76			PG 82					
	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28
Average 7-day Max Pavement Design Temperature, °C ¹	58			64			70			76			82					
Min Pavement Design Temperature, °C ¹	>-22	>-28	>-34	>-16	>-22	>-28	>-34	>-16	>-22	>-28	>-34	>-16	>-22	>-28	>-34	>-16	>-22	>-28
Flash Point, AASHTO T 48: Min,	ORIGINAL BINDER																	
Viscosity, AASHTO TP 48: ^{2,3} Max. 3.0 Pas, Test Temperature,	230°C																	
Dynamic Shear, AASHTO TP 5: ⁴ G*/sin (δ), Min, 1.00 kPa Test Temperature @ 10 rad/sec., Elastic Recovery, ASTM D 6084, 50°F, % Min	58°C			64°C			70°C			76°C			82°C					
Mass Loss, Max, %	ROLLING THIN FILM OVEN (Tex-541-C) 1.0																	
Dynamic Shear, AASHTO TP 5: G*/sin (δ) in, 2.20 kPa Test Temperature @10 rad/sec.,	58°C			64°C			70°C			76°C			82°C					
PAV Aging Temperature	PRESSURE AGING VESSEL (PAV) RESIDUE (AASHTO PP 1) 100°C																	
Dynamic Shear, AASHTO TP 5: G*/sin (δ) Max, 5000 kPa Test Temperature 10 rad/sec., °C	25	22	19	28	25	22	19	28	25	22	19	28	25	22	19	28	25	22
Creep Stiffness, AASHTO TP 1: ^{5,6} S, Max, 300 mPa, M - value, Min, 0.300 Test Temperature @ 60 sec., °C	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18
Direct Tension, AASHTO TP 3: ⁶ Failure Strain, Min, 1.0% Test Temperature @1.0 mm/min., °C	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18

¹ Pavement temperatures are estimated from air temperatures contained in the PGEXCEL3.xls software program, may be provided by the Department or by following the procedures as outlined in AASHTO MP 2 and PP 28.

- 2 This requirement may be waived at the Department's discretion if the supplier warrants that the asphalt binder can be adequately pumped, mixed and compacted at temperatures that meet all applicable safety, environmental, and constructability requirements. At test temperatures where the binder is a Newtonian fluid, any suitable standard means of viscosity measurement may be used, including capillary (AASHTO T 201 or T 202) or rotational viscometry (AASHTO TP 48).
- 3 Viscosity at 135°C is an indicator of mixing and compaction temperatures that can be expected in the lab and field. High values may indicate high mixing and compaction temperatures. Additionally, significant variation can occur from batch to batch. Contractors should be aware that variation could significantly impact their mixing and compaction operations. Contractors are therefore responsible for addressing any constructability issues that may arise.
- 4 For quality control of unmodified asphalt binder production, measurement of the viscosity of the original asphalt binder may be substituted for dynamic shear measurements of G^*/\sin (at test temperatures where the asphalt is a Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary (AASHTO T 201 or T 202) or rotational viscometry (AASHTO TP 48).
- 5 Silicone beam molds, as described in AASHTO TP 1-93, are acceptable for use.
- 6 If creep stiffness is below 300 mPa, direct tension test is not required. If creep stiffness is between 300 and 600 mPa, the direct tension failure strain requirement can be used instead of the creep stiffness requirement. The m-value requirement must be satisfied in both cases.

301.4 Equipment.

All equipment necessary to transport, store, sample, heat, apply, and incorporate asphalts, oils and emulsions shall be provided.

301.5 Construction

Typical materials used for specific applications are identified in Table 17. These are typical uses only and circumstances may require use of other material.

Table 17: Typical Material Use

Material Application	Typically Used Materials
Hot-Mixed, Hot-Laid Asphalt Mixtures	PG Binders, Modified PG Binders
Surface Treatment	AC-5, AC-10, AC-5 w/2% SBR, AC-10 w/2% SBR, AC-15P, AC-15-5TR, HFRS-2, MS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P,
Surface Treatment (Cool Weather)	RS-1P, CRS-1P, RC-250, RC-800, RC-3000, MC-250, MC-800, MC-3000, MC-2400L
Precoating	AC-5, AC-10, PG 64-22, SS-1, SS-1H, CSS-1, CSS-1H
Tack Coat	RC-250, SS-1, SS-1H, CSS-1, CSS-1H, EAP&T
Fog Seal	SS-1, SS-1H, CSS-1, CSS-1H
Hot-Mixed, Cold-Laid Asphalt Mixtures	AC-0.6, AC-1.5, AC-3, AES-300, AES-300P, CMS-2, CMS-2S
Patching Mix	MC-800, SCM I, SCM II, AES-300S
Recycling	AC-3, AES-150P, AES-300P, Recycling Agent, Emulsified Recycling Agent
Crack Sealing	SS-1P, Polymer Mod AE Crack Sealant, Rubber Asphalt Crack Sealers (Class A, Class B)
Prime	MC-30, AE-P, EAP&T, PCE
Curing Membrane	SS-1, SS-1H, CSS-1, CSS-1H, PCE
Erosion Control	SS-1, SS-1H, CSS-1, CSS-1H, PCE

301.6 Storage, Heating and Application Temperatures

Asphaltic materials should be applied at the temperature, which provides proper and uniform distribution. Within practical limits higher temperatures than necessary to produce the desired results shall be avoided. Satisfactory application usually should be obtained within the recommended ranges shown below.

No material shall be heated above the following maximum temperatures:

Table: 18 Recommended Temperature Ranges

Type-Grade	Recommended Range; °F (°C)		Maximum Temperature; °F (°C) for			
	Application/Mixing		Allowable Application		Storage	
AC-5, 10,20,30	275-350	(135-177)	375	(191)	400	(204)
AC-5 or AC-10 + 2% SBR	300-375	(142-191)	390*	(199)	375	(191)
AC-10 + 3% SBR, AC-45P	300-350	(142-191)	350	(177)	360	(182)
RC-250	125-180	(52-82)	200	(93)	200	(93)
RC-800	170-230	(77-110)	260	(127)	260	(127)
RC-3000	215-275	(102-135)	285	(141)	285	(141)
MC-30, AEP	70-150	(21-66)	175	(79)	175	(79)
MC-70	125-175	(52-79)	200	(93)	200	(93)
MC-250	125-210	(52-99)	240	(116)	240	(116)
MC-800, SCM I, SCM II	175-260	(79-127)	275	(135)	275	(135)
MC-3000 & MC-2400 Latex	225-275	(107-135)	290	(143)	290	(143)
HFRS-2, MS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P, CMS-2, CMS-2S, AES-300, AES-300S, AES-150P, AES-300P	120 - 160		180		180	
SS-1, SS-1h, SS-1P, CSS-1, CSS-1h, PCE, EAP & T, SS-1P, RS-1P, CRS-1P, CSS-1P, recycling agent, emulsified recycling agent, polymer modified AE crack sealant.	50-130	(10-54)	140	(60)	140	(60)
RS-2, RS-2h, MS-2, CRS-2, CRS-2h, CRS-2p, CMS-2, CMS-2S, HFRS-2, HFRS-2p, AES-300	110-160	(43-71)	170	(77)	170	(77)
Special Precoat Material	125-250	(52-121)	275	(135)	275	(135)
PG Binders, Modified PG Binders	275 - 350		350		350	
Rubber Asphalt Crack Sealers (Class A, Class B)	350 - 375		400		-	
Rubber-Asphalt Crack Sealer	350-375	(177-191)	400	(204)	-	

* AC-5 + 2% SBR and AC-10 + AC-10 + 2% SBR, which is designated for surface treatment work, may be heated to a maximum temperature of 390°F (200°C) by the supplier loading through an in-line heater, or with the permission of the Engineer or designated representative, these materials may be heated to maximum of 390°F (200°C) by the Contractor just prior to application. When any of the SBR-modified asphalt cements are used in asphaltic concrete, the storage temperature at the mix plant should not exceed 350°F (177°C).

Attention is called to the fact that asphaltic materials (except emulsions) are very flammable and constitute fire hazards. Proper precautions should be used in all cases, especially with RC cutbacks.

Utmost care shall be taken to prevent open flames from coming in contact with the asphaltic material or the gases of it. The Contractor shall be responsible for any fires or accidents, which may result from heating the asphaltic materials.

301.7 Measurement and Payment

All asphaltic materials included in this specification will be measured and paid for in accordance with the governing specifications for the Items of construction in which these materials are used.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification Item 301 "ASPHALTS, OILS AND EMULSIONS"

American Association of State Highway and Transportation Officials (AASHTO)

<u>Designation</u>	<u>Description</u>
AASHTO T-44	Solubility of Bituminous Materials in Organic Solvents
AASHTO T-48	Flash and Fire Points by Cleveland Open Cup
AASHTO T-49	Penetration of Bituminous Materials
AASHTO T-50	Float Test for Bituminous Materials
AASHTO T-51	Ductility of Bituminous Materials
AASHTO T-53	Distillation of Road Tar
AASHTO T-55	Water in Petroleum Products and Bituminous Materials by Distillation
AASHTO T-59	Testing Emulsified Asphalt
AASHTO T-72	Saybolt Viscosity
AASHTO T-78	Distillation of Cut-Back Asphaltic (Bituminous) Products
AASHTO T-79	Flash Point with Tag Open-Cup Apparatus
AASHTO T-201	Kinematic Viscosity of Asphalts
AASHTO T-202	Viscosity of Asphalts by Vacuum Capillary Viscometer
AASHTO TP-1	Creep Stiffness
AASHTO TP-3	Direct Tension
AASHTO TP-5	Dynamic Shear
AASHTO TP-48	Rotational Viscometry

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-200-F	Sieve Analysis of Fine and Coarse Aggregates
Tex-238-F	Laser Diffraction Particle Size Distribution Analyzer
Tex-509-C	Spot Test of Asphaltic Materials
Tex-525-C	Tests for Asphalt and Concrete Joint Sealers
Tex-533-C	Determination of Polymer Additive Percentages in Polymer Modified Asphalt Cements

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
D 217	Test Methods for Cone Penetration of Lubricating Grease
D 297	Test Methods for Rubber Products-Chemical Analysis
D 2186 Method A	Test Methods for Deposit-Forming Impurities in Steam
D 6084	Test Method for Elastic Recovery of Bituminous Materials by Ductilometer

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification Item 301 "ASPHALTS, OILS AND EMULSIONS"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 206	Asphalt Stabilized Base
Item No. 210	Flexible Base
Item No. 302	Aggregates for Surface Treatments
Item No. 306	Prime Coat
Item No. 307	Tack Coat
Item No. 310	Emulsified Asphalt Treatment
Item No. 311	Emulsified Asphalt Repaving
Item No. 312	Seal Coat
Item No. 313	Rubber Asphalt Joint and Crack Sealant
Item No. 315	Milling Asphaltic Concrete Paving
Item No. 320	Two Course Surface Treatment
Item No. 340	Hot Mix Asphaltic Concrete Pavement
Item No. 341	Paving Fabric
Item No. 350	Heating, Scarifying and Repaving
Item No. 351	Recycling Agent

Texas Department of Transportation: Standard Specifications for Construction And Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item 300	Asphalts, Oils and Emulsions
Item 301	Asphalt Antistripping Agents
Item 310	Prime Coat (Cutback Asphaltic Materials)
Item 314	Emulsified Asphalt Treatment
Item 316	Surface Treatments
Item 345	Asphalt Stabilized Base (Plant Mixed)
Item 354	Planning and/or Texturing Pavement
Item 520	Weighing and Measuring Equipment

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-126-E	Molding, Testing and Evaluation of Bituminous Black Base Materials
Tex-207-F	Determination of Density of Compacted Bituminous Mixtures
Tex-211-F	Recovery of Asphalt from Bituminous Mixtures by Absorption
Tex-215-	Determination of Asphalt Content of Rock Asphalt Process by Hot Solvent Method
Tex-217-F	Determination of Deleterious Material and Decantation Test for Coarse Aggregates
Tex-224-F	Determination of Flakiness

<u>RELATED</u> CROSS REFERENCE MATERIALS - continued

Specification Item 301 "ASPHALTS, OILS AND EMULSIONS"

Texas Department of Transportation: Manual of Testing Procedures – continued

<u>Designation</u>	<u>Description</u>
Tex-400-A	Method of Sampling Stone, Gravel, Sand and Mineral Aggregates
Tex-410-A	Abrasion of Coarse Aggregate Using the Los Angeles Machine
Tex-411-A	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
Tex-438-A	Accelerated Polish Test for Aggregate
Tex-460-A	Determination of Crushed Face Particle
Tex-501-C	Test for Water in Petroleum Products and Other Bituminous Materials
Tex-502-C	Test for Penetration of Bituminous Material
Tex-503-C	Test for Ductility of Bituminous Materials
Tex-504-C	Test for Flash and Fire Points of Petroleum Materials by Cleveland Open Cup

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-505-C	Test for Softening Point of Bituminous Materials by Ring-and-Ball Method
Tex-506-C	Test for Loss on Heating of Oils and Asphaltic Compounds
Tex-507-C	Proportion of Bitumen Soluble in Trichloroethylene
Tex-510-C	Determining the Effect of Heat and Air on Asphaltic Materials when Exposed in Thin Films
Tex-512-C	Test for Flash Points of Volative Flammable Materials by Tag Open Cup Apparatus
Tex-513-C	Test for Saybolt Viscosity
Tex-515-C	Distillation of Cut-Back Asphalt Products
Tex-519-C	Float Test for Bituminous Materials
Tex-520-C	Test for Residue of Specified Penetration
Tex-521-C	Testing Emulsified Asphalts
Tex-528-C	Test for Absolute Viscosity of Asphalt Cements
Tex-529-C	Test for Kinematic Viscosity of Asphalts

ITEM NO. 302

AGGREGATES FOR SURFACE TREATMENTS

302.1 Description

This item shall govern aggregate and precoated aggregate to be used in the construction of surface treatments.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

302.2 Submittals

The submittal requirements of this specification item include:

- A. Aggregate types, gradations and physical characteristics (i.e. flakiness index, % wear, soundness, polish value, etc).
- B. Proposed proportioning of materials.
- C. Aggregate precoat and fluxing material.
- D. Type of mixing plant and associated equipment including chart indicating the calibration of each cold bin.
- E. Aggregate storage/stockpiling plans.

302.3 Materials

A. Aggregates

Aggregates shall be composed of clean, tough and durable particles of gravel, crushed gravel, crushed stone, crushed slag or natural limestone rock asphalt. These materials shall not contain more than 2 percent by weight (mass) of soft particles and other deleterious materials as determined by TXDOT Test Method Tex-217-F, Part I. The natural limestone rock asphalt aggregate furnished shall have an average bitumen content from 4 to 7 percent by weight (mass) of naturally impregnated asphalt, as determined by TXDOT Test Method Tex-215-F and shall contain not more than 2 percent by weight (mass) of any one of or combination of iron pyrites or other objectionable matter, as determined by TXDOT Test Method Tex-217-F, Part I. No aggregate shall contain a total of more than 2 percent by weight (mass) of impurities or objectionable matter listed above.

The aggregate shall be either dark in color or be precoated. If not precoated, it shall be sufficiently washed as to produce a clean, dust free surface.

The aggregate shall not contain more than 1 percent loss from fine dust, clay-like particles and/or silt when tested in accordance with TXDOT Test Method Tex-217-F, Part II. The flakiness index for the aggregate, as determined by TXDOT Test Method Tex-224-F, shall not exceed 17 unless otherwise shown on the Drawings.

The percent of wear, as determined by TXDOT Test Method Tex-410-A (Los Angeles Abrasion Test), for each of the materials shall not exceed 35 percent.

The percent of wear on natural limestone rock asphalt aggregate as determined by TXDOT Test Method Tex-410-A shall be made on that portion of the material retained on the No. 4 (4.75 mm) sieve, having a impregnated asphalt content of less than 1 percent.

Crushed gravel shall have a minimum of 85 percent of the particles retained on the No. 4 (4.75 mm) sieve with two or more mechanically induced crushed faces, as determined by TXDOT Test Method Tex-460-A, Part I.

The aggregate will be subjected to five (5) cycles of magnesium sulfate soundness testing in accordance with Test Method Tex-411-A. The loss shall not exceed 25 percent, unless otherwise shown on the Drawings.

The polish value for the aggregate used in the surface or finish course shall be the value shown on the Drawings, when tested in accordance with TxDOT Test Method Tex-438-A. Unless otherwise shown on the Drawings, a minimum polish-value requirement of 30 will apply only to aggregate used in the travel lanes.

When aggregates requiring polish value are supplied from a source rated for a previous City of Round Rock roadway project or rated by TxDOT Materials and Tests Division, the Rated Source Polish Value (RSPV) for that source will be used to meet this requirement. When aggregates are supplied from a source that is not rated, the aggregate will be sampled and tested prior to use. The procedures will be in accordance with TxDOT Test Methods Tex-400-A and Tex-438-A, Part I. Blending of aggregates to achieve polish value will not be permitted, unless otherwise shown on the Drawings. If blending is allowed, TxDOT Test Method Tex-438-A, Part II, Method B will be used to determine the required blend percentages. However, a minimum of 50 percent by volume of non-polishing aggregate is required.

B. Precoat Material and Fluxing Material

1. The precoat material shall meet requirements for "Precoat Materials" as specified in Standard Specification Item No. 301, "Asphalts, Oils and Emulsions".
2. The fluxing material shall meet the requirements for "Fluxing Material " as specified in Standard Specification Item No. 301, "Asphalts, Oils and Emulsions".
3. Water in an amount not to exceed 3 percent by weight (mass) of the mixture may be used in preparing the mixture. The water shall be added as directed by the Engineer or designated representative during the mixing. In the event water is used in the mixing operation, adequate measuring devices shall be used and the water shall be administered to the mix through an approved spray bar. Potable water from City of Round Rock supplies is preferred, but the Contractor may submit test results of other water sources for approval by the Engineer or designated representative before use.

302.4 Types of Aggregates

The various types of aggregates are identified as follows:

A. Uncoated Aggregate Types.

Type	Description
A	gravel, crushed slag, crushed stone or natural limestone rock asphalt
B	crushed gravel, crushed slag, crushed stone or natural limestone rock asphalt
C	gravel, crushed slag or crushed stone
D	crushed gravel, crushed slag or crushed stone
E	natural limestone rock asphalt
F	Trap Rock

B. Precoated Aggregate.

Precoated aggregate shall be aggregate of the type and grade specified above, coated with 0.5 to 1.5 percent, by mass, of residual bitumen from a precoating material.

Where limestone rock asphalt is used, it shall be fluxed with 0.5 to 1.5 percent by mass of fluxing material.

The grade of aggregate specified shall meet all requirements of sections 302.3 and 302.4 prior to the application of the precoat or fluxing material.

The materials may be mixed on the job or at a central mixing plant and shipped ready for use. Mixes that do not maintain flow qualities such that the precoated aggregate may be satisfactorily spread by approved mechanical spreading devices will not be acceptable.

Materials that are not uniformly and/or properly coated, in the opinion of the Engineer or designated representative, will not be accepted for use.

The various types of precoated aggregates are identified as follows:

Precoated Aggregate Types

Type	Description
PA	gravel, crushed slag, crushed stone or natural limestone rock asphalt
PB	crushed gravel, crushed slag, crushed stone or natural limestone rock asphalt
PC	gravel, crushed slag or crushed stone
PD	crushed gravel, crushed slag or crushed stone
PE	natural limestone rock asphalt

302.5 Grades

When tested by TXDOT Test Method Tex-200-F, Part I, the gradation requirements for the several grades of aggregate shall be as follows:

Sieve Designation		Percent Retained By Weight (Mass) for				
US	SI	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
1 inch	25.0 mm	0				
7/8 inch	22.4 mm	0 - 2	0			
3/4 inch	19.0 mm	20 - 35	0 - 2	0		
5/8 inch	16.0 mm	85 - 100	20 - 40	0 - 2	0	
1/2 inch	12.5 mm		80 - 100	20 - 40	0 - 2	0
3/8 inch	9.5 mm	95 -100	95 -100	80 -100	20 - 35	0 - 5
1/4 inch	6.25 mm			95 -100	95 -100	40 - 85
No. 10	2.00 mm	99 - 100	99 - 100	99 - 100	99 - 100	98 - 100
No. 20	850 mm					99 - 100

When shown on the Drawings, the aggregate of the specified grade(s) shall have from 99.5 to 100 percent by weight (mass) retained on the no. 200 (75 µm) sieve.

302.6 Equipment For Precoating Aggregate

Mixing plants that will not continually meet all the requirements of this specification shall be rejected.

Mixing plants may be either the weigh batching type, the continuous mixing type or the drum mix type. Each type of plant shall be equipped with satisfactory conveyors, power units, aggregate handling equipment, aggregate screens and bins and shall consist of the essential pieces of equipment listed below:

If the Engineer or designated representative approves the use of emulsion as a precoat material, he may also waive the requirement for a dryer, as specified below, if it is demonstrated that a satisfactory coating can be obtained without drying or heating the aggregate.

When using a low grade fuel oil or waste oil the plant shall meet the requirements of article 340.4.(2) of TxDoT Specification Item 340, "Hot Mix Asphaltic Concrete Pavement".

A. Weigh Batching Type

1. Cold Aggregate Bin and Proportioning Device

The cold aggregate bins or aggregate stockpiles shall be of sufficient number and size to supply the amount of aggregate required to keep the plant in continuous operation. The proportioning device shall be such as

will provide a uniform and continuous flow of aggregate to the plant in the desired proportions.

2. Dryer

The dryer shall be of the type that continually agitates the aggregate during heating and in which the temperature can be so controlled that aggregate will not be damaged in the necessary drying and heating operations, which are required to obtain a mixture of the specified temperature.

3. Burner

The burner or combination of burners and type of fuel used shall be such that in the process of heating the aggregate to the desired or specified temperatures, no residue from the fuel shall adhere to the heated aggregate. A recording thermometer shall be provided which will record the temperature of the aggregate when it leaves the dryer. The dryer shall be of sufficient size to keep the plant in continuous operation. The dryer will not be required for precoating natural limestone rock asphalt.

4. Screening and Proportioning

The screening capacity and size of the bins shall be sufficient to screen and store the amount of aggregate required to properly operate the plant and keep the plant in continuous operation at full capacity. Proper provisions shall be made to enable inspection forces to have easy and safe access to the proper location on the mixing plant where accurate representative samples of aggregate may be taken from the bins for testing.

5. Weighing and Measuring Equipment

The weighing and measuring equipment shall be of sufficient capacity and of adequate design for proper batching. The following equipment, conforming to the requirements of the TxDOT Standard Specification, Item No. 520, "Weighing and Measuring Equipment", shall be furnished:

- (a) Aggregate weigh box and batching scales.
- (b) Bucket and scales for precoat material for flux oil.

A pressure type flow meter may be used to measure the precoat material or fluxing material for each batch.

If a pressure type flow meter is used to measure the asphaltic material, the requirements of TxDOT Specification Item 520, "Weighing and Measuring Equipment", shall apply.

Provisions of a permanent nature shall be made for checking the accuracy of the asphaltic material measuring device. The line to the measuring device shall be protected with a jacket of hot oil or other means approved by the Engineer to maintain the temperature of the line near the temperature specified for the precoating material.

6. Mixer

The mixer shall be of the pug mill type and shall have a capacity of not less than 3000 pounds (1350 kilograms) in a single batch. The number of blades and the position of same shall be such as to give a uniform and complete circulation of the batch in the mixer. The mixer shall be equipped with an approved spray bar that will distribute the precoat material or fluxing material quickly and uniformly throughout the mixer. Any mixer that has a tendency to segregate the mineral aggregate or fails to secure a thorough and uniform mixing with the precoat material or fluxing material shall not be used. All mixers shall be provided with an automatic time lock that will lock the discharge doors of the mixer for the required mixing period. The dump door or doors and the shaft seals of the mixer shall be tight enough to prevent the spilling of aggregate or mixture from the pug mill.

B. Continuous Mixing Type

1. Cold Aggregate Bin and Proportioning Device.

Same as for weigh batching type of plant.

2. Dryer.

Same as for weigh batching type of plant.

3. Screening and Proportioning.

Same as for weigh batching type of plant. These requirements shall also apply to materials that are stockpiled and that are proposed for direct use by a continuous mixing plant without the use of plant bins.

4. Aggregate Proportioning Device.

The aggregate proportioning device shall be so designed, that when properly operated, a uniform and continuous flow of aggregate into the mixer will be maintained.

5. Spray Bar for Precoat Material and Fluxing Material.

The spray bar for the precoat material or fluxing material shall be so designed that the material will spray uniformly and continuously into the mixer.

6. Meter for Precoat Material or Fluxing Material.

An accurate recording meter for precoat material or fluxing material shall be placed in the line leading to the spray bar so that the accumulative amount of precoat material or fluxing material being used can be accurately determined. Provisions of a permanent nature shall be made for checking the accuracy of the meter output.

7. Mixer

The mixer shall be of the pug mill continuous type and shall have a capacity of not less than 40 tons (36 megagrams) of mixture per hour.

Any mixer that has a tendency to segregate the aggregate or fails to secure a thorough and uniform mixing of the aggregate with the precoat material or fluxing material shall not be used.

C. Drum Mix Plant

Unless otherwise indicated on the Drawings or if natural limestone rock asphalt is to be used, the Contractor may elect to use the drum-mixing process. The plant shall be adequately designed and constructed for the process of mixing aggregates and precoat material in the dryer-drum without preheating the aggregates. The plant shall be equipped with satisfactory conveyors, power units, aggregate-handling equipment and feed controls and shall consist of the following essential pieces of equipment.

1. Cold Aggregate Bin and Feed System

The number of compartments in the cold aggregate bin shall be equal to or greater than the number of stockpiles of individual materials to be used.

The bin shall be of sufficient size to store the amount of aggregate required to keep the plant in continuous operation and of proper design to prevent overflow of material from one compartment to another. There shall be vertical partitions meeting the requirements of article 340.4. (2) of TxDOT Specification Item 340, "Hot Mix Asphaltic Concrete Pavement". The feed system shall provide a uniform and continuous flow of aggregate in the desired proportion to the dryer. The Contractor shall furnish a chart indicating the calibration of each cold bin in accordance with the manufacturer's recommendations or in a method acceptable to the Engineer or designated representative.

The system shall provide positive weight (mass) measurement of the combined cold aggregate feed by use of belt scales or other approved devices. Provisions of a permanent nature shall be made for checking the accuracy of the measuring device, as required by TxDOT Specification Item 520, "Weighing and Measuring Equipment". When a belt scale is used, mixture production shall be maintained so that the scale normally operates between 50 percent and 100 percent of its rated capacity. Belt scale operation below 50 percent of the rated capacity may be allowed by the Engineer or designated representative if accuracy checks show the scale to meet the requirements of TxDOT Specification Item 520, "Weighing and Measuring Equipment", at the selected rate and it can be satisfactorily demonstrated to the Engineer or designated representative that mixture uniformity and quality have not been adversely affected.

2. Scalping Screen

A scalping screen shall be required, unless otherwise indicated on the Drawings and shall be located ahead of the combined aggregate belt scale.

3. Precoat Material Measuring System

An asphaltic material measuring device meeting the requirements of the TXDOT Item No. 520, "Weighing and Measuring Equipment", shall be placed in the line leading to the drum mixer so that the accumulative amount of precoat material used can be accurately determined. Provisions of a permanent nature shall be made for checking the accuracy of the measuring device output. The measuring device and line to the measuring device shall be protected with a jacket of hot oil or other approved means to maintain the temperature of the line and measuring device near the temperature specified for the precoat material. The measuring system shall include an automatic temperature compensation device to maintain a constant percent by mass of precoating material in the mixture. Unless otherwise indicated, the temperature of the precoat material entering the measuring device shall be maintained at +10°F (+6°C) of the temperature at which the measuring set was calibrated and set.

4. Synchronization Equipment for Feed-Control Systems

The precoat material feed-control shall be coupled with the total aggregate weight (mass) measuring device in such a manner as to automatically vary the precoat material feed rate as required to maintain the required proportion.

5. Drum Mix System

The drum mix system shall be of the type that continually agitates the aggregate and precoat mixture during heating, and in which the temperature can be so controlled that aggregate and asphalt will not be damaged in the necessary drying and heating operations that are required to obtain a mixture at the specified temperature. A continuously-recording thermometer shall be provided which will indicate the temperature of the mixture as it leaves the drum mixer.

6. Surge-Storage System

A surge-storage system will be required. It shall be adequate to minimize the production interruptions during the normal day's operations and shall be constructed to minimize segregation. A device such as a gob hopper or other similar devices approved by the Engineer or designated representative to prevent segregation in the surge-storage bin will be required.

7. Heating Equipment for Precoat Material and Fluxing Material

Heating equipment for precoat material and fluxing material shall be adequate to heat the amount of material required to the desired temperature. The material may be heated by steam coils which shall be absolutely tight. Direct fire heating will be permitted, provided the heater used is manufactured by a reputable concern and there is positive circulation of the liquid throughout the heater. Agitation with steam or air

will not be permitted. The heating apparatus shall be equipped with a recording thermometer with a 24-hour chart that will record the temperature of the precoat material of fluxing material where it is at the point of highest temperature.

302.7 Storage, Proportioning and Mixing

A. Aggregate Storage

If the mineral aggregates are stored or stockpiled, they shall be handled in such a manner as to prevent segregation, mixing of the various materials or sizes and contamination with foreign materials. The grading of aggregates proposed for use and as supplied to the mixing plant shall be uniform. When directed by the Engineer or designated representative, aggregate materials shall not be added to stockpiles that have already been sampled for approval.

When asphalt cement is the precoating material, stockpile height shall be limited to approximately three (3) feet (one meter) immediately after production to limit the build up of heat. These stockpiles may be consolidated after cooling adequately, in the opinion of the Engineer or designated representative.

The use of limestone rock asphalt aggregate containing moisture in excess of the saturated surface-dry condition will not be permitted. Excess moisture will be evidenced by visual surface moisture on the aggregate or any unusual quantities of fines clinging to the aggregate.

B. Storage and Heating of Precoating Material or Fluxing Material

The precoating or fluxing material storage shall be ample to meet the requirements of the plant. The precoating materials shall not be heated in storage to a temperature in excess of 250°F (120°C) or the maximum temperature established in Specification Item 301, "Asphalts, Oils and Emulsions". All equipment used in the storage and handling of precoat material or fluxing material shall be kept in a clean condition at all times and shall be operated in such manner that there will be no contamination with foreign matter.

C. Feeding and Drying of Aggregate

The feeding of various sizes of aggregate, other than natural limestone rock asphalt, to the dryer shall be done through the cold aggregate bin and proportioning device in such a manner that a uniform and constant flow of material in the required proportions will be maintained. The aggregate shall be heated to the temperature necessary to produce a mixture meeting the requirements of Article 302.B.3 and 302.7.

D. Proportioning

The proportioning of the various materials entering into the mixture shall be as directed by the Engineer or designated representative and in accordance with these specifications. Aggregate shall be proportioned by weight (mass) using the weigh box and batching scales herein specified when the weigh-batch type of plant is used and by volume using the aggregate proportioning device when the

continuous mixer type of plant is used. The precoat material or fluxing material shall be proportioned by weight (mass) or by volume based on weight (mass) using the specified equipment.

E. Mixing

1. Batch Type Mixer

In the charging of the weigh box and the charging of the mixer from the weigh box, such methods or devices shall be used as are necessary to secure a uniform mixture. In introducing the batch into the mixer, the mineral aggregate shall be introduced first; shall be mixed thoroughly, as directed, to uniformly distribute the various sizes throughout the batch before the precoat material or fluxing material is added; the precoat material or fluxing material shall then be added and the mixing continued until such time that the aggregate is properly coated. This mixing period may be varied, if in the opinion of the Engineer or designated representative the mixture is not uniform.

2. Continuous Type Mixer and Drum Mixer

The amount of aggregate and precoat material or fluxing material entering the mixer and the rate of travel through the mixer shall be so coordinated that a uniform mixture of the specified grading and percent by weight (mass) of precoat material or fluxing material will be produced.

302.8 Physical Properties of the Mixture

The materials shall be mixed at a central mixing plant and shipped ready for use. Mixes that do not remain workable over a sufficient period of time or do not maintain flow qualities such that the precoated aggregate may be satisfactorily spread by normal approved mechanical spreading devices will not be acceptable. Materials that are not uniformly and/or properly coated or fluxed, in the opinion of the Engineer or designated representative will not be accepted for use.

302.9 Measurement and Payment

Aggregates and precoated aggregates provided in accordance with this specification will be measured and paid for in accordance with the governing specifications for the items of construction in which these materials are used.

No direct payment will be made for this item (subsidiary to other pay items).

End

SPECIFIC CROSS REFERENCE MATERIALS

Specification Item 302 "AGGREGATES FOR SURFACE TREATMENTS"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 301	Asphalts, Oils and Emulsions
Item No. 340	Hot Mix Asphaltic Concrete Pavement

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item 520	Weighing and Measuring Equipment

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-200-F	Sieve Analysis of Fine and Coarse Aggregates
Tex-215-F	Determination of Asphalt Content of Rock Asphalt By Hot Solvent Method
Tex-217-F	Determination of Deleterious Material and Decantation Test For Coarse Aggregates
Tex-224-F	Determination of Flakiness
Tex-400-A	Method of Sampling Stone, Gravel, Sand and Mineral Aggregates
Tex-410-A	Abrasion of Coarse Aggregate Using the Los Angeles Machine
Tex-411-A	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
Tex-438-A	Accelerated Polish Test for Aggregate
Tex-460-A	Determination of Crushed Face Particle

RELATED CROSS REFERENCE MATERIALS

Specification Item 302 "AGGREGATES FOR SURFACE TREATMENTS"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 206	Asphalt Stabilized Base
Item No. 210	Flexible Base
Item No. 306	Prime Coat
Item No. 307	Tack Coat
Item No. 310	Emulsified Asphalt Treatment
Item No. 311	Emulsified Asphalt Repaving
Item No. 320	Two Course Surface Treatment

RELATED CROSS REFERENCE MATERIALS - continued

Specification Item 302 "AGGREGATES FOR SURFACE TREATMENTS"

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item 300	Asphalts, Oils and Emulsions
Item 301	Asphalt Antistripping Agents
Item 310	Prime Coat (Cutback Asphaltic Materials)
Item 314	Emulsified Asphalt Treatment
Item 345	Asphalt Stabilized Base (Plant Mixed)
Item 520	Weighing and Measuring Equipment

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-126-E	Molding, Testing and Evaluation of Bituminous Black Base Materials
Tex-207-F	Determination of Density of Compacted Bituminous Mixtures

**ITEM NO. 306
PRIME COAT**

306.1 Description

This item shall govern the application of asphaltic material on the completed base course and/or other approved areas in accordance with the Drawings, these specifications or as directed by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

306.2 Submittals

The submittal requirements of this specification item include:

- A. List of recommended materials (i.e. prime material, dispersal agent, etc.).
- B. Temperature Viscosity data and proposed temperature of application.
- C. Characteristics (i.e. manufacturer, rate of application, speed, etc.) of the proposed pressure distributor including calibration documentation.
- D. List of facilities and equipment proposed for temperature measurements.
- E. List of facilities and equipment proposed for storage and handling of asphaltic materials.

306.3 Materials

A. Asphalt Materials

The asphalt material for Prime Coat shall meet the requirements of Cutback Asphalt, MC-30, Emulsion, SS-1, Emulsion CSS-1 or AE-P, Standard Specification Item No. 301, "Asphalts, Oils and Emulsions".

B. Water

Water shall be furnished by the Contractor and shall be clean and free from industrial wastes and other objectionable matter.

C. Dispersal Agent

Agent shall be added to water and sprayed on surfaces to be primed in accordance with asphalt manufacturer's recommendations.

306.3 Construction Methods

When, in the opinion of the Engineer or designated representative, the base course or other surface is satisfactory to receive the prime coat, the surface shall be prepared by sweeping or other approved methods as directed by the Engineer or designated representative. The surface shall be lightly sprinkled with water just prior to application of the asphaltic material unless this requirement is waived by the Engineer or designated representative. The Contractor shall submit a list of prime material(s) recommended for application on the work to the Engineer or designated representative

for approval. When emulsions are approved, a dispersal agent shall be added to the water before sprinkling.

The asphaltic material shall be applied on the clean surface by an approved type of self-propelled pressure distributor operated so as to distribute the prime coat at a rate ranging from 0.1 to 0.3 gallons per square yard (0.45 to 1.36 liters per square meter) of surface area. The material shall be evenly and smoothly distributed under pressure sufficient to assure proper distribution. During the application of prime coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutters or structures. The Contractor shall be responsible for cleaning all splattered areas.

Prime Coat may be applied when the temperature of the surface on which the prime coat is to be placed is 60°F (16°C) or above and the air temperature is above 50°F (10°C) and rising; the air temperature being taken in the shade and away from artificial heat. Asphaltic material shall not be placed when general weather conditions, in the opinion of the Engineer or designated representative, are not suitable.

The Contractor shall provide all necessary facilities and equipment for determining the temperature of the asphaltic material in all of the heating equipment and in the distributor, for determining the rate at which it is applied, and for securing uniformity at the junction of two (2) distributor loads.

The distributor shall have been calibrated within three (3) years from the date it is first used on this project. The Engineer or designated representative shall be furnished an accurate and satisfactory record of such calibration. After beginning the work, if the yield on the asphaltic material applied appears in error, the distributor shall be calibrated in a manner satisfactory to the Engineer or designated representative before proceeding with the work.

The Contractor shall be responsible for the maintenance of the surface until the work is accepted by the Engineer or designated representative. No traffic, hauling or placement of any subsequent courses shall be permitted over the freshly applied prime coat for a minimum of 48 hours or until the prime coat is accepted as dry and cured completely by the Engineer or designated representative.

All storage tanks, piping, retorts, booster tanks and distributors used in storing or handling asphaltic material shall be kept clean and in good operating condition at all times and they shall be operated in such a manner that there will be no contamination of the asphaltic material with foreign material. It shall be the responsibility of the Contractor to provide and maintain in good working order a recording thermometer at the storage heating unit at all times.

The Engineer or designated representative will approve the temperature of application based on the temperature-viscosity relationship that will permit application of the asphalt within the limits recommended in Standard Specification Item No. 301, "Asphalts, Oils and Emulsions". The Contractor shall apply the asphalt at a temperature within 15°F (8°C) of the temperature specified in Standard Specification Item No. 301, "Asphalt, Oils and Emulsions".

306.5 Measurement

The prime coat will be considered subsidiary to Standard Specification Item No. 340, "Hot Mix Asphaltic Concrete Pavement" unless included as a separate pay item in the contract. When included for payment, it shall be measured at point of delivery on the project in gallons (liters: 1 liter equals 0.264 gallons) at the applied temperature. The quantity to be paid for shall be the number of gallons used in the accepted prime coat.

306.6 Payment

The work performed and materials furnished as prescribed by this item, when included as a contract pay item, will be paid for at the unit bid price per gallon for "Prime Coat". The price shall include full compensation for cleaning the base course or other surface, for furnishing, heating, hauling and distributing the prime coat specified; for all freight involved and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under:

Prime Coat Per Gallon.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
--

Specification Item 306 "PRIME COAT"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
<u>Item No. 301</u>	Asphalts, Oils and Emulsions
<u>Item No. 340</u>	Hot Mix Asphaltic Concrete Pavement

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification Item 306 "PRIME COAT"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
<u>Item No. 206</u>	Asphalt Stabilized Base
<u>Item No. 210</u>	Flexible Base
<u>Item No. 307</u>	Tack Coat
<u>Item No. 310</u>	Emulsified Asphalt Treatment
<u>Item No. 311</u>	Emulsified Asphalt Repaving
<u>Item No. 320</u>	Two Course Surface Treatments

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item 300	Asphalts, Oils and Emulsions
Item 301	Asphalt Antistripping Agents
Item 310	Prime Coat (Cutback Asphaltic Materials)
Item 314	Emulsified Asphalt Treatment
Item 345	Asphalt Stabilized Base (Plant Mixed)
Item 520	Weighing and Measuring Equipment

**ITEM NO. 307
TACK COAT**

307.1 Description

This item shall govern the application of asphaltic material on completed base courses, existing pavement, bituminous surface, bridge deck, slab or prepared surface as indicated on the Drawings and as directed by the Engineer or designated representative. The application of asphaltic material on completed base courses shall only be applied after the prime coat has completely cured in accordance with Standard Specification Item No. 306, "Prime Coat"

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

307.2 Submittals

The submittal requirements of this specification item include:

- A. List of recommended materials (i.e. tack coat material, sand type, etc.).
- B. Temperature Viscosity data and proposed temperature of application.
- C. Characteristics (i.e. manufacturer, rate of application, speed, etc.) of the proposed pressure distributor including calibration documentation.
- D. List of facilities and equipment proposed for temperature measurements.
- E. List of facilities and equipment proposed for storage and handling of asphaltic materials.

307.3 Materials

A. Asphalt Materials

The asphalt material for "Tack Coat" shall meet the requirements for Cutback Asphalt or Emulsified Asphalt, Standard Specification Item No. 301, "Asphalts, Oils and Emulsions" as listed below. Cutback asphalt shall be made by combining 50 to 70 percent by volume of the asphaltic material as specified for the type of paving mixture with 30 to 50 percent by volume of gasoline and/or kerosene. The type of material shall be selected from the following table:

Temperature of Surface, °F (°C)	40 70°F (5 to 21°C)	Over 70°F (Over 21°C)
	RS-2	SS-1
	RS-2H	
	RC-250	MC-70
	CRS-2	CSS-1
	CRS-2H	CSS-1h

B. Water

Water shall be furnished by the Contractor and shall be clean and free from industrial wastes and other objectionable matter.

C. Sand

Sand may be Grade 1 conforming to Standard Specification Item No. 403, "Concrete Structures" or washed sand, largely siliceous, with the following gradation:

Sieve Designation		Percent Retained by Weight (Mass) Natural Sand
US	SI	
No. 8	2.36 mm	0
No. 16	1.18 mm	0-40
No. 30	600mm	25-65
No. 50	300mm	65-85
No. 100	150mm	85-98
No. 200	75mm	98-100

There shall not be more than 50 percent of the aggregate retained between any 2 sieves listed above and not more than 25 percent of the aggregate retained between the No. 50 (300 mm) and the No. 100 (150 mm) sieves.

307.4 Construction Methods

Tack coat shall be applied when the surface on which the tack coat is to be placed is 60°F (16°C) or above and the air temperature is above 50°F (10°C) and rising, where the air temperature is measured in the shade and away from any artificial heat. Asphaltic material shall not be placed when general weather conditions, in the opinion of the Engineer or designated representative, are not suitable.

Before the tack coat is applied, the surface shall be cleaned thoroughly to the satisfaction of the Engineer or designated representative. The asphaltic material shall be applied on the clean surface by an approved type of self-propelled pressure distributor, so operated as to distribute the tack coat at a rate not to exceed 0.10 gallon per square yard (0.45 liters per square meter) of surface, evenly and smoothly with sufficient pressure to provide proper distribution.

In those instances where the pavement mixture will adhere to the surface on which it is to be placed without the use of a tack coat, the tack coat may be eliminated by the Engineer or designated representative. All contact surfaces of curbs and structures and all joints shall be cleaned thoroughly and painted with a thin uniform coat of the asphaltic material used for tack coat. The tack coat shall be rolled with a pneumatic tire roller to distribute the asphaltic material uniformly over the tacked area. During the application of tack coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutters or structures. The Contractor shall clean splattered areas.

The distributor shall have been calibrated within three (3) years from the date it is first used on this project. The Engineer or designated representative shall be furnished an accurate and satisfactory record of such calibration. After beginning of the work, if the yield on the asphaltic material applied appears in error, the distributor shall be calibrated in a manner satisfactory to the Engineer or designated representative before proceeding with the work.

The Contractor shall provide all necessary facilities and equipment for determining the temperature of the asphaltic material in all of the heating equipment and in the distributor, for determining the rate at which it is applied, and for securing uniformity at the junction of two (2) distributor loads.

The Contractor shall be responsible for the maintenance of the surface until the HMAC is placed over the tack coat or the work is accepted by the Engineer or designated representative. No traffic, hauling or placement of any subsequent courses shall be permitted over the freshly applied tack coat unless it is blotted by the application of sand as directed by the Engineer or designated representative.

All storage tanks, piping, retorts, booster tanks and distributors used in storing or handling asphaltic material shall be kept clean and in good operating condition at all times and they shall be operated in such a manner that there will be no contamination of the asphaltic material with foreign material. It shall be the responsibility of the Contractor to provide and maintain in good working order a recording thermometer at the storage heating unit at all times.

The Contractor shall apply the asphalt at a temperature that will permit application of the asphalt within the limits recommended in Standard Specification Item No 301, "Asphalts, Oils and Emulsions". The application temperature shall be within 15⁰ F (8⁰C) of 160⁰ F (71⁰C).

307.5 Measurement

The asphaltic material for "Tack Coat" will be considered subsidiary to Standard Specification Item 340, "Hot Mix Asphaltic Concrete Pavement" unless included as a separate pay item in the contract. When included for payment, "Tack Coat" shall be measured at point of delivery on the project in gallons (liters: 1 liter equals 0.264 gallons) at the applied temperature. The quantity to be paid for shall be the number of gallons used.

307.6 Payment

The work performed and materials furnished as prescribed by this item, when included as a contract pay item, will be paid for at the unit bid price per gallon for "Tack Coat". The price shall include full compensation for cleaning the area to receive the "Tack Coat"; for furnishing, heating, hauling and distributing the tack coat specified; for all freight involved and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under:

Tack Coat	Per Gallon.
-----------	-------------

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
--

Specification Item 307 "TACK COAT"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
<u>Item No. 301</u>	Asphalts, Oils and Emulsions
<u>Item No. 340</u>	Hot Mix Asphaltic Concrete Pavement

<u>RELATED</u> CROSS REFERENCE MATERIALS

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
<u>Item No. 206</u>	Asphalt Stabilized Base
<u>Item No. 210</u>	Flexible Base
<u>Item No. 306</u>	Prime Coat
<u>Item No. 310</u>	Emulsified Asphalt Treatment
<u>Item No. 311</u>	Emulsified Asphalt Repaving
<u>Item No. 320</u>	Two Course Surface Treatment

Texas Department of Transportation: Standard Specifications for Construction And Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item 300	Asphalts, Oils and Emulsions
Item 301	Asphalt Antistripping Agents
Item 310	Prime Coat (Cutback Asphaltic Materials)
Item 314	Emulsified Asphalt Treatment
Item 345	Asphalt Stabilized Base (Plant Mixed)
Item 520	Weighing and Measuring Equipment

ITEM NO. 310 EMULSIFIED ASPHALT TREATMENT

310.1 Description

This item shall govern one or more applications of a mixture of emulsified asphalt and water to be used as a base or subgrade treatment, earthwork seal for erosion control, prime coat or dust palliative, which is constructed in accordance with the Drawings and these specifications. This mixture may be applied to the base course, subgrade, shoulders or detours at the locations and to the extent indicated on the Drawings or as directed by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

310.2 Submittals

The submittal requirements of this specification item include:

- A. List of recommended materials (i.e. emulsified asphalt, dispersal agent, etc.).
- B. Recommended use, rate of application and percent emulsified asphalt in the mixture.
- C. Characteristics (i.e. manufacturer, rate of application, speed, etc.) of the proposed sprinkler including calibration documentation.

310.3 Materials

The emulsified asphalt used shall meet the requirements of Standard Specification Item No. 301, "Asphalts, Oils and Emulsions". The water used shall be clean and free from industrial wastes and other objectionable matter.

310.4 Construction Methods

The emulsified asphalt mixture shall be applied by a self-propelled sprinkler that is equipped with positive and rapidly working cut-off valves and approved spray bars. The sprinkler shall be capable of maintaining the distribution of the mixture in a uniform and controllable rate of application and shall be operated, so as to uniformly distribute the mixture in the quantity required for the use.

The emulsion may be mixed in the sprinkler tank. The Contractor shall make suitable provisions for agitating the materials sufficiently to produce a uniform blend. The sprinkler tank shall have been calibrated within three (3) years from the date it is first used on this project. The Engineer shall be furnished an accurate and satisfactory record of such calibration. After beginning the work, if the yield of the emulsion applied appears to be in error, the distributor shall be calibrated in a manner satisfactory to the Engineer or designated representative before proceeding with the work.

An approved dispersal agent shall be added to water and sprayed on severely weathered asphalt surfaces to be treated in accordance with asphalt manufacturer's recommendations.

Where indicated on the Drawings, the "Emulsified Asphalt Treatment" shall be mixed with the base or subbase material. The emulsified asphalt and water mixture shall be applied and incorporated in the top portion of subbase or base course layers to the depth and width indicated on the Drawings or as directed by the Engineer or designated representative. Successive applications of a mixture of emulsified asphalt and water shall be completed for the area to be treated, with either a pressure distributor or an approved sprinkler, and the procedure shall be continued until all of the specified amount of emulsified asphalt has been incorporated in the material.

The percentage of emulsified asphalt in the mixture shall be regulated to insure that the specified amount of emulsified asphalt is incorporated in the material while maintaining the proper moisture content.

The treated material shall be mixed by blading, then shaped and compacted, as required by the pertinent specifications for the particular course, to the lines, grades and typical sections indicated on the Drawings. The surface shall be maintained with light applications of emulsified asphalt and water mixture or raw water, as directed by the Engineer or designated representative, during curing of the course.

Temporary pavement markings will be in accordance with Item No. 864, "Abbreviated Pavement Markings".

310.5 Rates of Application

Use	Rate of Application	
	Gallons/Square Yard	Liters/Square Meter
Dust Palliative	0.05 to 0.1	0.25 to 0.45
Base Course	0.35 to 0.5	1.60 to 2.25
Earthwork Seal	0.1 to 0.35	0.45 to 1.60
Prime Coat	See Specification Item No. 306	
Pavement Seal	0.1 to 0.35	0.45 to 1.60

310.6 Measurement

Emulsified asphalt will be measured by the gallon (liters: 1 liter equals 0.264 gallons) of emulsified asphalt used in the emulsified asphalt and water mixture.

310.7 Payment

The work performed and the emulsified asphalt furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid price for "Emulsified Asphalt" of the type specified. The price shall include full compensation for furnishing all required materials, mixing water for application, Dispersal Agent and for all freight involved; for all hauling, mixing and distributing the mixture, as specified; and for all manipulation, labor, tools, equipment, temporary pavement markings and incidentals necessary to complete the work.

Payment will be made under:

Emulsified Asphalt Per Gallon

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
--

Specification Item 310 "EMULSIFIED ASPHALT TREATMENT"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 301	Asphalts, Oils and Emulsions
Item No. 864	Abbreviated Pavement Markings

<u>RELATED</u> CROSS REFERENCE MATERIALS

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 206	Asphalt Stabilized Base
Item No. 210	Flexible Base
Item No. 306	Prime Coat
Item No. 307	Tack Coat
Item No. 310	Emulsified Asphalt Treatment
Item No. 311	Emulsified Asphalt Repaving
Item No. 320	Two Course Surface Treatment
Item No. 340	Hot Mix Asphaltic Concrete Pavement
Item No. 403	Concrete Structures

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item 300	Asphalts, Oils and Emulsions
Item 301	Asphalt Antistripping Agents
Item 310	Prime Coat (Cutback Asphaltic Materials)
Item 314	Emulsified Asphalt Treatment
Item 345	Asphalt Stabilized Base (Plant Mixed)
Item 520	Weighing and Measuring Equipment

ITEM NO. 311
EMULSIFIED ASPHALT REPAVING

311.1 Description

This item shall govern the application of emulsified asphalt, of the type specified, as a binding agent in the recycling mixture of existing asphaltic surfaced streets. When used in the recycling process, the emulsified asphalt increases the asphalt content of the material being reprocessed to a design amount. The emulsified asphalt can be used either independently or in conjunction with an emulsified recycling agent.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

311.2 Submittals

The submittal requirements of this specification item include:

- A. List of recommended materials (i.e. emulsified asphalt, recycling agent, etc.).
- B. Recommended Job Mix Formula, including rate of application and percent of emulsified asphalt in the mixture.

311.3 Materials

- A. When emulsified asphalt is used independently, it shall be SS-1 or CSS emulsion and conform to Item No. 301, "Asphalts, Oils and Emulsions".
- B. When emulsified asphalt is used in conjunction with an emulsified recycling agent, it shall be a cationic emulsion, CSS-1 and conform to Item No. 301, "Asphalts, Oils and Emulsions".

311.4 Construction Methods

Emulsified asphalt shall be added to the recycled asphalt during the heater-scarifier operation. The Job Mixed Formula shall be determined from the tests performed before the project begins. The actual rate of application will be established based on field conditions and conform to Item No. 350, "Heating, Scarifying and Repaving".

311.5 Measurement

Emulsified Asphalt will be measured by the gallon (liter: 1 liter equals 0.264 gallons), complete in place.

311.6 Payment

The work performed and materials furnished as prescribed by this item and measured as provided for under "Measurement" will be paid for at the unit bid price for this item. The price shall include full compensation for the work, materials, tools and other accessories needed to complete the work.

Payment will be made under:

Emulsified Asphalt	Per Gallon.
--------------------	-------------

SPECIFIC CROSS REFERENCE MATERIALS

Specification Item 311 "EMULSIFIED ASPHALT REPAVING"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 301	Asphalts, Oils and Emulsions
Item No. 350	Heating, Scarifying and Repaving

RELATED CROSS REFERENCE MATERIALS

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 206	Asphalt Stabilized Base
Item No. 210	Flexible Base
Item No. 306	Prime Coat
Item No. 307	Tack Coat
Item No. 310	Emulsified Asphalt Treatment
Item No. 320	Two Course Surface Treatment
Item No. 340	Hot Mix Asphaltic Concrete Pavement
Item No. 403	Concrete Structures
Item No. 864	Abbreviated Pavement Markings

Texas Department of Transportation: Standard Specifications for Construction And Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item 300	Asphalts, Oils and Emulsions
Item 301	Asphalt Antistripping Agents
Item 310	Prime Coat (Cutback Asphaltic Materials)
Item 314	Emulsified Asphalt Treatment
Item 345	Asphalt Stabilized Base (Plant Mixed)
Item 520	Weighing and Measuring Equipment

ITEM NO. 312 SEAL COAT

312.1 Description

This item shall govern the construction of a surface treatment composed of a single application of asphalt or latex-asphalt covered with aggregate for the sealing of existing pavements in accordance with the details on the Drawings and this specification item.

312.2 Submittals

The submittal requirements of this specification item include:

- A. Recommended design mix (emulsion type, aggregate type, type and % of polymer)
- B. Test results on the emulsion (Saybolt Furol Viscosity, storage stability, demulsibility, sieve test, distillation test and residue tests).
- C. Test results on the aggregate (gradation and percent wear).
- D. Characteristics (i.e. manufacturer, rate of application, speed, etc.) of the proposed distributor and aggregate spreader.
- E. List of facilities and equipment proposed for temperature measurements.
- F. List of facilities and equipment proposed for storage and handling of asphaltic materials.

312.3 Materials

- A. Asphaltic Materials

Asphaltic material shall conform to Item No. 301, "Asphalts, Oils and Emulsions" as follows:

- 1. Patching

Patching shall be completed with Class D HMAC conforming to Item No. 340, "Hot Mix Asphaltic Concrete".

- 2. Sealing

- a). Cool Weather of 65 to 80°F (18 to 27°C): HFRS-2.
- b). Warm Weather over 81°F (27°C): RS-2.

- B. Aggregate

Aggregate material shall conform to Item No. 302, "Aggregate for Surface Treatments". Unless otherwise specified on the drawings, the aggregate grading shall meet Grade 5.

- C. Aggregate (Stockpiled) (Stockpiled)

Aggregate may be stockpiled only with permission of the Engineer or designated representative at locations designated for stockpiling. The Contractor shall be responsible for all remedial pollution control measures during the clean up of the stockpiling.

D. Latex Additive

The latex shall be an emulsion of styrene-butadiene low-temperature copolymer in water. The emulsion shall have good storage stability and possess the following properties:

Monomer ratio, Butadiene/Styrene	(73 ±5)/(27 ±5)
Minimum solids content, % by weight (mass)	45
Viscosity of emulsion at 77°F ±1°F (25°C ±1°C), Cps, Maximum (No. 3 spindle, 20 rpm, Brookfield RVT Viscometer)	2000

The manufacturer shall furnish the actual styrene-butadiene rubber (SBR) content for each batch of latex emulsion. This information shall accompany all shipments to facilitate proper addition rates.

312.4 Equipment

Equipment will consist of the following: asphalt storage and heaters, distributors, aggregate spreaders, blade equipped tractor and drag broom, pneumatic rollers, water truck with pump and rotary broom.

All storage tanks, piping, retorts, booster tanks and distributors used in storage or handling of asphaltic material shall be kept clean and in good operating condition at all times and they shall be operated in such manner that there will be no contamination of the asphaltic material. The Contractor shall provide and maintain in good working order a recording thermometer to continuously indicate the temperature of the asphaltic material at the storage-heating unit, when storing of asphalt is permitted.

The distributor shall have pneumatic tires of such width and number that the load produced on the street surface shall not exceed 650 pounds per inch (12 kilograms per millimeter) of tire width and shall be so designed, equipped, maintained and operated that asphaltic material at even heat may be applied uniformly on variable widths of surface at readily determined and controlled rates of from 0.05 to 0.4 gallons per square yard (0.25 to 1.8 liters per square meter), with a pressure range of from 25 to 75 pounds per square inch (170 to 515 kilopascals), and with an allowable variation from any specified rate not to exceed 5 percent. Distributor equipment shall include tachometer, pressure gauges, volume measuring devices and a thermometer for reading temperatures of tank contents.

The aggregate spreading equipment shall be adjusted and capable of spreading aggregate at controlled amounts per square yard (square meter: 1 square meter equals 1.196 square yards) in a continuous manner.

The drag broom shall be lightweight street type, mounted on a frame, designed to spread aggregate uniformly over the surface of a bituminous pavement and equipped with pull plates for towing. Towing equipment shall be pneumatic tired.

Rollers shall conform to Item No. 232, "Rolling (Pneumatic Tire)", Light Pneumatic Tire Roller.

Rotary brooms shall be suitable for cleaning the surfaces of bituminous pavements.

Vacuum sweepers shall be suitable for removing any loose aggregate without disturbing the compacted seal coat.

312.5 Construction Methods

Prior to commencement of this work, all erosion control, environmental protection measures and all traffic control devices shall be in place.

Seal coats may be applied when the surface on which the seal coat is to be placed is 60°F (16°C) or above and the air temperature is above 50°F (10°C) and rising, where the air temperature is measured in the shade and away from artificial heat. Asphaltic material shall not be placed when general weather conditions are not suitable for a satisfactory seal coat or when the environment could be damaged.

A. Cracks and Holes

Cracks and holes will be patched by the Contractor prior to seal coat operations. Patching materials shall be hot mix, hot laid asphaltic concrete in conformance with Standard Specification Item No. 340, "Hot Mix Asphaltic Concrete Pavement" or other asphaltic materials as approved by the Engineer or designated representative.

B. Cleaning Existing Surfaces

Prior to placement of the seal coat, loose dirt and other objectionable material shall be removed from the existing surface. The surface will be cleaned with a rotary broom. Hand brooms will be used in areas not accessible to rotary brooms. The Engineer or designated representative must approve all streets before application of any asphalt.

C. Mixing Asphalt

When the air temperature is 80°F (27°C) or higher, latex shall be added to the asphalt at the rate of 1 1/2 to 2 percent by weight (mass) [solid bases]. The actual rate shall be in accordance with the drawings and/or as approved by the Engineer or designated representative. The asphalt shall be heated to 150°F (65°C) before adding the latex. The mixture shall be thoroughly mixed before application.

The finished latex-asphalt shall meet the following requirements:

Viscosity at 140 F, stokes (60°C, Pa-s)	1500 (150) maximum
Ductility at 39.2 F, 1 cm per min, cm (4°C, 1 mm/min, mm)	100 minimum

D. Application of Asphaltic Material

Immediately following the preparation of the existing surface by cleaning, the asphaltic material shall be applied at the rate of 0.25 to 0.30 gallon per square yard (0.9 to 1.1 liters per square meter) as determined by the Engineer or designated representative, so that uniform distribution is obtained at all points. Skip streaks on the pavement, due to defective distributor nozzles, will be reshot with a distributor at the expense of the Contractor.

The Contractor shall calibrate the spray bar nozzles by spreading building paper as required on the surface for a sufficient distance back from the end of each application so that flow through sprays may be started and stopped on the paper and so that all sprays will operate properly over the entire length being treated. Building paper so used shall be immediately removed and loaded on a truck. At the end of each day, the paper shall be disposed of at a permitted site approved by the Engineer or designated representative.

Application temperatures will be determined by weather conditions but the temperature of the asphaltic material to be applied shall be between 150 and 160°F (65 and 71°C) as determined by the Engineer or designated representative. When a street to be sealed is continuous through several intersections, sealed area will include all spandrels and stub-outs, unless otherwise directed by the Engineer or designated representative. Spandrels will be hand sprayed. Contractor shall not apply excessive amounts of asphaltic materials when hand spraying. Excessive materials applied shall be removed by the Contractor before spreading the aggregate.

The Contractor shall be required to seal all spandrels at the same time the adjacent streets are sealed, unless otherwise approved in writing by the Engineer.

During all applications, the surface of adjacent structures shall be protected in such a manner as to prevent their being splattered or marred. Building paper shall be spread on all manholes, valve boxes, junction boxes, etc. to protect the surface from asphaltic materials. Surfaces not intended for treatment that are splattered or marred shall be cleaned and restored at the Contractor's expense. The asphaltic material shall not be applied until the cover aggregate is available and ready to spread with assurance of continuous operation. No asphaltic material shall be placed which cannot be covered and rolled during daylight hours.

E. Spreading the Aggregate

The Contractor shall employ a mechanical aggregate spreader, which applies the aggregate uniformly over the surface at the rate of 15 to 20 pounds per square yard (8 to 11 kilograms per square meter). The actual rate shall be as directed by the Engineer or designated representative.

The covering material in the quantity specified shall be spread uniformly over the bituminous material as soon after application as possible. The aggregate shall be spread in the same width of application as for the asphaltic material and spread uniformly with the aggregate spreading equipment.

Trucks spreading aggregate shall be operated backward so that bituminous material will be covered before truck wheels pass over it. The aggregate shall be applied to a thickness that will not produce blanketing or stacking. Any blanketing or stacking shall be removed prior to rolling. Backspotting or

sprinkling cover aggregate shall be done by hand spreading, which will be continued during the operations whenever necessary, as directed by the Engineer or designated representative.

F. Brooming and Rolling

Rolling shall be started as soon as sufficient aggregate is spread to prevent pick-up and continued until no more aggregate can be worked into the surface. The surface shall be blanket rolled. The Contractor shall arrange his work so that all rolling of all cover aggregate applied that day is accomplished with a minimum of four complete coverages with pneumatic rollers prior to sundown.

In lieu of the rolling equipment specified, the Contractor may, upon written permission from the Engineer or designated representative, operate other compacting equipment that will produce equivalent relative compaction in the same period of time as the specified equipment.

Rollers shall be maintained in good repair and operating condition and shall be approved by the Engineer or designated representative.

The Contractor will be responsible for maintaining all streets for 48 hours after each street has been seal coated. Maintenance will consist of brooming, rolling and adding more aggregate as directed by the Engineer or designated representative.

G. Asphaltic Material Contractor's Responsibility

The Contractor shall furnish vendor's certified test report for asphaltic material shipped for the project. The report shall be delivered to the Engineer or designated representative before permission is granted for use of the material. Any change of source shall be reported prior to delivery.

312.6 Traffic Control Facilities

The Contractor shall arrange the seal coat operation in such a manner as to avoid excessive inconvenience to the public in the seal coat area.

The Contractor shall notify all abutting property owners along the street prior to initiation of the seal coat operation.

The Contractor shall have on the project site sufficient barricades, flag-persons and traffic control devices to assure a minimum of inconvenience to traffic around the construction area in conformance with the Texas Manual of Uniform Traffic Control Devices. If the Contractor's arrangements are not satisfactory to the Engineer or designated representative, the seal coat operation will not be allowed to commence.

After the seal coat has been applied, the Contractor shall post appropriate warning signs along these streets as directed by the Engineer or designated representative and maintain such signs for 48 hours.

312.7 Final Cleanup

The Contractor shall vacuum sweep the completed seal coat, curb areas, sidewalks and other surfaces to remove loose aggregate as required during the first week after the traffic is allowed on the street.

312.8 Measurement

All accepted Seal Coat will be measured by one of the following methods:

- A. "Asphaltic Material" will be measured in gallons (liters: 1 liter equals 0.264 gallons) at the applied temperature at the point of application on the street.
- B. "Aggregate" will be measured by the cubic yard (cubic meter: 1 cubic meter equals 1.31 cubic yards) in vehicles as applied on the street.
- C. "Aggregate (Stockpiled)", if required to be furnished, will be measured by the cubic yard (cubic meter: 1 cubic meter equals 1.31 cubic yards) of material in vehicles at the point of stockpiling.
- D. "Complete in Place" will be measured by the square yard (square meter: 1 square meter equals 1.196 square yards) of surface area treated.

312.9 Payment

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid prices stipulated in the bid for "Seal Coat, Asphaltic Material", "Seal Coat, Aggregate", "Seal Coat, Aggregate (Stockpiled)" or "Seal Coat, Complete in Place". The unit bid prices shall each include full compensation for: a) furnishing, delivering and placing all materials; b) patching, brooming, compacting and rolling; c) cleaning the existing surface, covering excess asphaltic material, removing excess aggregate and cleaning gutters and cleaning stockpiles sites; d) a 48 hour maintenance period and e) all labor, equipment, tools and incidentals necessary to complete the work required as indicated on the drawings.

Payment will be made under one of the following:

Seal Coat, Asphaltic Material	Per Gallon.
Seal Coat, Aggregate	Per Cubic Yard.
Seal Coat, Aggregate (Stockpiled)	Per Cubic Yard.
Seal Coat, Complete in Place	Per Square Yard.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
--

Specification Item No. 312, "SEAL COAT"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 232	Rolling (Pneumatic Tire)
Item No. 301	Asphalts, Oils and Emulsions
Item No. 302	Aggregates for Surface Treatments
Item No. 340	Hot Mix Asphaltic Concrete Pavement

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS - continued
--

Specification Item No. 312, "SEAL COAT"

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-200-F	Sieve Analysis of Fine and Coarse Aggregates
Tex-410-A	Abrasion of Coarse Aggregate Using the Los Angeles Machine
Tex-502-C	Test for Penetration of Bituminous Material
Tex-503-C	Test for Ductility of Bituminous Materials
Tex-504-C	Test for Flash and Fire Points of Petroleum Materials by Cleveland Open Cup
Tex-506-C	Test for Loss on Heating of Oils and Asphaltic Compounds
Tex-507-C	Proportion of Bitumen Soluble in Trichloro-ethylene
Tex-513-C	Test for Saybolt Viscosity
Tex-519-C	Float Test for Bituminous Materials
Tex-520-C	Test for Residue of Specified Penetration
Tex-521-C	Testing Emulsified Asphalts
Tex-528-C	Test for Absolute Viscosity of Asphalt Cements
Tex-529-C	Test for Kinematic Viscosity of Asphalts

RELATED CROSS REFERENCE MATERIALS

Specification Item No. 312, "SEAL COAT"

City of Round Rock Standard Specifications

Designation Description

Item No. 310	Emulsified Asphalt Treatment
Item No. 313	Rubber Asphalt Joint and Crack Sealant
Item No. 315	Milling Asphaltic Concrete Paving and Non Portland Cement Concrete Bases
Item No. 316	Polymerized Asphalt Interlayer Seal
Item No. 320	Two Course Surface Treatment
Item No. 350	Heating, Scarifying and Repaving
Item No. 801	Construction Detours
Item No. 803	Barricades, Signs and Traffic Handling
Item No. 870	Work Zone Pavement Markings
Item No. 874	Eliminating Existing Pavement Markings and Markers

RELATED CROSS REFERENCE MATERIALS - continued

Specification Item No. 312, "SEAL COAT"

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 300	Asphalts, Oils and Emulsions
Item No. 302	Aggregates for Surface Treatments
Item No. 314	Emulsified Asphalt Treatment
Item No. 315	Emulsified Asphalt Seal
Item No. 316	Surface Treatments
Item No. 345	Asphalt Stabilized Base (Plant Mixed)
Item No. 520	Weighing and Measuring Equipment

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-509-C	Spot Test of Asphaltic Materials
Tex-510-C	Determining the Effect of Heat and Air on Asphaltic Materials when Exposed in Thin Films
Tex-512-C	Test for Flash Points of Volative Flammable Materials by Tag Open-Cup Apparatus

**ITEM NO. 313
CLEANING AND/OR SEALING
JOINTS AND CRACKS (ASPHALTIC CONCRETE)**

313.1 Description

This item shall govern the cleaning and/or sealing of joints and cracks that are 1/16 inch (1.5 mm) or greater in asphaltic concrete pavement in conformity to the lines, grades and details indicated on the Drawings or as established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

313.2 Submittals

The submittal requirements of this specification item include:

- A. Sealant Type (Polymer Modified Emulsion, Rubber-Asphalt or Self-Leveling Low Silicone) and method of application (crack sealing, joint sealing, squeegee, etc),
- B. Manufacturer certification that the product to be supplied meets or exceeds the specification requirements,
- C. Manufacturer recommended procedures for preparation, dispensing, application, curing etc of the sealant, and
- D. Listing of the equipment proposed for the Work.

313.3 Materials

Joints and/or cracks shall be sealed with the materials indicated on the Drawings. The materials shall meet the requirements shown below:

Material	Specification	Recommended Use
Polymer Modified Emulsion	301; Subarticle 301.3.1.1	Fine Cracks 1/16 to 1/8 in (1.5 to 3 mm)
Rubber-Asphalt Crack Sealing Compound	301; Subarticle 301.3.1.2	Cracks: >1/8 inches (>3.2 mm)
Self-Leveling Low Modulus Silicon	Class 5, TxDot DMS-6310	Joints

Fine aggregate used to cover the crack-sealing compound shall meet with the approval of the Engineer or designated representative.

The sealing compound shall be delivered in the manufacturer's original sealed containers. Each container shall be legibly marked with the name of the manufacturer, the trade name of the sealer, the manufacturer's batch number or lot, the pouring temperature, and the safe heating temperature.

313.4 Equipment

Equipment, tools and machinery necessary for proper prosecution of the Work shall be on the project and shall be approved by the Engineer or designated representative prior to the initiation of the joint and crack cleaning and sealing operations

313.5 Heating and Application Equipment

A. Polymer Emulsified Emulsion

Polymer Emulsified Emulsion may be heated in a conventional asphalt distributor or in an asphalt heater equipped with an agitator to insure that the emulsified asphalt is circulated during the heating process and achieves a uniform temperature rise. Temperature gauges shall be provided at strategic locations to enable the operator to accurately control the temperature of the emulsion to avoid overheating the material. The unit shall be equipped with a gear-driven asphalt pump with adequate pressure to dispense the emulsion in joints and cracks.

B. Rubber-Asphalt Crack Sealing Compound

The sealant shall be heated in a double jacketed heater using a heat transfer oil so that no direct flame comes in contact with the shell of the vessel containing the sealing compound. The heater reservoir shall be equipped with an agitator to insure that the sealing compound is circulated during the heating process to achieve a uniform temperature rise and to maintain the desired temperature. Accurate temperature gauges and positive temperature controls shall be provided to monitor the temperature of the vessel contents and prevent overheating the material. The heater shall be equipped with a gear-driven asphalt pump with adequate pressure to dispense the rubber-asphalt crack sealing compound.

C. Self-Leveling Low Modulus Silicone

The sealant shall be prepared and dispensed using the manufacturer's recommended equipment.

313.6 Joint and Crack Cleaning Equipment

All equipment used in cleaning joints and cracks shall be capable of delivering a sufficient volume of filtered air, free of oil, water or other contaminants, to insure the removal of all loose debris from the joints or cracks to be sealed.

When specified on the Drawings, joints shall be routed. The router shall be of sufficient size to rout the joints to the widths and depths shown on the Drawings.

313.7 Construction Methods

The bonding surface of cracks and joints shall be cleaned of infiltrated material with compressed air or other methods approved by the Engineer or designated representative to a depth at least twice the joint or crack width. When routing of the joints is indicated on the Drawings, the joints shall be routed and blown clean with

filtered compressed air. All material removed from joints and cracks shall be removed from the paved surface of the roadway.

No sealing of any joints or cracks shall be done when the joints or cracks are damp, unless drying of the joints and cracks with compressed air can be demonstrated and meets with the approval of the Engineer or designated representative.

The joint or crack sealing material shall be applied using a pressure nozzle. Polymer modified emulsion and rubber- asphalt crack sealing compound shall penetrate and completely fill each crack and/or joint. All cracks and/or joints filled with these materials shall be squeegeed. The amount of sealing compound used shall be limited so that after the squeegee has been applied, the finished band shall be no more than 1-1/2 inches (38 mm) wide and shall not exceed a depth of 1/8 in. (3.2 mm) above the pavement surface.

Self-leveling low modulus silicone joint sealing compound shall be applied so that it penetrates the joint and fills so that the top of the sealant shall be 1/4 to 3/8 inch (6.4 to 9.5 mm) below the pavement surface.

When directed by the Engineer or designated representative, a light coating of fine aggregate shall be applied to the cracks and joints before opening to traffic to prevent tracking.

When the number of cracks is so great that crack sealing in the manner described previously is impractical, the area shall be squeegee sealed. Areas to be squeegee sealed shall be indicated on the Drawings or established by the Engineer or designated representative. When all cracks in the area have been cleaned, the crack sealing material shall be applied and the excess shall be squeegeed over the area between the cracks. All polymer modified emulsion or hot poured rubber squeegee sealed areas shall be covered immediately after application with a light coating of fine aggregate.

313.8 Measurement

Accepted work performed under this item shall be considered subsidiary to other pay items and will not be measured and paid for unless a separate pay item is provided in the contract documents.

If a pay item is included in the contract documents, acceptable work for "Polymer Modified Emulsion", "Rubber Asphalt Joint and Crack Sealer" or "Self-leveling Low Modulus Silicone" shall be measured by the linear foot (meter: 1 meter equals 3.281 feet) of cracks sealed.

If a pay item is included in the contract documents, acceptable work for "Polymer Modified Emulsion", "Rubber Asphalt Joint and Crack Sealer" or "Self-leveling Low Modulus Silicone" shall be measured by the pound (kilograms: 1 kilogram equals 2.205 pounds) of crack sealer used.

If a pay item is included in the contract documents, acceptable work for Squeegee seal with "Polymer Modified Emulsion" or "Rubber Asphalt Joint and Crack Sealer" shall be measured by the square yard (square meter: 1 square meter equals 1.196 square yards) of surface area sealed. The square yard (square meter) calculations will be based on neat dimensions of the sealed area

313.9 Payment

When included as a pay item in the contract documents, the work performed and materials furnished as provided by this item and measured in accordance with Article 313.8, "Measurement", will be paid for at the appropriate unit bid price bid. The unit bid prices shall include full compensation for cleaning and, if necessary, routing the crack/joint; furnishing, heating, hauling, and placing the crack sealer; all freight involved and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under:

Polymer Modified Emulsion Joint and Crack Sealer	Per Lineal Foot.
Rubber Asphalt Joint and Crack Sealer	Per Lineal Foot.
Self-leveling Low Modulus Silicone joint and Crack Sealer	Per Lineal Foot.
Polymer Modified Emulsion Joint and Crack Sealer	Per Pound of Sealer Used.
Rubber Asphalt Joint and Crack Sealer	Per Pound of Sealer Used.
Self-leveling Low Modulus Silicone joint and Crack Sealer	Per Pound of Sealer Used.
Polymer Modified Emulsion Squeegee Sealing	Per square yard.
Rubber Asphalt Squeegee Sealing	Per square yard.

End

SPECIFIC CROSS REFERENCE MATERIALS

Item No. 313, "CLEANING AND/OR SEALING JOINTS AND CRACKS (ASPHALTIC CONCRETE)"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 301	Asphalts, Oils and Emulsions

Texas Department of Transportation: Departmental Materials Specifications

<u>Designation</u>	<u>Description</u>
DMS 6310	Joint Sealants and Seals

RELATED CROSS REFERENCE MATERIALS

Item No. 313, "CLEANING AND/OR SEALING JOINTS AND CRACKS (ASPHALTIC CONCRETE)"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 413	Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 300	Asphalts, Oils and Emulsions
Item No. 352	Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)
Item No. 433	Joint Sealants and Fillers
Item No. 438	Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)

ITEM NO. 315
MILLING ASPHALTIC CONCRETE PAVEMENT AND
NON-PORTLAND CEMENT CONCRETE BASES

315.1 Description

This item shall govern for the planing or the planing and texturing of existing asphaltic concrete pavement, asphalt stabilized and other non Portland cement Concrete base to depths indicated at the locations shown on the Drawings or as directed by the Engineer or designated representative. The item shall also include removal, and disposal or salvage/stockpiling the milled materials at the locations designated by the Engineer or designated representative.

When shown on the Drawings, the salvaged asphaltic concrete pavement and/or stabilized base, including any accompanying surface treatment, plant mix seal and micro-surfacing, may be allowed or required for use in other construction items of this project

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

315.2 Submittals

The submittal requirements of this specification item include:

- A. Characteristics (i.e. manufacturer, power, stability, speed, etc.) and capabilities (depth of cut, dust control, etc.) of the proposed milling equipment.
- B. Proposed plan for grade reference, control point spacing and support system.
- C. Proposed dust control plans including proposed equipment (type street sweeper, loader, water trucks, sprayers, etc.).

315.3 Equipment

The equipment for removing the pavement surface shall be a power operated planing machine or grinder with a minimum 2 feet (1.8 meter) cutting width. For detail work and cutting widths less than 2 feet (1.8 meter), equipment with less than 2 feet (1.8 meter) cutting width shall be allowed. The equipment shall be self-propelled with sufficient power, traction and stability to maintain accurate depth of cut and slope. The equipment shall be capable of removing in one pass, asphaltic concrete pavement of a thickness of 1 inch and any required thickness less than 1 inch (25 millimeters) in a minimum 3 foot (0.9 meters) width. Machines capable of removing, in one pass, a depth greater than 1 inch (25 millimeters) will be permitted.

The grade reference used by the Contractor may be of any type approved by the Engineer or designated representative. Control points, if required by the Drawings, shall be set at intervals not to exceed 50 feet (15 meters). The Contractor shall set the grade reference from the control points. The grade reference shall have sufficient support so that the maximum deflection shall not exceed two millimeters (1/16 inch) between supports.

The machine shall have a manual system providing for uniformly varying the depth of cut while the machine is in motion, thereby making it possible to cut flush to all inlets, manholes, or other obstructions within the paved area. The speed of the machine shall be variable in order to leave the desired grid pattern as specified in sections 315.4 and 315.5.

The machine shall be equipped with an integral loading and reclaiming means to immediately remove material being cut from the surface of the roadway and discharge the cuttings into a truck, all in one operation. The machine shall be equipped with means to control dust created by the cutting action. Adequate backup equipment (mechanical street sweepers, loaders, water truck, sprayers, brooms etc.) and personnel will also be provided to keep flying dust to a minimum and to insure that all cuttings are removed from the street surface daily. Stockpiling of planed material will not be permitted on the project site.

Various machines may be permitted to make trial runs to demonstrate the capabilities of that machine and to determine the acceptability of that machine to the Engineer or designated representative. Any machine that is incapable, in the opinion of the Engineer or designated representative, of meeting these requirements will not be permitted.

315.4 Construction Methods

A. General. The pavement surface shall be removed for the length, depth and width and to the typical section shown on the Drawings, and to the lines and grades established by the Engineer or designated representative. The planed surface shall provide a satisfactory riding surface free from gouges, continuous longitudinal grooves, ridges, oil film and other imperfections of workmanship and shall have a uniform textured appearance.

When an existing asphaltic concrete pavement overlay is to be removed from an underlying Portland cement concrete pavement, all of the asphaltic concrete pavement shall be removed, leaving a uniform surface of Portland cement concrete, unless otherwise directed by the Engineer or designated representative.

B. Surface Milling. Surface milling shall be taken to a minimum depth of 2 inches (50 mm) or deeper as may be dictated by delamination of asphalt layers during the milling operation, to a depth of 1 inch (25 millimeters) below the lip gutter transitioning to the existing surface in 3 feet (0.9 meter) or as indicated on the Drawings for resurfacing operations. The pavement surface shall be removed to the appropriate milling depths around all castings within the area to be milled. When milling is used for leveling without the addition of asphalt, the milled surface shall be free of ridges deeper than 3/16 inch (5 millimeters).

Pavement, which is adjacent to steep curbs, inlets, manholes or other obstructions and that is not removed by the planing machine, shall be removed by other methods, acceptable to the Engineer or designated representative.

The pavement and curb surfaces shall be swept with a street sweeper or other sweeping equipment approved by the Engineer or designated representative to remove all debris leaving a clean and presentable condition.

- C. Edge Milling. Edge milling at the gutter lip shall be taken to a minimum depth of 1/4 inch (6 mm) less than the overlay thickness and shall transition to the existing surface in a minimum of 6 feet (1.8 meters).
- D. Spot Milling. Milling for spot repairs shall be completed in successive passes to the depth specified. Ramping for spot repairs shall be minimized. "Transition milling required at the beginning and ending of the overlay shall be taken to a minimum depth of the overlay thickness and transition to the existing surface for the length specified in the plans.
- E. Miscellaneous. Unless otherwise specified, the milling material shall remain the property of the Contractor. Temporary stockpiling shall not be permitted on site. Temporary pavement markings shall conform to Item No. 864, "Abbreviated Pavement Markings".

315.5 Surface Texture (Temporary Traffic Only)

In those areas where traffic will temporarily be permitted, the texture produced shall be a grid pattern or any other pattern with discontinuous longitudinal striations that will provide, in the opinion of the Engineer, a satisfactory riding surface.

When the planed pavement will not be overlaid, the minimum texture depth resulting from the number of measurements directed by the Engineer shall not be less than 3/64 inch (1.25 millimeters), unless specified otherwise on the Drawings. When these texture requirements are not met, the Contractor shall cease operations until the Engineer is satisfied that changes in the texturing procedures will produce an acceptable texture.

The Contractor shall take care to prevent damage to armor joints, sealed expansion joints and/or other appurtenances.

The surface of the pavement, after planing, shall have a smooth riding quality and shall be true to the established line, grade and cross section.

315.6 Measurement

Work prescribed by this item will be measured by the square yard (square meter: 1 square meter equals 1.196 square yards) of surface area for actual quantities based on the neat dimensions indicated for surface and transition milling, spot repairs and edge milling to the specified width. Ramping for spot repairs shall not be measured for payment. Surface milling for spot repairs shall be considered subsidiary to the spot milling area measured.

Measurement will be made only one time regardless of the number of passes required by the machine to secure the depth desired.

315.7 Payment

The work performed in accordance with this item and measured as provided under "Measurement", will be paid for at the unit bid price per square yard for "Milling

Asphaltic Concrete Paving and Non-Portland Cement Bases". The price shall include full compensation for removal of all materials to the depth shown; minimizing the dust escaping to the atmosphere; loading, hauling, unloading and satisfactorily storing or disposing of the material; and for all labor, tools, equipment, manipulation, temporary pavement markings and incidentals to complete the work, including mobilization of the milling machine.

No payment will be made for work done by any machine on a trial run to demonstrate its ability to meet this specification unless the work performed is acceptable under this specification.

Payment will be made under the following:

Surface Milling	Per Square Yard.
Profile Milling	Per Square Yard.
Transition Milling	Per Square Yard.
Edge Milling	Per Square Yard.
Spot Milling	Per Square Yard.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification Item 315 "MILLING ASPHALTIC CONCRETE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 642	Silt Fence (SF)
Item No. 864	Abbreviated Pavement Markings

RELATED CROSS REFERENCE MATERIALS

Specification Item 315 "MILLING ASPHALTIC CONCRETE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 206	Asphalt Stabilized Base
Item No. 210	Flexible Base
Item No. 301	Asphalts, Oils and Emulsions
Item No. 306	Prime Coat
Item No. 307	Tack Coat
Item No. 310	Emulsified Asphalt Treatment
Item No. 311	Emulsified Asphalt Repaving
Item No. 312	Seal Coat
Item No. 320	Two Course Surface Treatment
Item No. 340	Hot Mix Asphaltic Concrete Pavement
Item No. 341	Paving Fabric
Item No. 350	Heating, Scarifying and Repaving
Item No. 351	Recycling Agent

Texas Department of Transportation: Standard Specifications for Construction And Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item 300	Asphalts, Oils and Emulsions
Item 301	Asphalt Antistripping Agents
Item 310	Prime Coat (Cutback Asphaltic Materials)
Item 314	Emulsified Asphalt Treatment
Item 345	Asphalt Stabilized Base (Plant Mixed)
Item 354	Planning and/or Texturing Pavement

**ITEM NO. 316
POLYMERIZED ASPHALT INTERLAYER SEAL**

316.1 Description

This item shall govern the sealing of an existing pavement surface with a single application of polymerized asphalt covered with aggregate prior to the construction of asphalt overlays.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses

316.2 Submittals

The submittal requirements of this specification item include:

- A. Recommended design mix (emulsion type, aggregate type, type and % of polymer)
- B. Test results on the emulsion (Saybolt Furol Viscosity, storage stability, demulsibility, sieve test, distillation test and residue tests).
- C. Test results on the aggregate (gradation and percent wear).
- D. Characteristics (i.e. manufacturer, rate of application, speed, etc.) of the proposed distributor and aggregate spreader.
- E. List of facilities and equipment proposed for temperature measurements.
- F. List of facilities and equipment proposed for storage and handling of asphaltic materials.

316.3 Material

- A. Polymerized Asphalt Emulsion

The asphalt must be mixed with 3% of HFRS-2P polymer or as determined by the Engineer or designated representative prior to emulsification. The emulsion is classified as a high float, rapid setting, anionic type emulsion for underseal coat. The product shall meet the following characteristics and test requirements.

- 1. Tests on emulsion:

	Minimum	Maximum
Viscosity, Saybolt Furol at 122°F (50°C), sec	150	400
Storage stability, 1 day, %	-	1
Demulsibility, 35 ml of 0.02 N CaCl ₂ , %	40	-
Sieve Test, %	-	0.1
** Distillation Test:		
Oil Distillate by Volume of Emulsion, %	-	1/2
Residue, % by weight (mass)	65	-

** The temperature on the lower thermometer shall be brought slowly to 350°F (177°C) plus or minus 10°F (5°C) and maintained at this temperature for 20 minutes. The total distillation shall be completed in 60 minutes plus or minus 5 minutes from the first application of heat.

The material after setting undisturbed for 24 hours shall show no white milky separation, but shall be smooth and homogeneous throughout.

2. Test Results on Residue from Distillation

Tests on Residue from Distillation	Minimum	Maximum
Float Value at 140°F (60°C), sec	1200	-
Penetration at 77°F (25°C), 100g., 5 sec., 0.1 mm	100	140
Ductility, 77°F, 5 cm/min, cm (25°C, 50 mm/min, mm)	100 (1000)	-
Viscosity at 140°F, poises (60°C, Pa-s)	1500 (150)	-
Solubility in Trichloroethylene, %	97.5	-

B. Aggregate

Aggregate material shall be crushed limestone or dolomite. The percent of wear as determined by test method Tex-410-A (Los Angeles Abrasion Test) shall not exceed (35) percent. The aggregate, when tested by TxDoT Test Method Tex-200-F, Part I, shall meet the following gradation requirements:

Sieve Sizes	% by Weight (mass)
Retained on 1/2" (12.5 mm) sieve	0
Retained on 3/8" (9.5 mm) sieve	0 - 5
Retained on No. 4 (4.75 mm) sieve	15 - 45
Retained on No. 10 (2.00 mm) sieve	90 - 100
Retained on No. 20 (.00 mm) sieve	95 - 100

316.4 Equipment

The equipment for construction of the interlayer seal shall include the following: asphalt storage tanks and heaters, distributors, aggregate spreaders, blade equipped tractor and drag broom, pneumatic rollers, water truck with pump and rotary broom.

All equipment used in storing or handling asphaltic material shall be kept clean and in good operating condition at all times and shall be operated in such manner that there will be no contamination of the asphalt material. It shall be the responsibility of the Contractor to provide and maintain a recording thermometer to continuously indicate the temperature of the asphalt material at the storage-heating unit, when storing of asphalt is permitted.

The distributor shall have pneumatic tires of such width and number that the load produced on the street surface shall not exceed 650 pounds per inch (12 kilograms per millimeter) of tire width and shall be so designed, equipped, maintained and operated that asphaltic material at even heat may be applied uniformly on variable widths of surface at readily determined and controlled rates of from 0.05 to 0.2 gallons per square yard (0.25 to 0.9 liters per square meter), with a pressure range of from 25 to 75 pounds per square inch (170 to 515 kilo Pascals), and with an allowable variation from any specified rate not to exceed 5 percent. Distributor equipment shall include tachometer, pressure gauges, volume measuring devices and a thermometer for reading temperatures of tank contents.

The aggregate spreading equipment shall be adjusted and capable of spreading aggregate at controlled amounts per square yard (square meter: 1 square meter equals 1.196 square yards) in a continuous manner.

The drag broom shall be light weight street type, mounted on a frame, designed to spread aggregate uniformly over the surface of a bituminous pavement and equipped with pull plates for towing. Towing equipment shall be pneumatic tired.

Rollers shall conform to Item No. 232, "Rolling (Pneumatic Tire)", Light Pneumatic Tire Roller.

Rotary brooms shall be suitable for cleaning the surfaces of bituminous pavements.

Vacuum sweepers shall be suitable for removing any loose aggregate without disturbing the compacted seal coat.

316.5 Construction Methods

Prior to commencement of this work, all erosion control, environmental protection measures and all traffic control devices shall be in place.

Seal Coats may be applied when when the surface on which the seal coat is to be placed is 60°F (16°C) or above and the air temperature is above 50°F (10°C) and rising, where the air temperature is measured in the shade and away from artificial heat. Asphaltic material shall not be placed when general weather conditions are not suitable for a satisfactory seal coat or when the environment could be damaged.

A. Cracks and Holes

Cracks and holes will be patched by the Contractor prior to seal coat operations. Patching materials shall be hot mix, hot laid Asphaltic Concrete Pavement in conformance with Item 340, "Hot Mix Asphaltic Concrete Pavement", or other asphaltic materials as approved by the Engineer or designated representative.

B. Cleaning Existing Surfaces

Prior to placement of the seal coat, loose dirt and other objectionable material shall be removed from the existing surface. The surface will be cleaned with a rotary broom. Hand brooms will be used in areas not accessible to rotary brooms. The Engineer or designated representative must approve all streets before application of any asphalt.

C. Application of Asphaltic Material

Immediately following the preparation of the existing surface by cleaning, the asphaltic material shall be applied at the rate of 0.2 to 0.24 gallon per square yard (0.9 to 1.1 liters per square meter) as determined by the Engineer or designated representative, so that uniform distribution is obtained at all points. Skip streaks on the pavement, due to defective distributor nozzles, will be reshot with a distributor at the expense of the Contractor.

The Contractor shall calibrate the spray bar nozzles by spreading building paper as required on the surface for a sufficient distance back from the end of each application so that flow through sprays may be started and stopped on the paper and so that all sprays will operate properly over the entire length being treated. Building paper so used shall be immediately removed and loaded on a truck. At the end of each day, the paper shall be disposed of at a permitted site approved by the Engineer or designated representative.

Application temperatures will be determined by weather conditions but the temperature of the asphaltic material to be applied shall be between 150 and 160°F (65 and 71°C) as determined by the Engineer or designated representative. When a street to be sealed is continuous through several intersections, sealed area will include all spandrels and stub-outs, unless otherwise directed by the Engineer or designated representative. Spandrels will be hand sprayed. Contractor shall not apply excessive amounts of asphaltic materials when hand spraying. Excessive materials applied shall be removed by the Contractor before spreading the aggregate.

The Contractor shall be required to seal all spandrels at the same time the adjacent streets are sealed, unless otherwise approved in writing by the Engineer or designated representative.

During all applications, the surface of adjacent structures shall be protected in such a manner as to prevent their being splattered or marred. Building paper shall be spread on all manholes, valve boxes, junction boxes, etc. to protect the surface from asphaltic materials. Surfaces not intended to be sealed that are splattered or marred shall be cleaned and restored at the Contractor's expense. The asphaltic material shall not be applied until the cover aggregate is available and ready to spread with assurance of continuous operation.

No asphaltic material shall be placed which cannot be covered and rolled during operating hours established for that street as stipulated on the drawings.

D. Spreading the Aggregate

The Contractor shall employ a mechanical aggregate spreader, which applies the aggregate uniformly over the surface at the rate of 15 to 20 pounds per square yard (8 to 11 kilograms per square meter). The actual rate shall be as directed by the Engineer or designated representative.

The covering material in the quantity specified shall be spread uniformly over the bituminous material as soon after application as possible. The aggregate shall

be spread in the same width of application as for the asphaltic material and spread uniformly with the aggregate spreading equipment.

Trucks spreading aggregate shall be operated backward so that bituminous material will be covered before truck wheels pass over it. The aggregate shall not be applied in such thickness to cause blanketing or stacking. Any blanketing or stacking shall be removed prior to rolling. Backspotting or sprinkling cover aggregate shall be done by hand spreading, which will be continued during the operations whenever necessary, as directed by the Engineer or designated representative.

E. Brooming and Rolling

Rolling shall be started as soon as sufficient aggregate is spread to prevent pick-up and continued until no more aggregate can be worked into the surface. The surface shall be blanket rolled. The Contractor shall arrange his work so that all rolling of all cover aggregate applied that day is accomplished prior to sundown with a minimum of four complete coverages with pneumatic rollers.

In lieu of the rolling equipment specified, the Contractor may, upon written permission from the Engineer or designated representative, operate other compaction equipment that will produce equivalent relative compaction in the same period of time as the specified equipment.

Rollers shall be maintained in good repair and operating condition and shall be approved by the Engineer or designated representative.

The pony blading or drag brooming should start as soon as possible after the rolling has started and the surface has set sufficiently to prevent excessive marking of the seal surface. Further pony blading or drag brooming should be done as often as necessary to keep cover aggregate uniformly distributed over the street surface. At no time shall there be less than 2 pneumatic tire rollers on the job. The use of the pony blade or drag broom in connection with the rolling will be left to the opinion of the Engineer or designated representative as to which gives the desired results.

The Contractor will be responsible for maintaining all streets for 48 hours after each street has been seal coated. Maintenance will consist of brooming, rolling and adding more aggregate as directed by the Engineer or designated representative.

F. Curing of Interlayer Seal

The Contractor shall allow the interlayer seal to cure a minimum of 24 hours before applying the HMAC overlay unless otherwise approved by the Engineer or designated representative.

G. Asphaltic Material Contractor's Responsibility

The Contractor shall furnish vendor's certified test report for asphaltic material shipped for the project. The report shall be delivered to the Engineer or designated representative before permission is granted for use of the material. Any change of source shall be reported prior to delivery.

316.6 Traffic Control Facilities

The Contractor shall schedule and conduct the seal coat operations to avoid excessive inconvenience to the public in the seal coat area.

The Contractor shall notify all abutting property owners along the street prior to initiation of the seal coat operation.

The Contractor shall have on the project site sufficient barricades, flag-persons and traffic control devices to assure a minimum of inconvenience to traffic around the construction area in conformance with the Texas Manual of Uniform Traffic Control Devices. If the Contractor's arrangements are not satisfactory to the Engineer or designated representative, the seal coat operation will not be allowed to commence.

After the seal has been applied, the Contractor shall post appropriate warning signs along these streets as directed by the Engineer or designated representative and maintain such signs for 48 hours.

316.7 Final Cleanup

The Contractor shall vacuum sweep the completed seal coat, curb, sidewalk and other areas to remove loose aggregate as required during the first week after the traffic is allowed on the street.

316.8 Measurement

All accepted Polymerized Asphalt Underseal Coat will be measured by one of the following methods:

- A. "Polymerized Asphalt Emulsion" will be measured in gallons (liters: 1 liter equals 0.26 gallons) at the applied temperature at the point of application on the street.
- B. "Aggregate" will be measured by the cubic yard (cubic meters: 1 cubic meter equals 1.31 cubic yards) in vehicles as applied on the street.
- C. "Complete in Place" will be measured by the square yard (square meter: 1 square meter equals 1.196 square yards) of surface area treated, including polymerized asphalt emulsion and aggregate.

316.9 Payment

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid prices stipulated in the bid for "Polymerized Asphalt Underseal Coat", "Polymerized Asphalt Emulsion", "Polymerized Underseal Coat, Aggregate" or "Polymerized Asphalt Underseal Coat, Complete in Place". The unit bid prices shall include full compensation for: a) furnishing, delivering and placing all materials; b) patching, brooming, compacting and rolling; c) cleaning the existing surface and gutters, covering excess asphaltic material, removal of excess aggregate and cleaning stockpiles sites; d) a 48 hour maintenance period and e) all labor, equipment, tools and incidentals necessary to complete the required work as indicated on the Drawings.

Payment will be made under one of the following:

Polymerized Asphalt Underseal Coat, Polymerized Asphalt Emulsion	Per Gallon.
Polymerized Asphalt Underseal Coat, Aggregate	Per Cubic Yard.
Polymerized Asphalt Underseal Coat, Complete in Place	Per Sq. Yard.

End

SPECIFIC CROSS REFERENCE MATERIALS

Specification Item No. 316, "POLYMERIZED ASPHALT INTERLAYER SEAL"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 232	Rolling (Pneumatic Tire)
Item No. 301	Asphalts, Oils and Emulsions
Item No. 302	Aggregates for Surface Treatments
Item No. 310	Emulsified Asphalt Treatment
Item No. 312	Seal Coat
Item No. 313	Rubber Asphalt Joint and Crack Sealant
Item No. 340	Hot Mix Asphaltic Concrete Pavement

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 300	Asphalts, Oils and Emulsions
Item No. 302	Aggregates for Surface Treatments
Item No. 315	Emulsified Asphalt Seal

RELATED CROSS REFERENCE MATERIALS

Specification Item No. 316, "POLYMERIZED ASPHALT INTERLAYER SEAL"

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-200-F	Sieve Analysis of Fine and Coarse Aggregates
Tex-410-A	Abrasion of Coarse Aggregate Using the Los Angeles Machine
Tex-502-C	Test for Penetration of Bituminous Material
Tex-503-C	Test for Ductility of Bituminous Materials
Tex-504-C	Test for Flash and Fire Points of Petroleum Materials by Cleveland Open Cup
Tex-506-C	Test for Loss on Heating of Oils and Asphaltic Compounds
Tex-507-C	Proportion of Bitumen Soluble in Trichloro-ethylene
Tex-513-C	Test for Saybolt Viscosity
Tex-519-C	Float Test for Bituminous Materials
Tex-520-C	Test for Residue of Specified Penetration
Tex-521-C	Testing Emulsified Asphalts
Tex-528-C	Test for Absolute Viscosity of Asphalt Cements
Tex-529-C	Test for Kinematic Viscosity of Asphalts

RELATED CROSS REFERENCE MATERIALS - continued

Specification Item No. 316, "POLYMERIZED ASPHALT INTERLAYER SEAL"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 315	Milling Asphaltic Concrete Paving and Non Portland Cement Concrete Bases
Item No. 320	Two Course Surface Treatment
Item No. 350	Heating, Scarifying and Repaving
Item No. 801	Construction Detours
Item No. 803	Barricades, Signs and Traffic Handling
Item No. 870	Work Zone Pavement Markings
Item No. 874	Eliminating Existing Pavement Markings and Markers

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 314	Emulsified Asphalt Treatment
Item No. 316	Surface Treatments
Item No. 345	Asphalt Stabilized Base (Plant Mixed)
Item No. 520	Weighing and Measuring Equipment

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-509-C	Spot Test of Asphaltic Materials
Tex-510-C	Determining the Effect of Heat and Air on Asphaltic Materials when Exposed in Thin Films
Tex-512-C	Test for Flash Points of Volative Flammable Materials by Tag Open-Cup Apparatus

ITEM NO. 320

TWO COURSE SURFACE TREATMENT

320.1 Description

This item shall govern the construction of a wearing surface composed of a double application of asphaltic material, each covered with aggregate, constructed on existing pavements, a prepared base course or surface in accordance with these specifications.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

320.2 Submittals

The submittal requirements of this specification item include:

- A. Recommended design mix (asphaltic material, aggregate type, modifier type and %)
- B. Test results on the asphaltic material (Viscosity, penetration, solubility, ductility, stability, distillation test, residue tests, etc.).
- C. Test results on the aggregate (gradation and percent wear).
- D. Characteristics (i.e. manufacturer, rate of application, speed, etc.) of the proposed distributor and aggregate spreader.
- E. List of facilities and equipment proposed for temperature measurements.
- F. List of facilities and equipment proposed for storage and handling of asphaltic materials.

320.3 Materials

All material shall be of the type(s) and grade(s) shown on the Drawings and shall conform to the pertinent material requirements for the following items:

A. Asphaltic Materials

The asphaltic materials used shall conform to Item No. 301, "Asphalts, Oils and Emulsions" as follows:

- 1. Air Temperature 65 to 80°F (18 to 27°C), HFRS-2
- 2. Air Temperature over 81°F (27°C), RS-2

B. Aggregate

The aggregate materials shall conform to Item No. 302, "Aggregate for Surface Treatments" as follows:

- 1. First Course
Grade 3
- 2. Second Course
Grade 5

C. Aggregate (Stockpiled)

When the Drawings include the Item, "Aggregate (Stockpiled)", aggregate of the type and grade specified for the surface treatment shall be stockpiled within the limits of the project at sites designated on the drawings or as directed by the Engineer or designated representative. Stockpile sites shall be leveled, if required and prepared as specified herein. The Contractor shall load, haul, distribute and apply the stockpiled aggregate in accordance with specification requirements governing for this item. The stockpile areas and remaining stockpiles shall be left in a neat condition satisfactory to the Engineer or designated representative.

D. Temporary Pavement Markings

Temporary pavement markings shall conform to Item No. 864, "Abbreviated Pavement Markings".

320.4 Construction Methods

Prior to commencement of this work, all required erosion control and tree protection measures shall be in place and existing utilities located and protected. Construction equipment shall not be operated within the drip line of trees unless approved by the City Forestry Manager. Construction materials shall not be stockpiled under the canopies of trees. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed and approved by the City Forestry Manager.

The two course surface treatment shall be applied when the air temperature is above 50°F (10°C) and rising. Air temperature shall be taken in the shade and away from artificial heat. The two course surface treatment shall not be applied when the temperature of the roadway surface is below 60°F(16°C).

When latex modified asphalt cement is specified, the two course surface treatment shall be applied when the air temperature is above 70°F (21°C) and rising. Air temperature shall be taken in the shade and away from artificial heat. The two course surface treatment shall not be applied when the temperature of the roadway surface is below 70°F(21°C).

Asphaltic material shall not be placed when general weather conditions, in the opinion of the Engineer or designated representative, are not suitable.

The area to be treated shall be cleaned of dirt, dust or other deleterious matter by sweeping or other approved methods. If deemed necessary by the Engineer or designated representative, the surface shall be lightly sprinkled just prior to the first application of asphaltic material.

The Contractor shall be responsible for the proper preparation of all stockpile areas before aggregates are placed thereon, including leveling, cleaning of debris necessary for protection of the aggregate to prevent any contamination thereof and clean up of any stockpile area at the completion of the work.

All storage tanks, piping, retorts, booster tanks and distributors used in storing or handling asphaltic materials shall be kept clean and in good operating condition at all

times and shall be operated in such manner that there will be no contamination of the asphaltic material with foreign material. It shall be the responsibility of the Contractor to provide and maintain in good working order a recording thermometer at the storage heating unit at all times.

Application temperatures will be determined by weather conditions within the limits recommended in Specification Item 301, "Asphalts, Oils and Emulsions", as determined by the Engineer or designated representative.

The Contractor shall provide all necessary facilities for determining the temperature of the asphaltic material in all of the heating equipment and in the distributor for determining the rate at which it is applied and for securing uniformity at the junction of two distributor loads. The distributor shall have been calibrated within three (3) years from the date it is first used on this project. The Contractor shall furnish the Engineer or designated representative with an accurate and satisfactory record of such calibration. After beginning the work, should the rate of the asphaltic material appear to be inappropriate, the distributor shall be recalibrated to provide a satisfactory to the Engineer or designated representative before proceeding with the work

When a uniform application of asphaltic material is not being achieved, the Engineer or designated representative may require that the Contractor provide an operator at the rear of the distributor to manually control the spray bar operations.

Asphaltic material for each course may be applied for the full width of the surface treatment in one application, unless the width exceeds 26 feet (8 meters). No traffic or hauling will be permitted over the freshly applied asphaltic material. The asphaltic material shall not be applied until immediate covering is assured.

A. First Course

Asphaltic material for the first course shall be applied on the clean surface by an approved type of self-propelled pressure distributor so operated as to distribute the material, evenly and smoothly, under a pressure necessary for proper distribution at a rate of 0.30 to 0.35 gallons per square yard (1.4 to 1.6 liters per square meter) or as directed by the Engineer or designated representative.

Aggregate for the first course shall be immediately and uniformly applied and spread by an approved self-propelled continuous feed aggregate spreader, unless otherwise indicated or authorized by the Engineer in writing. The aggregate shall be applied at the approximate rate of 15 to 20 lbs. per square yard (8 to 11 kilograms per square meter) or as directed by the Engineer or designated representative. The Contractor shall be responsible for the maintenance of the surface of the first course until the second course is applied.

The entire surface shall then be broomed, bladed or raked as required by the Engineer and shall be thoroughly rolled in accordance with Specification Item 230, "Rolling (Flat Wheel)" with power rollers of the three-wheel or tandem, self-propelled type, weighing not less than 3 tons (2.7 megagrams) nor more than 6 tons (5.4 megagrams). All wheels shall be flat.

In lieu of the rolling equipment specified, the Contractor may, upon written permission from the Engineer or designated representative, 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 as would be expected of the specified equipment, as determined by the Engineer or designated representative, its use shall be discontinued. Rollers shall be maintained in good repair and condition and shall be approved by the Engineer or designated representative prior to their use.

B. Second Course

It is the intent of this specification that the application of asphalt and aggregate for the second course be applied within the same day or immediately thereafter and prior to opening the roadway to traffic.

The second course shall consist of asphaltic material and aggregate applied and covered in the manner specified for the first application. The surface shall then be broomed, bladed or raked as required by the Engineer or designated representative and thoroughly rolled in accordance with Standard Specification Item 232, "Rolling (Pneumatic Tire)" with a pneumatic tire roller. Asphaltic materials for the course shall be applied at the rate of 0.25 gallons per square yard (1.1 liters per square meter) or as directed by the Engineer or designated representative. Aggregate for the second course shall be applied at the rate of 14 to 18 lbs. per square yard (7.5 to 10 kilograms per square meter) or as directed by the Engineer or designated representative.

The Contractor shall be responsible for the maintenance of the surface treatment until the work is accepted by the Engineer or designated representative. All holes or failures in the surface shall be repaired by use of additional asphalt and aggregate. All fat or bleeding surfaces shall be covered with approved cover material in such a manner that the asphaltic material will not adhere to or be picked up by the wheels of vehicles.

Temporary pavement markings shall be placed in accordance with Item No. 864, "Abbreviated Pavement Markings".

320.5 Measurement

A "Two Course Surface Treatment" application shall be measured by the square yard (square meter: 1 square meter equals 1.196 square yards) of completed and accepted two-course surface treatment.

320.6 Payment

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid at the unit bid price for two course surface treatment. The price shall each include full compensation for: a) cleaning and sprinkling the base; furnishing, preparing, hauling and placing all materials, and rolling, b) all freight involved; c) all manipulations, labor, tools, equipment cleanup, and temporary pavement markings and d) all incidentals necessary to complete the work.

Payment will be made under the following:

Two Course Surface Treatment

Per Square Yard, Plan Quantity

End

SPECIFIC CROSS REFERENCE MATERIALS

Specification Item 320 "TWO COURSE SURFACE TREATMENT"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 232	Rolling (Pneumatic Tire)
Item No. 301	Asphalts, Oils and Emulsions
Item No. 302	Aggregates for Surface Treatments
Item No. 642	Silt Fence (SF)
Item No. 864	Abbreviated Pavement Markings

RELATED CROSS REFERENCE MATERIALS

Specification Item 320 "TWO COURSE SURFACE TREATMENT"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 206	Asphalt Stabilized Base
Item No. 210	Flexible Base
Item No. 306	Prime Coat
Item No. 307	Tack Coat
Item No. 310	Emulsified Asphalt Treatment
Item No. 311	Emulsified Asphalt Repaving
Item No. 312	Seal Coat
Item No. 340	Hot Mix Asphaltic Concrete Pavement
Item No. 341	Paving Fabric
Item No. 350	Heating, Scarifying and Repaving
Item No. 351	Recycling Agent

Texas Department of Transportation: Standard Specifications for Construction And Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item 300	Asphalts, Oils and Emulsions
Item 301	Asphalt Antistripping Agents
Item 310	Prime Coat (Cutback Asphaltic Materials)
Item 314	Emulsified Asphalt Treatment
Item 316	Surface Treatments
Item 345	Asphalt Stabilized Base (Plant Mixed)
Item 354	Planing and/or Texturing Pavement

ITEM NO. 340
HOT MIX ASPHALTIC CONCRETE PAVEMENT

340.1 Description

This item shall govern base, level up, and pavement surface courses composed of a compacted mixture of aggregate and asphaltic cement mixed hot in a mixing plant. The hot mix asphaltic (HMA) concrete pavement shall be constructed on a previously completed and approved subgrade, subbase material, base material, concrete slab or existing pavement.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

340.2 Submittals

The submittal requirements of this specification item may include:

- A. A mix design submittal including the plant corrected Job Mix Formula (JMF) for the hot mix asphaltic concrete.
- B. Certification that the aggregate materials meet appropriate quality requirements.
- C. Particle-size gradation and specific gravity tests on all aggregate materials.
- D. Certification that the asphalt cement for paving materials meet appropriate quality requirements.

340.3 Materials

The Contractor shall furnish materials to meet the requirements specified herein and shall be solely responsible for the quality and consistency of the product delivered to the Project.

- A. Aggregate: The aggregate shall be composed of coarse aggregate, a fine aggregate and, if required or allowed, mineral filler and reclaimed asphalt pavement (RAP). RAP use will be allowed in all base course mixtures except as specifically excluded herein, in the Contract Documents or on the Drawings, provided no more than 20% RAP is used.

RAP use will not be permitted in pavement surface courses.

Aggregates shall meet the quality requirements of Table 1 and other requirements as specified herein. The aggregate contained in RAP will not be required to meet Table 1 requirements unless indicated otherwise on the Drawings.

- 1. Coarse Aggregate: Coarse aggregate is defined as that part of the aggregate retained on the No. 10 (2.00 mm) sieve and shall consist of clean, tough, durable fragments of crushed stone or crushed gravel of uniform quality throughout.

Gravel from each source shall be crushed to the extent that it has a minimum of 85% of the particles retained on the No. 4 (4.75 mm) sieve with two or more mechanically induced crushed faces as determined by

TxDOT Test Method TEX-460-A (Part I). The material passing the No. 4 (4.75 mm) sieve and retained on the No. 10 (2.00 mm) sieve must be the produced from crushing aggregate that was originally retained on the No. 4 (4.75 mm) sieve.

- 2. Reclaimed Asphalt Pavement (RAP): RAP is defined as a salvaged, milled, pulverized, broken or crushed asphaltic pavement. The RAP to be used in the mix shall be crushed or broken to the extent that 100 percent will pass the 2-inch (50 mm) sieve.

The RAP shall be stockpiled in such a manner that assures that it will not become contaminated by dirt or other objectionable materials. Unless indicated otherwise on the Drawings, stockpiled, crushed RAP must not exhibit a decantation more than 5 percent or a plasticity index more than 8, when tested in accordance with TxDOT Test Method Tex-406-A, Part I, or Test Method Tex-106-E, respectively.

- 3. Fine Aggregate: Fine aggregate is defined as that part of the aggregate passing the No. 10 (2.00 mm) sieve and shall be of uniform quality throughout. A maximum of 15 percent of the total aggregate may be field sand or other uncrushed fine aggregate.

Screenings shall be supplied from sources whose coarse aggregate meets the abrasion and magnesium sulfate soundness loss requirements shown in Table 1.

- a. Unless indicated otherwise on the Drawings, stone screenings, which are the product of a rock crushing operation, are required and shall meet the following gradation requirements when tested in accordance with TxDOT Test Method Tex-200-F, Part I.

Material	Percent by Weight (Mass)
Passing 3/8 inch (9.50 mm) sieve.....	100
Passing No. 10 (2.00 mm) sieve.....	70-100
Passing No. 200 (75 µm) sieve.....	0-15

- b. Crushed gravel screenings may be used with, or in lieu of, stone screenings only when indicated on the Drawings. Crushed gravel screenings must be the product of crushing aggregate that was originally retained on the No. 4 (4.75 mm) sieve and must meet the gradation for stone screenings shown above.

- 4. Mineral Filler: Mineral filler shall consist of thoroughly dried stone dust, Portland cement, fly ash, lime or other mineral dust approved by the Engineer or designated representative. The mineral filler shall be free from foreign matter.

Portland cement manufactured in a cement kiln fueled by hazardous

waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Commission on Environmental Quality (TCEQ) and the U. S. Environmental Protection Agency (EPA). Supplier shall provide current TCEQ and EPA authorizations to operate the facility.

Fly ash obtained from a source using a process fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Commission on Environmental Quality (TCEQ) and the U. S. Environmental Protection Agency (EPA). Supplier shall provide current TCEQ and EPA authorizations to operate the facility.

The addition of baghouse fines or other collected fines will be permitted if the mixture quality is not adversely affected in the opinion of the Engineer or designated representative. In no case shall the amount of material passing the No. 200 (75 µm) sieve exceed the tolerances of the job-mix formula or the master gradation limits.

When tested by TEX-200-F (Part I or Part III, as applicable), the mineral filler shall meet the following gradation requirements. Baghouse fines are not required to meet the gradation requirements.

Material	Percent by Weight (mass)
Passing No. 30 (600 µm) Sieve.....	95 - 100
Passing No. 80 (187.5 µm) Sieve, not less than.....	75
Passing No. 200 (75 µm) Sieve, not less than.....	55

TABLE 1: AGGREGATE QUALITY REQUIREMENTS *

Requirement	Test Method	Amount
COARSE AGGREGATE		
Deleterious Material, percent, maximum	Tex-217-F, I	1.5
Decantation, percent, maximum	Tex-217-F, II	1.5
Los Angeles Abrasion, percent, maximum	Tex-410-A	40
Magnesium Sulfate Soundness Loss 5 cycle, percent, maximum	Tex-410-A	30
FINE AGGREGATE		
Linear Shrinkage, maximum	Tex-107-E, II	3
COMBINED AGGREGATES		
Sand Equivalent Value, minimum	Tex-203-F	45

* Aggregates, without added mineral filler or additives, combined as used in the job-mix formula (Plant Corrected).

- B. Asphaltic Material:
1. Paving Mixture: Asphalt cement for the paving mixture shall conform to the requirements of Standard Specification Item No. 301, "Asphalts, Oils and Emulsions", for AC-20 or PG64-22, Styrene (SBS) Modified Asphalt Cement, AC-SBS Blend AC-45P or PG76-22S, unless otherwise indicated in the Project Documents.
 2. Tack Coat: Tack Coat shall conform to Standard Specification Item No. 307, "Tack Coat".
- C. Additives: Additives to facilitate mixing and/or improve the quality of the asphaltic mixture or tack coat may be used with the authorization of the Engineer or designated representative. The Contractor may choose to use either lime or a liquid anti-stripping agent to reduce moisture susceptibility of the aggregate.

340.4 Paving Mixtures

An asphalt mixture design is developed by a laboratory process, which includes the determination of the quality and quantity of the asphalt cement and the individual aggregates, and the testing of the combined mixture (Laboratory Design). The Laboratory Design is subsequently revised to produce an appropriate job mix formula.

The job mix formula (JMF) lists the quantity of each component to be used in the mix after the laboratory design has been adjusted by running it through a particular plant (i.e. the mix design is Plant Corrected). The JMF will be the standard to which the Acceptance Plan will be applied. The JMF of one drum or batching unit shall not be used for another unit.

The Contractor shall submit to the Engineer on forms provided by the Engineer or designated representative, an asphalt mixture design reviewed, signed and sealed by a Registered Professional Engineer licensed in the State of Texas or certified by a TxDOT Level II Certified Asphalt Technician. An asphalt mixture design shall be submitted for a comprehensive review every two (2) years. Mix designs older than one year will not be accepted without a review of current test data of the proposed materials and current mix design to ensure that the materials meet specification requirements.

The JMF (Plant Corrected) shall be submitted to the Engineer or designated representative on a form provided by the Engineer, and to the Construction Inspector or Project Manager of the Project for review, for each individual Project, a minimum of three (3) working days before the mixture is to be placed. Under no circumstances will a mixture be placed before its use is reviewed and approved by the Engineer or designated representative.

Performance of the mix design shall remain the responsibility of the Contractor.

- A. Mixture Design: The mix shall be designed in accordance with TxDOT Construction Bulletin C-14 and Test Method Tex-204-F to conform with the requirements herein. The master grading limits of the appropriate type and the JMF will be plotted on a graduated chart with sieve sizes raised to the 0.45

power and will be submitted to the Engineer or designated representative with the asphalt mixture design. The Bulk Specific Gravity of aggregates in RAP will be determined on extracted aggregates.

- B. Types: The blend of coarse aggregate, fine aggregate, and mineral filler, if allowed, that is established by TxDOT Test Method Tex-200-F, Dry Sieve Analysis, shall conform to the master gradation shown in Table 2 for the type of specified mixture. The voids in the mineral aggregate (VMA) will be determined as a mixture design requirement only, in accordance with TxDOT Test Method Tex-207-F, and shall not be less than the value indicated in Table 2.

TABLE 2: Master Grading - Percent Passing by Weight (Mass) or Volume

Sieve Size US (SI)	Type A Coarse Base	Type B Fine Base	Type C Coarse Surface	Type D Fine Surface	Type F Fine Mixture
1-1/2" (37.5 mm)	100				
1-1/4" (31 mm)	95-100				
1" (25 mm)		100			
7/8" (22 mm)	70-90	95-100	100		
5/8" (15.5 mm)		75-95	95-100		
1/2" (12.5 mm)	50-70			100	
3/8" (9.5 mm)		60-80	70-85	85-100	100
1/4" (6.25 mm)					95-100
No. 4 (4.75 mm)	30-50	40-60	43-63	50-70	
No. 10 (2.00 mm)	20-34	27-40	30-40	32-42	32-42
No. 40 (425 µm)	5-20	10-25	10-25	11-26	9-24
No. 80 (187.5 µm)	2-12	3-13	3-13	4-14	3-13
No. 200 (75 µm)	1-6*	1-6*	1-6*	1-6*	1-6*
VMA % minimum	11	12	13	14	15
Rec. Min. Lift	3" (75 mm)	2" (50 mm)	1-3/4" (70 mm)	1" (50 mm)	3/4" (20 mm)

- C. Tolerances: Fluctuations in the aggregate gradation and asphalt content of the Job Mix Formula (JMF) shall not vary by more than the following criteria but the aggregate gradation shall be limited to the range of the master gradation as established by TEX-210-F.

SIEVES	Percent By Weight (Mass)
2" (50 mm) Sieve through No. 10 (2.00 mm) Sieve	±5.0
No. 40 (425 µm) through No. 200 (75 µm) Sieve	± 3.0
Asphalt Content	±0.5

- D. Stability and Density: The mixture shall be designed at or near optimum density, as indicated on the Drawings, to conform to the following percent of Maximum Theoretical Density as measured by TxDOT Test Method TEX-227-F and

Stability conforming to TxDOT Test Method TEX-208-F. The laboratory mixture shall be molded in accordance with TxDOT Test Method TEX-206-F and the Bulk Specific Gravity determined in accordance with TxDOT Test Method TEX-207-F.

	Optimum Laboratory Density (%)	Laboratory Density (%)		Stability
		Min.	Max.	
Local Streets Surface Courses	96	94.5	97.5	35 Min.
Collectors & Arterials Surface Courses	96	94.5	97.5	40-60
All Base Courses	96	94.5	97.5	35 Min.

- E. Job Mix Formula Field Adjustments: The Contractor shall produce a mixture of uniform composition closely conforming to the reviewed JMF, that falls within the limits of the tolerances given above and the Acceptance Plan.

If it is determined by the City of Round Rock that adjustments to the JMF are necessary to achieve the specified requirements, the Engineer or designated representative may allow adjustments of the JMF within the following limits without a laboratory redesign of the mixture. The adjusted JMF shall not exceed the master grading criteria for the type of mixture specified. The proposed JMF adjustments shall not exceed 5 percent on any one sieve, 1/2-inch (12.5 mm) size and larger, or 3 percent on the sieve size below the 1/2-inch (12.5 mm) sieve of the JMF (Plant Corrected) reviewed for the Project.

When the proposed adjustments exceed either the 5 or 3 percent limits, and the Engineer or designated representative determines that the impact of these changes may adversely affect pavement performance, a new laboratory mixture design will be required.

The asphalt content may be adjusted with the concurrence of the Engineer or designated representative to maintain desirable laboratory density near the optimum value while achieving other mix requirements. However, increasing the asphalt content of the mixture in order to reduce pavement air voids will not be allowed. Also, if the percent air voids is determined to be less than 4 percent, adjustments shall be made to the plant production by the Contractor, within the tolerances as outlined above, so that an adequate air void level is attained.

340.5 Equipment

The trucks that deliver the hot mix asphalt concrete material to the project shall be of sufficient number to insure a continuous paving operation. All equipment used for the production, placement and compaction of the mixture shall be maintained in good repair and operating conditions to the satisfaction of the Engineer or designated representative. All equipment shall be made available for inspection. If the Engineer or designated representative expresses concern about the condition of any equipment, it shall not be used until it is repaired to the satisfaction of the Engineer or designated representative.

- A. **Mixing Plants:** Plants may be of the weigh-batch type, the modified weigh-batch type or drum-mix type equipped with suitable material conveyers, power units, mixing equipment, aggregate proportioning devices, dryers, bins, dust collectors and sensing and recording devices as appropriate for the mixing plant type. The mixing plants shall meet the requirements specified in Section 340.4, 'Equipment of TxDOT Specification Item No. 340, "Hot Mix Asphaltic Concrete Pavement"'.
- B. **Spreading and Finishing Paving Machine:** The paving machine shall be self-propelled and equipped with a heated compacting screed capable of producing a finish surface meeting the requirements of the street cross-section indicated on the Drawings and all surface criteria. Extensions to the screed shall have the same heating and compacting capabilities as the primary unit, except for use on variable depth tapered areas and/or as approved by the Engineer or designated representative.

The paving machine shall be equipped with an approved automatic dual longitudinal screed control system and an automatic transverse screed control system. The longitudinal controls shall be capable of operating from any longitudinal grade reference including a string line, ski, mobile string line or matching shoe. Unless indicated otherwise on the Drawings, the Contractor may use any one of these grade references. The selected grade reference equipment shall be maintained in good operating condition by personnel trained in the use of the specific type of equipment.

The Contractor shall furnish all labor and equipment required for establishing and maintaining appropriate grade reference.

- C. **Rollers:** The Contractor shall select rollers conforming to Item 230, "Rolling (Flat Wheel)" and Item 232, "Rolling (Pneumatic Tire)". Rollers that do not conform to these requirements shall be immediately removed from the Project.
- D. **Motor Grader:** A self-propelled power motor grader may only be used when its use is approved by the Engineer or designated representative. It shall have a blade of not less than 12 feet (3.66 meters) and a wheelbase of not less than 16 feet (4.88 meters). Smaller graders may be used for small irregular areas when approved by the Engineer or designated representative.
- E. **Material Transfer Equipment:** Equipment for transferring the HMA mixture from the hauling units or the roadbed to the spreading and finishing machine will be allowed unless indicated otherwise on the Drawings.

Windrow pick-up equipment, if permitted by the Engineer or designated representative, shall be constructed in such a manner that substantially all of the HMA mixture deposited on the roadbed is picked up and loaded into the spreading and finishing machine. The HMA mixture shall not be contaminated with foreign material. The loading equipment shall be designed so that it does not interfere with the spreading and finishing machine in obtaining the required line, grade and surface without resorting to hand finishing.

- F. **Straightedges and Templates:** The Contractor shall provide a ten-foot (3.05 meter) straightedge acceptable to the Engineer or designated representative for

surface testing. Satisfactory templates shall be provided as required by the Engineer or designated representative.

340.6 Stockpiling Aggregates

Aggregates shall be stockpiled to facilitate blending. When the aggregate is not stockpiled on a hard, non-contaminant base, the bottom six-inch (150 mm) depth of the stockpiles shall not be used in asphaltic mixtures. Where space is limited at the plant site, the aggregate stockpiles shall be separated by walls or other appropriate barriers.

Aggregates shall be stockpiled and handled in a manner that will insure minimization of segregation and contamination. Aggregate and RAP stockpiles shall only contain material from a single source.

340.7 Mixture Temperature

The Contractor shall select a target temperature for discharge of the HMA mixture from the mixer between 250°F (120°C) and 350°F (176°C) that is suitable to weather and Project conditions. The target temperature shall be reported to the Engineer or designated representative daily and recorded in the Daily Progress Report. The HMA mixture temperature shall not vary by more than 25°F (14°C) from the target temperature for discharge from the mixer. HMA mixtures that are discharged from the mixer at a temperature exceeding 360°F (182°C) or a temperature more than 50°F (28°C) below the target temperature shall not be accepted and shall not be placed on the Project.

340.8 Mixture Storage

A surge-storage system may be used to minimize production interruptions during a normal day of operation. When approved by the Engineer or designated representative, overnight storage of HMA mixture in insulated storage bins may be used provided that material temperature and physical properties of the HMA mixture are not adversely affected. HMA mixtures that include hardened lumps shall not be used. Stored HMA mixtures shall not be exempt from any requirements provided in this specification.

When a surge-storage system is used, it shall be equipped with a device such as a job hopper or other device approved by the Engineer or designated representative to prevent segregation in the surge-storage bin.

340.9 Mixture Moisture Content

Hot mix asphalt (HMA) mixtures produced from any plant shall not have a moisture content in excess of 1 percent by weight (mass) when discharged from the mixer. The moisture content shall be determined in accordance with TxDOT Test Method Tex-212-F, Part II, except that the sample shall be left in the oven a total of not less than four (4) hours.

340.10 Construction Methods

- A. General: The Contractor shall be responsible for the production, transportation, placement and compaction of the specified HMA paving mixture to the requirements of this specification. The Contractor shall also be responsible for providing a safe environment for inspection personnel to inspect the equipment and to acquire samples.

All hot mix asphalt concrete pavement surface courses shall be placed with a spreading and finishing (lay-down) machine only. All hot mix asphalt concrete pavement base layers with the possible exception of the first lift of the base layer shall also be placed with a spreading and finishing (lay-down) machine. Longitudinal pavement joints shall be located under the proposed lane lines. Density tests shall be taken prior to opening to traffic.

The first lift of a base layer may be placed with a motor grader if approved in advance by the Engineer or designated representative. The loose measure thickness of this first lift shall not exceed 6 inches (150 mm). If placed with a motor grader, the first lift shall achieve a minimum in-place relative density of 89% as determined by TxDOT test procedures TEX-207-F and TEX-227-F. All subsequent lifts should be placed with a spreading and finishing (lay-down) machine and shall be subject to the requirements of Section 340.12, "Acceptance Plan". Density tests will be taken randomly to confirm compliance with the specification requirements.

For hot mix asphalt overlays, an automatic screed shall be used with outriggers.

Any material delivered to the Project that by visual inspection can reasonably be expected not to meet specification requirements (i.e. segregated or burned material, deficient or excess asphalt, low mixing temperature, visible contaminants, etc.), as determined by the Engineer or designated representative, shall not be used or left in place.

Equipment shall be inspected prior to use and, if found to be defective or in an operating condition that could potentially affect the quality of the finished pavement, as determined by the Engineer or designated representative, its use shall not be allowed. Leakage of fuels, oils, grease, hydraulic or brake fluids or other contaminants onto the prepared surface or newly-laid HMA layer will not be allowed and may require replacement of the affected pavement area.

The HMA paving mixture, when placed with a spreading and finishing machine, shall not be placed when the air temperature is below 50°F (10°C) and is falling, but it may be placed when the air temperature is above 40°F (4°C) and is rising, as measured in a shaded area away from artificial heat.

The paving mixture, when used as a level-up course or when spread with a motor grader, shall not be placed when the air temperature is below 60°F (15°C) and is falling, but it may be placed when the air temperature is 50°F (10°C) and is rising, as measured in a shaded area away from artificial heat. An HMA layer with a thickness of 1-1/2 inches (37.5 mm) and less shall not be placed when the

temperature of the surface on which the layer is to be placed is below 50°F (10°C). The temperature shall be taken in a shaded area away from artificial heat.

Additional surface temperature requirements may be included in the Contract Documents or indicated on the Drawings.

Surfaces to be paved shall be finished, primed, cured, broomed and tacked, as appropriate, to the satisfaction of the Engineer or designated representative. If the surface on which the first course of the paving mixture is to be placed is a flexible base course, and a cut-back asphalt is to be used as a prime coat, the flexible base shall have been primed and cured a minimum of 24 hours before the paving mixture may be placed. The 24-hour restriction will not apply to a flexible base that has been primed with material other than a cutback. However, the surface on which the tack coat and/or paving mixture are to be placed shall be in a dry condition.

Pavement shall be opened to traffic as soon as possible after temporary pavement markings or permanent markings are in place as indicated on the Drawings or as directed by the Engineer or designated representative. Construction traffic allowed on pavements open to the public will be subject to all laws governing traffic on streets and highways.

- B. Tack Coat: The surface upon which the tack is to be placed shall be cleaned thoroughly to the satisfaction of the Engineer or designated representative. The surface shall be given a uniform application of tack coat as governed by Standard Specification Item No. 307, "Tack Coat". The tack coat shall be applied, as directed by the Engineer or designated representative, with an approved sprayer at a rate not to exceed 0.05 gallons per square yard. (0.225 liters per square meter) of surface area. Where the paving mixture will adhere to the surface on which it is to be placed without the use of a tack coat, the tack coat may be eliminated when approved by the Engineer or designated representative. All contact surfaces of curbs, castings and all structures and all joints shall be painted with a thin uniform application of tack coat.

During the application of tack coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutter and structures. Before the Work can be accepted, all splatter shall be removed by the Contractor at his own expense.

- C. Transporting Hot Mix Asphaltic (HMA) Concrete: The HMA mixture shall be hauled to the Work site in tight vehicles that were previously cleaned of all foreign material. Dispatching of the vehicles shall normally be arranged so that all material delivered is placed and all rolling completed during daylight hours. Nighttime paving may be allowed, when approved in advance by the Engineer or designated representative.

In cool weather or for long hauls, truck bodies containing the HMA mixture shall be covered.

If necessary, to prevent the HMA mixture from adhering to the truck body, the inside of the truck may be given a light coating of a release agent satisfactory to the Engineer or designated representative.

- D. HMA Placement: The HMA mixture shall be dumped and spread on the approved prepared surface with the spreading and finishing machine. When properly compacted, the finished pavement shall be smooth, of uniform texture and density and shall meet the requirements of the typical cross sections and the surface tests. In addition the placement of the HMA mixture shall be done without tearing, shoving, gouging or segregating the mixture and without producing streaks in the HMA layer.

Discharge of the HMA mixture into the finishing machine shall be controlled so that the spreading and finishing machine is not bounced or jarred and the required lines and grades shall be obtained without resorting to hand finishing except as permitted below in this Section.

Unless indicated otherwise on the Drawings, dumping of the HMA material in a windrow and then placing the HMA mixture in the finishing machine with windrow pick-up equipment will be permitted provided the temperature of the HMA mixture does not drop more than 50°F (28°C) below the target temperature before being placed by the finishing machine.

Under no circumstances will the HMA material be permitted to be dumped on or near the job site and then reloaded for hauling to the site of placement. Exceptions may be allowed if approved by the Engineer or designated representative.

The windrow pick-up equipment shall be operated in such a manner that substantially all the mixture deposited on the roadbed or prepared surface is picked up and loaded into the finishing machine without contamination by foreign material. The windrow pick-up equipment will also be so operated that the finishing machine will obtain the required line, grade and surface without resorting to hand finishing. Any operation of the windrow pick-up equipment resulting in accumulation and subsequent shedding of accumulated material into the HMA mixture will not be permitted.

When approved by the Engineer or designated representative, level-up courses may be spread with a motor grader that meets the requirements of this specification item.

The spreading and finishing machine shall be operated at a uniform forward speed consistent with the plant production rate, hauling capability and roller train capacity to result in a continuous operation. Stopping of the spreading and finishing machine between trucks is to be held to a minimum. If, in the opinion of the Engineer or designated representative, delivery of material is adversely affecting the condition of the HMA layer (excessive stopping of the spreading and finishing machine, loss of mixture temperature, etc.), the Engineer or designated representative may require paving operations to cease until acceptable methods

are provided to minimize starting and stopping of the spreading and finishing machine.

The hopper gates of the spreading and finishing machine shall be adjusted to provide an adequate and consistent flow of material. This shall result in enough material being delivered to the augers so that they are operating approximately 85 percent of the time or more. The augers shall provide means to supply adequate flow of material to the center of the paver. Augers shall supply an adequate flow of material for the full width of the mat being placed, as approved by the Engineer or designated representative. Augers should be kept approximately one-half to three-quarters full of HMA mixture at all times during the paving operation.

When the HMA mixture is placed in a narrow strip along the edge of an existing pavement, or is used to level up small areas of an existing pavement or is placed in small irregular areas where the use of a finishing machine is not practical, the finishing machine may be eliminated when permitted by the Engineer or designated representative.

The paving material adjacent to castings and flush curb and gutter and structures shall be finished uniformly high so that when compacted, it will be slightly above but not more than 1/8 inch (3 mm) above the edge of the casting or gutter lip. Construction joints of successive courses of HMA material shall be offset at least 6 inches (150 mm). Longitudinal joints in the layer shall be placed to coincide with lane lines as directed the Engineer or designated representative. Transverse joints shall be offset a minimum of 5 feet (1.5 meters).

- E. Compaction: The pavement layers/lifts shall be compacted thoroughly and uniformly to obtain the compaction and cross section meeting the requirements indicated on the Drawings and this specification item.

Regardless of the method used for compaction, all rolling to achieve specified density shall cease before the temperature of the HMA mixture drops below 175°F (80°C).

Rolling with a pneumatic tire roller shall be used to seal the surface. Rolling with a tandem or other steel-wheel roller shall be provided if required to iron out any roller marks. Surface sealing and removal of roller marks may be accomplished at HMA temperatures below 175°F (80°C).

Vibratory rollers shall not be allowed in the vibrating mode on layers with a plan thickness less than 1 1/2 inches (37.5 mm).

The motion of the rollers shall be slow enough to avoid other than usual initial displacement. If any displacement occurs, it shall be corrected to the satisfaction of the Engineer or designated representative.

The roller shall not be allowed to stand on pavement, which has not been compacted to minimum density requirements. In order to prevent adhesion of the surface mixture to the steel-wheel rollers, the wheels shall be thoroughly moistened with water; however an excess of water will not be allowed. Necessary precautions shall be taken to prevent the dropping of diesel, gasoline,

oil, grease or other foreign matter on the pavement, either when the rollers are in operation or when standing.

The edges of the pavement along curbs, headers and similar structures, and all places not accessible to the roller, or in such positions as will not allow thorough compaction with the rollers, shall be thoroughly compacted with lightly oiled tamps.

Rolling with a trench roller will be required on widened areas, in trenches and other limited areas where satisfactory density cannot be obtained with the approved rollers.

340.11 Sampling and Testing

The HMA mixture shall be tested daily at the Project site for conformance to specification requirements. The Inspector shall utilize a random selection method to determine sample locations based on the Contractor's anticipated production. Each day's anticipated production shall be divided into three (3) essentially equal single-pass, sub-area lots. Each day's sample locations shall be equally distributed over the three (3) sub-areas. If, due to the weather or plant malfunctions, the Contractor's daily-anticipated production is not attained, the random locations will not be recalculated. Also, no more than one location of the three (3) sub-areas shall be located in an irregular shaped area such as a cul-de-sac. Unless directed otherwise by the Engineer or designated representative, a minimum of three bag samples and three correlating 6-inch (150-mm) cores will be obtained from each day's production.

Bag samples shall be taken during lay-down operations. The primary sampling point for the bag samples shall be from the windrow if a windrow elevator is used. If a windrow elevator is not used, the sample shall be taken from the middle of the paving machine hopper. This sampling location will require a stoppage in the paving operation in order for the Inspector or testing personnel to safely secure a sample from the hopper.

One core shall be taken for every 2,000 single-pass square yards (1,675 single-pass square meters) with a minimum of three (3) cores for all projects. One core shall be taken at the same station and pass sampled for each of the bag samples. Cores shall be taken by a testing laboratory within 48 hours of pavement laydown unless otherwise directed by the Engineer or designated representative.

For total areas of less than 500 square yards (420 square meters), a total of only two bag samples and two correlating cores will be obtained. If the Contractor desires additional testing, it shall be at its own entire expense.

The Engineer or designated representative may alter, increase or waive the testing schedule to ensure material and workmanship compliance with specification requirements. Acceptability of the completed pavement shall be based on the average of test results for the Project as defined in Section 340.12, "Acceptance Plan" of this item.

Gradation, asphalt content and stability value of the HMA mixture shall be reported for each of the bag samples. The stability value reported for each of the bag samples shall be the average of three (3) tests per bag.

Pavement thickness and density shall be determined from 6-inch (150 mm) field cores. For each day's placement, density of cores for which no corresponding bag samples were taken shall be determined by using the average Maximum Theoretical Density of the day's three (3) bag samples or as may otherwise be determined by the Engineer or designated representative.

When, in the opinion of the Engineer or designated representative, test results appear unrepresentative, additional testing may be authorized. The retesting will be at the expense of the Contractor and the results of the retesting shall be averaged with the results of the original testing. If the results of retesting indicate that the original test results were erroneous, the original test results will be discarded. In the instance of erroneous original test results the subsequent first set of retests will be at the expense of the Owner/Developer.

Pavements with low-density results may be recored; but the pavement shall not receive any additional compactive effort.

Pavements that will not or cannot be cored within 48 hours shall be closed to both public and construction traffic.

340.12 Acceptance Plan

For the purpose of the Acceptance Plan only, the "Paving Project" of each of the specified mixture types shall be defined by the Engineer or designated representative before the paving operation begins. Considerations for defining the Paving Project shall include paving operations staged due to traffic considerations, pavement structural section (i.e. with varying layer thicknesses), time required for paving, changes to the Job Mix Formula, phasing of large projects, or other factors affecting the consistency in the production, lay-down/compaction, use of completed portions, and/or aging of in-place material.

Acceptability of the completed pavement structure for a Paving Project shall be based on all daily averages of three test results and when approved by the Engineer or designated representative the overall average of all test results for each of the mixture/layer types specified on the Drawings.

Pay adjustments for two or more acceptance factors shall be accumulative. Pay adjustments of 100% unit price reduction shall require removal and replacement of the Work. Replacement materials shall be subject to all requirements of this specification. The decision of the Engineer or designated representative related to the removal and replacement of the Work shall be the final authority.

A. Non-Pay-Adjustment Acceptance Factors:

1. **Surface Characteristics:** Unless otherwise directed by the Engineer or designated representative, all pavements shall be tested for smoothness. Surfaces shall be tested with a 10-foot (3.05 meter) straightedge parallel to the roadway centerline and perpendicular to the centerline on flat, cross-slope sections. Maximum allowable deviation in 10 feet shall be 1/8 inch (1-mm per meter) parallel to the centerline and 1/4 inch (2-mm per meter) perpendicular to the centerline. Sections exceeding these maximums shall be corrected to the satisfaction of the Engineer or

designated representative. The completed surface must meet the approval of the Engineer or designated representative for surface smoothness, finish and appearance.

If the surface ravel, ruts or deteriorates in any manner prior to the end of the warranty period, it will be the Contractor's responsibility to correct this condition at its own entire expense to the satisfaction of the Engineer or designated representative in conformance with the requirements of this specification.

For HMAC rehabilitation and overlay projects, if cracks develop in the pavement surface within the warranty period, the Contractor, at his expense, shall seal the cracks in accordance with Standard Specification Item No. 313, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)".

For new HMAC roadways constructed in accordance with the Drawings and specifications, if cracks less than 1/4 inch (6 mm) in width develop in the pavement surface within the warranty period, the Contractor, at his expense, shall seal the cracks in accordance with Standard Specification Item No. 313, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)".

If cracks equal to or greater than 1/4 inch (6 mm) in width develop in the pavement surface within the one-year warranty period, the cracking shall be reviewed and evaluated by the Engineer or designated representative and the contractor shall perform corrective action as required up to and including removal and replacement of the pavement, at the contractor's sole expense.

2. **Stability:** Stability test results shall be used as indicators of potential problems. Where stability test results fall below the range specified in this specification, additional tests shall be taken as directed by the Engineer or designated representative for further evaluation and monitoring of the paving mixture. This additional stability testing will be at the expense of the Contractor. When, in the opinion of the Engineer or designated representative, the stability is deemed unacceptable for the intended use of the pavement, the paving mixture shall be removed and replaced to the limits indicated by test results or may be left in place on conditions acceptable to the Engineer or designated representative. When the paving mixture is removed and replaced, it shall be at the sole expense of the Contractor.
3. **Laboratory Density:** Laboratory density results as determined by TxDOT Test Method Tex-207-F shall be used as indicators of potential problems. Where laboratory density test results are less than 94.5% or more than 97.5% of mix design maximum density, additional tests shall be taken as directed by the Engineer or designated representative for further evaluation and monitoring of the paving mixture. This additional laboratory density testing will be at the expense of the Contractor. When,

in the opinion of the Engineer or designated representative, the laboratory density is deemed unacceptable for the intended use of the pavement, the paving mixture shall be removed and replaced to the limits indicated by test results.

The removal and replacement of the paving mixture shall be at the sole expense of the Contractor.

4. Limited Areas: Irrespective of an acceptable overall Paving Project average for any or all of the Pay-Adjustment Acceptance Factors, limited substandard portions of the Work, as determined by the Engineer or designated representative, shall be remedied or removed and replaced to the satisfaction of the Engineer or designated representative at the sole expense of the Contractor.

- B. Pay-Adjustment Acceptance Factors: Contract unit prices shall be adjusted for paving mixtures that fail to meet acceptance criteria for gradation, asphalt content, density and mat thickness in accordance with the following:

Gradation Acceptance Schedule (TEX-210-F)

Sieve	Deviation From Job Mix Formula		Percent Contract Unit Price Reduction
	Daily Average	Overall Average	
Total retained on No. 10 (2.00 mm)	± 6.5 6.6±	± 5.0 5.1±	0 10
Passing No. 200 (75 µm)	± 3.9 4.0±	± 3.0 3.1±	0 5

Asphalt Content Acceptance Schedule (TEX-210-F, Part II)

Deviation from the Job Mix Formula		Percent Contract Unit Price Reduction	
Daily Average	Overall Average	Local Streets*	All Others
± 0.5	± 0.4	0	0
±0.51 to ±0.60	±0.41 to ±0.50	15	25
+0.61 to +0.70	+0.51 to +0.60	25**	100; Remove and Replace
-0.61 to -0.70	-0.51 to -0.60	100: Remove and Replace	100; Remove and Replace
Over ±0.70	Over ±0.60	100: Remove and Replace	100; Remove and Replace

*A local or residential street that serves as access to residence or other abutting property.

**If the street has an ADT of 500, or less, with 1%, or less, of truck traffic, plus a 2 year warranty; otherwise, Remove and Replace

Density Acceptance Schedule (TEX-207-F/TEX-227-F)

*Percent Density		Percent Contract Unit Price Reduction	
Daily Average	Overall Average	1-1/2" (38 mm) Thickness or Greater	Less than 1-1/2" (38 mm) Thickness
Above 96.5 90.5 to 96.5 90.5 to 87.6 Less than 87.6	Above 96 91 to 96 90.9 to 88.1 Less than 88.1	100; Remove and Replace 0 0.625 per 0.10% deficiency in density 100: Remove and Replace	100; Remove and Replace 0 0.50 per 0.10% deficiency in density 100; Remove and Replace
*Core bulk density divided by max. theoretical density			

Thickness Acceptance Schedule

Variance Percent of Thickness		Percent Contract Unit Price Reduction
Daily Average	Overall Average	
0 - 15.0	0 - 10	0
15.1 - 20.0	10.1 - 16	20
20.1 - 30.0	16.1 - 25	50
Over 30.0	Over 25	100; Remove and Replace or mill/overlay 1" (25 mm) minimum

The Density Acceptance Schedule For Irregularly Shaped Areas; Hike And Bike Trails And Utility Trenches (see following table) will apply to utility trenches of widths less than 4 feet (1.2 meter) and to irregular shaped areas and hike and bike trails in which an appropriate rolling pattern cannot be established making it difficult to achieve compaction.

Density Acceptance Schedule For Irregularly Shaped Areas; Hike And Bike Trails and Utility Trenches (TEX-207-F/TEX-227-F)

*Percent Density	Percent Contract Unit Price Reduction	
Daily Average	1-1/2" (38 mm) Thickness or Greater	Less than 1-1/2" (38 mm) Thickness
Above 96.5 96.5 to 89.0 89.0 to 86.1 Less than 86.1	100; Remove and Replace 0 0.625 per 0.10% deficiency in density 100: Remove and Replace	100; Remove and Replace 0 0.50 per 0.10% deficiency in density 100; Remove and Replace
*Core bulk density divided by maximum theoretical density		

The Density Acceptance Schedule will apply to utility trenches 4 feet (1.2 meter) or wider.

Core thicknesses greater than Drawing requirements shall be factored into the average thickness calculation as the Drawing required thickness. If total thickness of lift(s)

proves to be less than required, the Contractor may remove and replace the overlay deficient areas as agreed to by the Engineer or designated representative. Overlays to correct thickness deficiencies shall be not less than one (1) inch (25-mm) thick. Overlays shall require milling of the asphalt in order to prevent a "featheredge" of the overlaying pavement.

The extent of the area to be overlaid or removed and replaced shall be determined by additional cores with thicknesses greater than or equal to the required thickness. All additional coring that is necessary to determine the area shall be paid for by the Contractor.

340.13 Measurement

Work performed and material placed shall be measured under one of the following methods. When drawing quantity measurement is specified, adjustment of quantity may be made as follows. If the quantity measured as outlined vary from those shown on the Drawings by more than 5%, either party to the Contract may request in writing and adjustment of the quantity by each separate bid item. The party to the Contract which requests the adjustment shall present to the other party one copy of measurements and calculations showing the revised quantity in question. This revised quantity, when approved by the Engineer or designated representative, shall constitute the final quantity for which payment will be made. However, no adjustment will be made for any quantity, which exceeds the Drawing required thickness.

- A. Method A: Asphaltic concrete pavement shall be measured by the ton (2,000 pounds) of the type actually used in completed and accepted Work in accordance with the Drawings and specifications.

The measurement shall be made on approved truck scales that meet the requirements of the National Institute of Standards and Technology Handbooks

44 and 112 except that the required accuracy shall be 0.4 percent of the load being weighed. The Contractor shall furnish a report of calibration from a scale mechanic licensed by the Texas Department of Agriculture certifying that the scales meet this requirement.

- B. Method B: Asphaltic concrete pavement shall be measured by the square yard of specified total thickness of the type of paving mixture actually used in completed and accepted Work in accordance with Drawings and specifications. Multiple lifts of the same type shall be considered as one for square yard measurement purposes.
- C. Method C: Asphaltic concrete pavement shall be measured by the lineal foot of specified total thickness of the type of paving mixture actually used in completed and accepted Work in accordance with Drawings and specifications. Multiple lifts of the same type shall be considered as one for linear foot measurement purposes.

340.14 Payment

Work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid prices or pay adjusted unit

price for Hot Mix Asphaltic Concrete Pavement, of the types and thicknesses specified. The unit bid prices shall include full compensation for furnishing all labor, equipment, time, materials and incidentals necessary to complete the Work.

Removal of existing hot mix asphalt concrete transition areas prior to overlay, tack coat, saw cutting and temporary pavement markings will not be measured or paid for directly but shall be considered subsidiary to Standard Specification Item No. 340, "Hot Mix Asphaltic Concrete Pavement".

Payment for Work meeting these specifications will be made under one of the following:

Hot Mix Asphaltic Concrete Pavement, Type _____,	Per Ton
Hot Mix Asphaltic Concrete Pavement, ___inches, Type _____.	Per Square Yard.
Hot Mix Asphaltic Concrete Pavement, ___Inches, Type _____.	Per Lineal Foot.
Hot Mix Asphaltic Concrete Pavement, ___Inches, Type _____	Per Drawing Quantity.
Hot Mix Asphaltic Concrete Pavement, ___in., Type _____, Level-up Course.	Lump Sum
Crack Sealing Mobilization,	Lump Sum
Crack Sealing,	per Lineal Foot

End

<i>SPECIFIC</i> CROSS REFERENCE MATERIALS
Specification Item 340 "HOT MIX ASPHALTIC CONCRETE PAVEMENT"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 230	Rolling (Flat Wheel)
Item No. 232	Rolling (Pneumatic Tire)
Item No. 301	Asphalts, Oils and Emulsions
Item No. 307	Tack Coat
Item No. 313	Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-106E	Method of Calculating the Plasticity Index of Soils
Tex-107E	Determination of Bar Linear Shrinkage of Soils
Tex-200-F	Sieve Analysis of Fine and Coarse Aggregates
Tex-203-F	Sand Equivalent Test
Tex-204-F	Design of Bituminous Mixtures
Tex-207-F	Determination of Density of Compacted Bituminous Mixtures
Tex-208-F	Test for Stabilometer Value of Bituminous Mixtures
Tex-210-F	Determination of Asphalt Content of Bituminous Mixtures by Extraction

Tex-212-F, Part II	Determination of Moisture Content of Bituminous Mixtures (by oven drying)
Tex-217-F	Determination of Deleterious Material and Decantation Test For Coarse Aggregates
Tex-227-F	Theoretical Maximum Specific Gravity of Bituminous Mixtures
Tex-410-A	Abrasion of Coarse Aggregate Using the Los Angeles Machine
Tex-460-A	Determination of Crushed Face Particle

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item 340	Hot Mix Asphalt Concrete Pavement

<i>RELATED</i> CROSS REFERENCE MATERIALS
Specification Item 340 "HOT MIX ASPHALTIC CONCRETE PAVEMENT"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 206	Asphalt Stabilized Base
Item No. 210	Flexible Base
Item No. 306	Prime Coat
Item No. 310	Emulsified Asphalt Treatment
Item No. 311	Emulsified Asphalt Repaving
Item No. 320	Two Course Surface Treatment

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-215-F	Determination of Asphalt Content of Rock Asphalt By Hot Solvent Method
Tex-224-F	Determination of Flakiness
Tex-400-A	Method of Sampling Stone, Gravel, Sand and Mineral Aggregates
Tex-411-A	Soundness of Aggregate by Use of Sodium Sulfate or magnesium Sulfate
Tex-438-A	Accelerated Polish Test for Aggregate

ITEM NO. 341 PAVING FABRIC

341.1 Description

This item shall consist of the furnishing and installation of a fabric underseal in accordance with this specification and as indicated on the Drawings. This work shall consist of a single application of asphalt covered with 1 layer of the fabric with or without sand.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

341.2 Submittals

The submittal requirements of this specification item include:

- A. Catalog cuts,
- B. Samples of material selected,
- C. Testing results,
- D. Manufacturer's recommended installation procedures, and
- E. Manufacturer certification of compliance with this specification.

341.3 Material

- A. Tack Coat

Asphalt cement tack coat shall conform to Item No. 301, "Asphalt, Oils and Emulsions", AC-10.

- B. Sand

Washed concrete sand shall be Aggregate Grade No. 1 and shall conform to Item No. 403, "Concrete for Structures".

- C. Paving Fabric

Fabric shall be constructed exclusively of man-made thermoplastic fibers. These fibers may be oriented in the fabric in either a random or an aligned orientation and the fibers may be either continuous or discontinuous throughout the fabric.

The fabric itself shall be mildew resistant, rot proof and shall be designed for use with asphalt cements at temperatures up to 325°F (163°C).

- 1. Physical Requirements

The fabric supplied shall meet the following requirements when sampled and tested in accordance with the methods specified.

TEST	METHOD	REQUIREMENT	
		Minimum	Maximum
Original Physical Properties			
Fabric weight, oz./sq.yd (kg/m ²).	TxDoT Tex-616-J*	3.5 (0.12)	9.0 (0.30)
"Apparent elongation" at "breaking load" on warp-wise and fill-wise specimens, percent	ASTM D 5034 Method G**	50	150
"Breaking load", on warp-wise and fill-wise specimens, pounds (Newtons)	ASTM D 5034 Method G**	80 (356)	—
Asphalt retention, gal/yd ² (L/m ²).	TxDoT Tex-616-J*	0.15 (0.68)	0.60 (2.72)
Change in area, %		—	±15

* TxDoT Tex-616-J, "Testing of Construction Fibers"

** ASTM D 5034, grab method G, "Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)"

2. Packaging Requirements

The fabric shall be packaged in rolls of the length and width specified on the Drawings or as directed by the Engineer or designated representative. The fabric itself shall be uniformly wound onto suitable cylindrical forms or cores to aid in handling and unrolling. Each roll of fabric and the form or core upon which it is rolled shall be packaged individually in a suitable sheath, wrapper or container to help protect the fabric from damage due to ultraviolet light and moisture during normal storage and handling.

3. Identification Requirements

Each roll shall be identified by a label or tag securely fixed to the outside of the roll on one end. This label or tag must list the following required information (example of each shown in parenthesis):

- Ø A unique roll number, serially designated (Roll No. 31275)
- Ø Manufacturer lot number or control numbers, if any (Lot 290 Control 6740)
- Ø Name of fabric manufacturer (Afghan Fabrics)
- Ø Date of manufacture (Jan. 16, 1999)
- Ø Brand name of the product ("Fabriweld"),
- Ø Manufacturer's style or catalog designation of the fabric, if any ("300-X")
- Ø Roll width in inches or yards (millimeters or meters) [Width 150 inches (3.8 meters)]
- Ø Roll length in yards (meters) [Length 100 yards (91.4 meters)]
- Ø gross weight of the entire package which is to include fabric, core, wrapping and sheath or container identification tag, etc [Gross 147 pounds (66.6 kilograms)]
- Ø Tare weight of core, wrapping sheath or container identification tag,

etc [Tare 18 pounds (8.15 kilograms)]

Ø Net weight of fabric alone [Net Wt. 129 pounds (58.4 kilograms)]

4. Sampling Requirements

Sampling for testing purposes shall be acquired in accordance with TxDOT Test Method "Tex-735-I, Sampling of Construction Fabrics".

5. Basis for Rejection

If any individual roll fails to meet the fabric weight requirement when the entire roll is weighed then that roll is subject to rejection. If any individual sample, selected at random from 100 rolls (or fraction thereof), fails to meet any specification requirement, then that roll shall be rejected and two additional samples shall be taken, 1 from each of 2 other additional rolls selected at random from the same 100 roll lot (or fraction thereof). If either of these 2 additional samples fails to comply with any portion of the specification, then the entire quantity of rolls represented by that sample shall be rejected.

6. Testing Requirements

Testing shall be conducted in accordance with the test methods identified in this specification item.

7. Manufacturers Certification

The manufacturer will furnish certification of compliance with the specifications with each batch of rolls.

341.4 Equipment

A. Asphalt Distributor

A hydrostatic type distributor shall be used which is capable of spraying the asphaltic binder at the temperature and application rate specified on the Drawings or as directed by the Engineer or designated representative. The Contractor shall provide all necessary facilities for determining the temperature of the asphaltic material. The distributor shall apply the asphalt cement evenly and smoothly under a pressure necessary for proper distribution. It must be adjustable to give a uniform spray pattern over the entire width of application.

The distributor shall be equipped with a hand spray with only 1 nozzle. The hand spray must be easily controlled and have a positive shut off valve. Hand spraying shall be kept to a minimum and limited to areas where a distributor cannot be used.

B. Fabric Handling Equipment

The fabric may be placed with machine laydown equipment or by manual method. A length of A.S.A. standard 1-inch (25 mm) pipe to handle the roll width being used, together with a suitable roll braking device, shall be used for the manual method.

C. Asphalt Storage and Handling Equipment

All equipment used in storing or handling asphalt cement shall be kept clean and in good working order at all times, and shall be operated in such a manner that there will be no contamination of the asphalt cement. The Contractor shall provide and maintain a recording thermometer to continuously indicate the asphalt cement temperature at the storage-heating unit.

D. Miscellaneous Equipment

Stiff bristle brooms to smooth fabric and scissors for cutting the fabric shall be used. Buckets and squeegees can be used for applying asphalt tack coat to fabric laps and joints. A pneumatic roller to smooth fabric into the asphalt binder may be needed should rain or other unforeseeable conditions cause bubbles or wrinkling.

E. Roller

A light pneumatic tire roller conforming to Item No. 232, "Rolling (Pneumatic Tire)" shall be used.

341.5 Construction Methods

A. General

It shall be the responsibility of the Contractor to produce, transport, furnish and place the tack coat and paving fabric in accordance with these specifications and as approved by the Engineer or designated representative.

The tack coat shall not be applied when the air temperature is below 60°F (15°C) and falling, but may be applied when the air temperature is above 50°F (10°C) and rising, as measured in a shaded area away from artificial heat. In addition the tack coat shall not be applied when the temperature of the surface on which it is to be placed is below 60°F (15°C). The tack coat shall only be placed when the humidity, general weather conditions, temperature and moisture condition of the base, in the opinion of the Engineer or designated representative, are suitable.

Application temperature of the tack coat will be selected within the limits recommended in Standard Specification Item No. 301, "Asphalts, Oils and Emulsions", as approved by the Engineer or designated representative. The Contractor shall apply the asphalt cement at a temperature within 15°F(8°C) of the temperature selected.

B. Level-up Courses

Placing a level-up course with a spreading and finishing machine, where required, shall precede the placement of the tack coat and paving fabric and shall conform to Standard Specification Item No. 340, "Hot Mix Asphaltic Concrete Pavement".

C. Surface Preparation

The surface area upon which the fabric layer is to be placed shall be cleaned of

dirt, dust or other deleterious material by sweeping or other approved methods.

D. Application of Asphalt Cement

Asphalt cement shall be applied ahead of the fabric placement in widths 6 inches (150 mm) wider than the fabric, except when placed against a curb and gutter.

The asphalt tack coat shall be uniformly applied with the specified distributor. Hand spraying shall be kept to a minimum. Tack coat shall be applied at a rate between 0.15 and 0.28 gallons per square yard (0.68 to 1.27 liters per square meter). The exact rate to be used shall be approved by the Engineer or designated representative. The rate may require slight adjustment as directed by the Engineer or designated representative to prevent an excessive application.

String lines shall be set by the Contractor for alignment as required by the Engineer or designated representative.

E. Fabric Laydown

Immediately upon application of the asphalt cement tack coat, the fabric shall be aligned and carefully broomed and/or rolled onto the fresh asphalt cement tack coat with equipment approved by the Engineer or designated representative. The fabric shall be placed essentially wrinkle free. Air bubbles shall be removed by brooming to insure complete contact with the roadway surface. In the event the initial alignment is not satisfactory and causes the fabric to wrinkle during placement, the fabric shall be cut out and realigned overlapping the previous material and proceeding as before. The replacement fabric shall be lapped 6 inches (150 mm) minimum and additional asphalt cement tack coat shall be applied to satisfy the absorption of the resulting double layer.

If the edges of the fabric tend to be displaced because of air currents, the Engineer or designated representative may require that the edges be secured at 15-foot (5 meter) intervals. In the event this procedure does not prove satisfactory, then work will be suspended until conditions are more favorable.

All fabric transverse joints shall be lapped a minimum of 6 inches (150 mm). Laps shall be in the direction of travel when traffic is allowed directly on the fabric. In lapping joints, the top fabric shall be folded back to allow application of a light coat of asphalt cement. The top fabric shall then be placed back onto the asphalt cement, broomed and squeegeed out smoothly. Rolling and/or brooming the fabric into the asphalt cement at the joints shall be accomplished in such a way that the air bubbles, which form under the fabric will be removed. This may be accomplished by brooming from the center of the fabric toward the outer edges. The fabric shall be neatly cut and contoured at all joints as directed by the Engineer or designated representative.

Adjacent longitudinal rolls of fabric shall overlap a minimum of 4 inches (100 mm). Additional asphalt cement shall be applied to satisfy the absorption of the resulting double layer.

The fabric shall be carefully cut to fit around utility castings. When required by the Engineer or designated representative, the installed fabric shall be covered with a thin layer of clean sand or clean crusher screenings at a rate sufficient to absorb any excess asphalt cement. If localized areas appear, which indicate excessive amounts of tack coat (bleeding), they shall be blotted with concrete sand.

If for any reason, there is bond loss before application of the HMAC overlay, it shall be corrected by pneumatic rolling until adhesion is restored. If traffic must be temporarily allowed on the membrane prior to the overlay, the fabric shall be lightly sanded (1 to 2 pounds/square yard) for protection during the period of use.

Turning of the laydown machine and other vehicles shall be gradual and kept to a minimum to avoid damage to the fabric membrane. If equipment tires tend to stick to the fabric membrane during the overlay operation, a small quantity of sand shall be broadcast ahead of the paving equipment.

F. Asphaltic Overlay

The Asphaltic Concrete shall conform to Item No. 340, "Hot Mix Asphaltic Concrete Pavement" and be placed as soon as possible after the paving fabric has been rolled into the tack coat.

G. Manufacturers Recommendations

In other matters not specifically detailed on the Drawings or included herein, the Contractor shall use recommended procedures as prescribed by the manufacturer of the fabric.

341.6 Measurement

Accepted work performed as prescribed by this item will be measured by the square yard (square meter: 1 square meter equals 1.196 square yards) of surface area covered. Level-up and finished Hot Mix Asphaltic Concrete courses, performed where required, will be measured and paid in conformance with Standard Specification Item No. 340, "Hot Mix Asphaltic Concrete Pavement".

341.7 Payment

The work performed as prescribed by this item will be paid for at the unit bid price per square yard for "Paving Fabric". The unit bid price shall include full compensation for: a) preparation of the surface to receive the fabric; b) furnishing and placement of all materials, including asphalt cement tack coat and paving fabric, sand and all other materials and manipulation, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Paving Fabric Per Square Yard.

End

<i>SPECIFIC</i> CROSS REFERENCE MATERIALS
--

Specification Item 341, "PAVING FABRIC"

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
D 5034	Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)
D 1682	Test Methods for Breaking Load and Elongation of Textile Fabrics

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-616-J	Testing of Construction Fabrics
Tex-735-I	Sampling of Construction Fabrics

<i>RELATED</i> CROSS REFERENCE MATERIALS

Specification 341, "PAVING FABRIC"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 232	Rolling (Pneumatic Tire)
Item No. 301	Asphalts, Oils and Emulsions
Item No. 340	Hot Mix Asphaltic Concrete Pavement
Item No. 403	Concrete for Structures
Item No. 307	Tack Coat
Item No. 312	Seal Coat
Item No. 315	Milling Asphaltic Concrete Pavement
Item No. 316	Polymerized Asphalt Concrete Pavement
Item No. 801	Construction Detours
Item No. 803	Barricades, Signs and Traffic Handling

**ITEM NO. 350
HEATING, SCARIFYING AND REPAVING**

350.1 Description

This item shall govern for Asphaltic Concrete surface rehabilitation, a process that consists of a simultaneous multistep process of softening the existing asphaltic concrete surface with heat, scarifying to the depth shown on the Drawings, and thoroughly remixing, leveling and compacting the material. Scarified material shall be blended with fresh hot asphaltic concrete mixture, and when required with an asphalt recycling agent. The item shall also include the application of temporary lane markers and their removal when no longer needed.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

350.2 Submittals

The submittal requirements of this specification item include:

- A. Recommended Recycled Job Mix Formula (type and % of asphaltic material, recycling agent, etc.)
- B. Test results on the recycled mixture (asphalt content, stability, penetration).
- C. Characteristics (i.e. manufacturer, depth of application, speed, etc.) of the proposed heater-scarifier machine.
- D. List of facilities and equipment proposed for blending an asphalt recycling agent during mixing operations.
- E. List of facilities and equipment proposed for spreading and finishing the recycled mixture.
- F. Plan, pattern and equipment proposed for compaction of the recycled mixture.

350.3 Materials

- A. Recycled Asphaltic Concrete

The Contractor shall establish a Job Mix Formula for the scarified asphalt based on samples obtained by the Owner/Developer from the areas to be repaved. The Contractor shall submit a copy of the mix design to the Engineer or designated representative for review prior to commencing field operations. The Job Mix Formula shall restore the recycled material to the following values:

Item	Test	Values
Asphalt Content	Tex-210-F	5 ± .3
Stability	Tex-208-F	40-55
Penetration	Tex-502-C	55-90

Although the overlay process is integral to the work provided by this specification, the overlay and level-up material requirements, measurement and payment shall be governed by Item 340 Hot Mix Asphaltic Concrete Pavement.

B. Binding Agents

1. Recycling Agent

When a rejuvenating or plasticizing agent is required it shall conform to Item No. 351, "Recycling Agent".

2. Asphaltic Materials

Asphaltic materials shall be SS-1 or CSS-1 and conform to Item No. 301, "Asphalts, Oils and Emulsions".

C. Traffic Tape

Temporary traffic lane tape shall conform to Item No. 864 "Abbreviated Pavement Markings".

350.4 Equipment

The equipment for heating, scarifying, mixing, placing and finishing shall be approved by the Engineer or designated representative. The equipment shall consist of the following:

A. Heater-Scarifier

The heater-scarifier shall be a self-contained machine specifically designed to reprocess upper layers of existing asphaltic pavements. The heater-scarifier machine shall be self-propelled and capable of heating and scarifying the existing asphalt surface to a minimum depth of 3/4 inch (20 mm), uniformly spraying binding agents onto the scarified material, thoroughly mixing and screeding the scarified and enriched material to the desired longitudinal profile and transverse section. The heater-scarifier shall possess the following:

1. Heating Component

The heating component shall have a radiant heating mechanism capable of heating asphaltic concrete pavements sufficiently to allow scarification of the material to the desired depth without breaking aggregate particles, without overheating, charring or burning the existing asphaltic surface, and without producing undesirable pollutants. The entire heating unit shall be enclosed and vented to contain the heat and prevent damage to trees and shrubs, while meeting the State and Federal air pollution control laws. If excessive smoke is produced or the asphaltic mixture is burned, the Engineer or designated representative may require that operations be discontinued. Operations shall not be resumed until adjustments have been made to the satisfaction of the Engineer or designated representative.

2. Scarifying Component

The scarifying component shall consist of multiple racks of teeth capable of penetrating and loosening the heated existing asphaltic surface of a minimum of 3/4 inch (20 mm). The racks shall be vertically and sectionally adjustable to clear obstructions in the pavement surface. The final scarifying shall be within 1/4 inch (6 mm) of the specified finished pavement cross-section and slope.

3. Blending the Recycling Agent

A system for adding and uniformly blending an asphalt recycling agent during the mixing operation. The system shall be synchronized to provide a uniform application at the specified rate with a tolerance of ± 5 percent from the design rate.

4. Mixing and Distribution

A unit capable of gathering the heated and scarified asphaltic concrete pavement, adding and uniformly mixing the fresh asphaltic concrete, and distributing the blended mixture over the width being processed.

5. Spreading and Finishing Component

The spreading and finishing component shall be self-propelled or integral to the power train of the heater-scarifier. It shall have electronic screed control capability and shall produce a high quality, smooth surface conforming to the requirements of the typical cross section and Specification Item No. 340, "Hot Mix Asphaltic Concrete Pavement".

6. Pugmill

An onboard pugmill, if required on the Drawings.

B. Rollers

Equipment shall conform to the requirements of Item No. 230, Rolling (Flat Wheel)" and Item No. 232, "Rolling (Pneumatic Wheel)". One flat steel wheel roller and one pneumatic roller, at a minimum, shall be used to compact the materials.

350.5 Construction

The work provided by this specification shall be performed when the air temperature is a minimum of 50°F (10°C) and rising and the pavement surface temperature is 50°F (10°C) or higher. The air temperature shall be taken in the shade away from artificial heat.

The area to be resurfaced shall be cleaned of all dirt and objectionable material by blading, brooming or other approved methods, prior to beginning heater-scarification operations. Level-up operations shall be completed as directed by the Engineer or designated representative. The existing asphaltic pavement surface shall be evenly heated, scarified and reworked to the widths and depths shown on the Drawings or a minimum depth of 3/4 inch (20 mm). Heating shall be controlled to assure uniform heat

penetration without causing differential softening of the pavement. Charring of the asphalt will not be permitted. The scarified material shall be gathered, mixed and distributed to the desired longitudinal profile and transverse section. The asphalt recycling agent, when required, shall be applied uniformly to the scarified material prior to mixing and leveling unless otherwise approved by the Engineer or designated representative. The rate of application shall be as selected by the Engineer or designated representative based on laboratory tests on pavement samples. The required amount of fresh hot mix asphaltic concrete shall be added and thoroughly mixed with the scarified material, and the blend shall be leveled and compacted.

All work under this item shall be in conformity with the typical sections shown on the Drawings and to the lines and grades as established by the Engineer or designated representative.

The heated and scarified material shall have a temperature between 225°F (110°C) and 265°F (130°C) as measured immediately behind the scarifier.

There shall be no burning of trees, shrubs, or other landscaping adjacent to the pavement. It shall be the responsibility of the Contractor to protect the adjacent landscape from heat damage.

Application of the binding agent shall be adjusted in areas with level-up material. Under no circumstances shall the scarifying penetrate into an existing flexible base course. The overlay HMAC shall be placed on the scarified material while the road surface temperature is still above 200°F (93°C). The recycled material and overlay course shall be rolled simultaneously. The overlay course shall be compacted to the specified thickness and applicable density in accordance with Item No. 340 Hot Mix Asphaltic Concrete Pavement. In order to insure a full thickness welded mat at longitudinal seams, 4 inches (100 mm) of the newly laid adjoining mat shall be heated so that a minimum of 2 inches (50 mm) can be cut back.

The varying properties of existing asphalt pavements, as encountered in the field may dictate that the depth of scarification, binding agent rate of application or the overlay thickness be adjusted, as required or directed by the Engineer or designated representative, to maintain the design depth of combined recycled and new hot mix.

Compaction shall begin before the material temperature drops below 190°F (90°C). All rolling shall be completed before the mixture temperature drops below 175°F (80°C) unless determined by the Engineer or designated representative that a higher minimum temperature is required for proper compaction.

Rolling shall be continued until desired compaction is obtained and all roller marks are eliminated. A minimum of one (1) tandem roller and one (1) pneumatic-tire roller shall be provided for each work site unless otherwise directed by the Engineer or designated representative.

The Contractor may, with permission from the Engineer or designated representative, operate other compacting equipment that will produce equivalent compaction as the specified equipment. If the substituted compaction equipment fails to produce the compaction expected of the specified equipment, as determined by the Engineer or designated representative, its use shall be discontinued.

The edges of the pavement along curbs, headers and similar structures, and all places not accessible to the roller, or locations at which thorough compaction is not possible, shall be thoroughly compacted with tamps.

Temporary lane marking shall be placed as soon as surface temperature permits. All marking shall conform to the Texas Manual of Uniform Traffic Control Devices for Street and Highways. Unless otherwise specified or directed by the Engineer or designated representative, the placement pattern shall be 24 inches (600 mm) of tape at 80 foot (24 meter) intervals parallel to the flow of traffic. All temporary lane marking tape shall be removed by the Contractor when no longer needed, as determined by the Engineer or designated representative.

350.6 Measurement

Asphalt "Heating, Scarifying and Repaving" as described above shall be measured by the square yard (square meter: 1 square meter equals 1.196 square yards) of surface area of completed and accepted work. The asphalt recycling agent or asphaltic material will be considered subsidiary to Item No. 350, "Heating, Scarifying and Repaving", unless included as a separate pay item in the contract. When included for payment, it shall be measured in gallons (liters: 1 liter equals 0.264 gallons). Temporary traffic tape and placement shall be subsidiary to this item.

350.7 Payment

This item will be paid for at the contract unit bid price for "Heating, Scarifying and Repaving" as provided. The price shall include full compensation for all work including all labor, equipment, materials, heating, scarifying, mixing, rolling, temporary traffic tape and incidentals necessary to complete the work. The binding agents will be considered subsidiary to this item, unless included in the contract as a separate item. When included for payment the binding agent will be paid for at the unit price bid for "Recycling Agent" or "Asphaltic Materials", (SS-1 or CSS-1) as indicated.

Payment will be made under the following:

Heating, Scarifying and Repaving	Per Square Yard.
----------------------------------	------------------

Payment for asphaltic material or asphalt recycling agent, when included as a separate contract pay item, will be made under:

Asphaltic Materials,	Per Gallon.
Recycling Agent,	Per Gallon.
Asphaltic Materials,	Per Gallon.

End

SPECIFIC CROSS REFERENCE MATERIALS

Specification Item 350S "HEATING, SCARIFYING AND REPAVING ASPHALTIC CONCRETE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 230	Rolling (Flat Wheel)
Item No. 232	Rolling (Pneumatic Tire)
Item No. 301	Asphalts, Oils and Emulsions
Item No. 340	Hot Mix Asphaltic Concrete Pavement
Item No. 351	Recycling Agent
Item No. 864	Abbreviated Pavement Markings

Texas Department of Transportation: Manual of Testing

<u>Designation</u>	<u>Description</u>
Tex-208-F	Test for Stabilometer Value of Bituminous Mixtures
Tex-210-F	Determination of Asphalt Content of Bituminous Mixtures by Extraction
Tex-502-C	Test for Penetration Test of Bituminous Mixtures

RELATED CROSS REFERENCE MATERIALS

Specification Item 350S "HEATING, SCARIFYING AND REPAVING ASPHALTIC CONCRETE"

Texas Manual for Uniform Traffic Control DevicesCity of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 206	Asphalt Stabilized Base
Item No. 210	Flexible Base
Item No. 306	Prime Coat
Item No. 307	Tack Coat
Item No. 310	Emulsified Asphalt Treatment
Item No. 311	Emulsified Asphalt Repaving
Item No. 312	Seal Coat
Item No. 320	Two Course Surface Treatment
Item No. 341	Paving Fabric
Item No. 350	Heating, Scarifying and Repaving
Item No. 642	Silt Fence (SF)

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item 300	Asphalts, Oils and Emulsions
Item 301	Asphalt Antistripping Agents
Item 310	Prime Coat (Cutback Asphaltic Materials)
Item 314	Emulsified Asphalt Treatment
Item 345	Asphalt Stabilized Base (Plant Mixed)
Item 354	Planning and/or Texturing Pavement
Item 358	Asphaltic Concrete Surface Rehabilitation

**ITEM NO. 351
RECYCLING AGENT**

351.1 Description

This item shall govern the requirements and uses for recycling agents used in the repaving of asphaltic surfaced streets. Recycling agents are used to restore the plasticity to existing asphaltic paving. Either the agent is used independently or an emulsified agent is used in conjunction with cationic emulsified asphalt.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

351.2 Submittals

The submittal requirements of this specification item include:

- A. Type of recycling agent (petroleum oil or petroleum oil emulsion) including an emulsion designation as cationic or anionic.
- B. Physical and chemical test results on emulsified recycling agent (Saybolt-Furol viscosity, % residue, miscibility, test results of residue from evaporation, etc.).

351.3 Materials

The asphalt recycling agent shall be either a petroleum oil, referred as a recycling agent, or a petroleum oil emulsion, referred to as emulsified recycling agent. These agents may be used alone or the emulsified recycling agent may be used in conjunction with emulsified asphalt having the same particle charge, i.e., a cationic emulsified asphalt may be used with a cationic emulsified recycling agent and an anionic emulsified asphalt may be used with an anionic emulsified recycling agent. The supplier must state the charge of the emulsified recycling agent being furnished, i.e., cationic or anionic. Specific physical and chemical requirements are listed below:

EMULSIFIED RECYCLING AGENT

		Requirements	
Test on emulsion:		Minimum	Maximum
Viscosity, Saybolt Furol @ 25°C (77°F), SFS		15	100
Residue*, % w (mass) *		60	-
Miscibility **	No coagulation		
Sieve analysis, % w (mass)		-	0.1
Test of residue from Evaporation test		minimum	maximum
Flash point, C.O.C.,	202°C (400°F)		
Viscosity @ 60°, (140°F), cst		75	250
Viscosity @ 135°C, (275°F), cst		-	10.0

* Residue shall be determined by the evaporation method set forth in ASTM D244, except that the sample shall be maintained at 300°F (150°C) until foaming ceases, then cooled and weighed.

** Performed according to Test Method TxDOT Test Method Tex-521-C except that 0.02 N calcium chloride solution shall be used in place of water.

The ability of the residue from the evaporation test to restore the original properties of aged asphalt cement shall be determined as follows. The residue shall be blended uniformly in the laboratory with a standard 14 to 16 penetration asphalt at a maximum rate of 20% by weight (mass) of the asphalt. The resulting blend must comply with all the requirements of Specification Item subarticle 301.2.(1) for AC-20 asphalt cement

The standard asphalt cement for the above blend shall be obtained by subjecting an AC-20, meeting all requirements of this item, to the thin film oven test as specified in TxDOT Test Method Tex-510-C except that the test period shall be increased so as obtain the required penetration.

When a petroleum oil recycling agent is specified, it shall meet the same requirements indicated above for the Residue from Evaporation Test on emulsified recycling agent.

351.4 Construction Methods

The rejuvenating agent, when required, shall be applied at a rate specified by the Engineer or designated representative in accordance with Item No. 350, "Heating, Scarifying and Repaving".

351.5 Measurement

"Recycling Agent" will be measured by the gallon (liter: 1 liter equals 0.264 gallons), complete in place.

351.6 Payment

The work will be performed and materials furnished as prescribed by this item and measured as provided for under "Measurement" will be paid for at the unit bid price for this item. The price shall include full compensation for the work, materials, tools and other accessories needed to complete the work.

Payment, when included as a contract pay item, will be made under:

Recycling Agent, Per Gallon.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
--

Specification Item 351 "RECYCLING AGENT"
--

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 301	Asphalts, Oils and Emulsions
Item No. 350	Heating, Scarifying and Repaving

Texas Department of Transportation: Manual of Testing

<u>Designation</u>	<u>Description</u>
Tex-521C	Testing Emulsified Asphalts
Tex 510-C	Determining the Effect of Heat and Air on Asphaltic Material When exposed in Thin Films

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
D-92	Test Method For Flash and Fire Points by Cleveland Open Cup
D-244	Standard Methods of Testing Emulsified Asphalts
D-445	Test Method for Kinematic Viscosity of Transparent and Opaque Liquids

RELATED CROSS REFERENCE MATERIALS

Specification Item 351 "RECYCLING AGENT"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 206	Asphalt Stabilized Base
Item No. 210	Flexible Base
Item No. 230	Rolling (Flat Wheel)
Item No. 232	Rolling (Pneumatic Tire)
Item No. 306	Prime Coat
Item No. 307	Tack Coat
Item No. 310	Emulsified Asphalt Treatment
Item No. 311	Emulsified Asphalt Repaving
Item No. 312	Seal Coat
Item No. 320	Two Course Surface Treatment
Item No. 340	Hot Mix Asphaltic Concrete Pavement
Item No. 341	Paving Fabric
Item No. 864	Abbreviated Pavement Markings

RELATED CROSS REFERENCE MATERIALS - continued

Specification Item 351 "RECYCLING AGENT"

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item 300	Asphalts, Oils and Emulsions
Item 301	Asphalt Antistripping Agents
Item 310	Prime Coat (Cutback Asphaltic Materials)
Item 314	Emulsified Asphalt Treatment
Item 345	Asphalt Stabilized Base (Plant Mixed)
Item 354	Planing and/or Texturing Pavement
Item 358	Asphaltic Concrete Surface Rehabilitation

ITEM NO. 360 CONCRETE PAVEMENT

360.1 Description

This item shall consist of a pavement and/or base of Portland Cement concrete, with or without reinforcement as indicated on the Drawings, with or without monolithic curbs, constructed as herein specified, on prepared subgrade or base course in conformity with the thickness and typical cross sections indicated on the Drawings. Concrete to be considered of satisfactory quality provided it is made (a) of materials accepted for job, (b) in the proportions established by the Contractor and (c) mixed, placed, finished and cured in accordance with the requirements of this specification.

360.2 Materials

(1) Cementitious Materials

Portland cement shall conform to ASTM C 150, Type I (General Purpose) and Type III (High Early Strength). Type III cement shall be used when high early strength concrete is indicated on the Drawings. If the use of high early cement is not specified and the Contractor desires to use it, he shall obtain written permission from the Engineer or designated representative prior to its use and shall assume all additional costs incurred by the use of such cement. All cement shall be of the same type and from the same source for a project unless written permission is first received from the Engineer or designated representative.

Portland cement manufactured in a cement kiln fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Commission on Environmental Quality (TCEQ) and the United States Environmental Protection Agency (USEPA). Supplier shall provide current TCEQ and EPA authorizations to operate the facility.

Bulk or sacked cement may be used and a bag shall contain 94 pounds net. All bags shall be in good condition at the time of inspection. Bulk cement shall be weighed on approved scales as herein prescribed.

All cement shall be stored in a suitable weather tight building or bin, which will protect the cement from dampness. The cement shall be so stored as to provide easy access for proper inspection. Any cement, which has become partially set or which contains hard lumps or cakes or cement salvaged from discarded or used bags, shall not be used.

Fly ash (denoted by Texas DOT designations Type A and Type B) may replace 20 to 35 percent of a mix design's Portland cement content by absolute volume. Fly ash shall not be used in mix designs with less than five (5) sacks of Portland cement per cubic yard unless specifically permitted by the Contract plans of project manual. Fly ash shall conform to the requirements of Item 405, "Concrete Admixtures".

(2) Admixtures

Concrete admixtures conforming to Item No. 405, "Concrete Admixtures" may be used when approved by the Engineer to minimize segregation, improve workability, reduce the amount of mixing water and to provide normal hot weather concreting provisions. The use of admixtures shall not alter the approved mix designs, except for water content.

(3) Coarse Aggregate

Coarse aggregate shall consist of durable particles of gravel, crushed blast furnace slag and/or crushed stone of reasonably uniform quality throughout, free from injurious amounts of salt, alkali, vegetable matter or other objectionable material, either free or as an adherent coating on the aggregate. It shall not contain more than 0.25 percent by weight of clay lumps nor more than 1.0 percent by weight of shale nor more than 5.0 percent by weight of laminated and/or friable particles when tested in accordance with Texas DOT Test Method Tex-413-A.

Coarse aggregate shall have a wear of not more than 45 percent when tested according to Texas DOT Test Method Tex-410-A and when tested by standard laboratory methods shall meet the following grading requirements:

Retained on 1 3/4 inch sieve	0%
Retained on 1 1/2 inch sieve	0 to 5%
Retained on 3/4 inch sieve	30 to 65%
Retained on 3/8 inch sieve	70 to 90%
Retained on No. 4 sieve	95 to 100%

Loss by Decantation Texas DOT Test Method *Tex-406-A. 1.0% Maximum

- * In the case of aggregate made primarily from crushing of stone. If the material finer than the 200 sieve is definitely established to be the dust of fracture essentially free from clay or shale as established by Part III of Texas DOT Test Method Tex-406-A, the percent may be increased to 1.5.

When the plans do not require a monolithic pour of curb or curb and gutter, the Contractor may elect to use the following gradation of coarse aggregate for curb or curb and gutter:

Retained on 1 1/2 inch sieve	0%
Retained on 3/8 inch sieve	5 to 30%
Retained on No. 4 sieve	75 to 100%

Where the coarse aggregate is delivered on the job in 2 or more sizes or types, each type and/or size shall be batched and weighed separately.

All aggregates shall be handled and stored in such a manner as to prevent size

segregation and contamination by foreign substances and to maintain as nearly as possible a uniform condition of moisture. When segregation is apparent, the aggregate shall be remixed with suitable equipment as required. At time of its use, the aggregate shall be free from frozen material and aggregate containing foreign materials will be rejected. Coarse aggregate that contains more than 0.5 percent free moisture by weight shall be stockpiled for at least 24 hours prior to use.

Adequate storage facilities shall be provided for approved materials. The intermixing of non-approved materials with approved materials either in stockpiles or in bins will not be permitted. Aggregates from different sources shall be stored in different stockpiles unless otherwise approved by the Engineer.

(4) Fine Aggregate

Fine aggregate shall be free from injurious materials of salt, alkali or vegetable matter. It shall not contain more than 0.5 percent by weight of clay lumps. When subjected to the color test for organic impurities, Texas DOT Test Method Tex-408-A, the fine aggregate shall not show a color darker than standard.

The fine aggregate shall have a tensile strength of mortar equal to or greater than the strength of standard Ottawa sand mortar when tested in accordance with Texas DOT Test Method Tex-317-D.

Unless specified otherwise, fine aggregate shall meet the following grading requirements:

Retained on 3/8 inch 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 30%
Retained on No. 30 sieve	35 to 75%
Retained on No. 50 sieve	70 to 90%
Retained on No. 100 sieve	90 to 100%
Retained on No. 200 sieve	97 to 100%

Fine aggregate will be subjected to the Sand Equivalent Test, Texas DOT Test Method Tex-203-F. The sand equivalent value shall not be less than 80.

(5) Mineral Filler

Mineral filler shall consist of clean stone dust, crushed sand, crushed shell or other approved inert material. It shall meet the following requirements when tested in accordance with Texas DOT Test Method Tex-401-A:

Retained on No. 30 sieve	0%
Retained on No. 200 sieve	0 to 35%

Where fine aggregate is delivered to the job in 2 or more sizes or types, each type and/or size of material shall be batched and weighed separately. Where mineral filler is used, it shall be batched and weighed separately. At the time of its use the fine aggregate shall be free from frozen material and aggregate containing foreign material will be rejected.

All fine aggregate shall be stockpiled for at least 24 hours prior to use.

(6) Mixing Water

Water for use in concrete and for curing shall be free from oils, acids, organic matter or other deleterious substances and shall not contain more than 1,000 parts per million of chlorides as Cl nor more than 1,000 parts per million of sulfates as SO₄.

Water from municipal supplies approved by the State Health Department will not require testing. Contractor shall sample and test water from other sources and submit test results to the Engineer for approval 10 days prior to proposed use.

Tests shall be made in accordance with "Standard Method of Test for Quality of Water to be used in Concrete", AASHTO Method T-26.

(7) Transit-mixed Concrete

The use of transit-mixed (ready-mixed) concrete will be permitted by the Engineer provided the batching plant and mixer trucks meet requirements of quality specified herein.

When ready-mixed concrete is used, additional mortar (1 sack cement, 3 parts sand and sufficient water) shall be added to each batch to coat the drum of the mixer or agitator truck. Delivery of concrete to the site of the work and its discharge from the truck mixer, agitator or non-agitating equipment shall be in accordance with the requirements of Item No. 410, "Concrete Structures".

Ready-mixed concrete, batching plant and mixer truck operation shall include the following:

- (a) A ticket system will be used that includes a copy for the construction inspector. The ticket will have machine stamped time/date of the concrete batch, weight of cement, sand and aggregates; exact nomenclature and written quantities of admixtures and water. Any item missing or incomplete on the ticket may be cause for rejection of the concrete.
- (b) Sufficient trucks will be available to support continuous slab placements. The Contractor will satisfy the Engineer that adequate standby trucks are available to support monolithic placement requirements.
- (c) A portion of the mixing water, required by the batch design to produce the specified slump, may be withheld and added at the job site but only with the permission of the Engineer and under the Inspector's observation.

When water is added under these conditions, it will be thoroughly mixed before any slump or strength samples are taken.

(8) Joint Sealer

Unless otherwise shown on the plans, joint sealant for concrete pavement used on airport runways and/or taxiways shall be Texas DOT Class 5. All other joint sealant shall be Texas DOT Class 2.

As a minimum, the joint sealant shall comply with the following. The manufacturer of the joint sealant shall furnish certification that the product to be supplied meets or exceeds the specification.

- (a) Class 2 (Hot Poured Rubber-Asphalt). This sealer shall conform to Item 313, Rubber Asphalt Joint and Crack Sealant". The sealer must be compatible with asphaltic concrete.
- (b) Class 5 (Low Modulus Silicone Sealant for Concrete Pavement). This material shall be furnished in a one-part silicone formulation, which does not require a primer for bond to concrete. A backer rod shall be required which will be compatible with the sealant. No bond or reaction shall occur between the rod and sealant. The sealant shall adhere to the sides of the concrete joint. It shall not crack or break when exposed to temperatures below 32° F.

The sealant material shall have the following properties:

Color	Gray
Flow, MIL-2-8802D, Sec 4.8.4, max	0.2
Working time, minutes	10
Tack-free time at 77 F +/- 2 F, MIL-2-8802D,	
Sec 4.8.7, minutes	60
Cure time at 77° F, days	7-14
Full Adhesion, days	14-21

As Cured - after 7 days at 77 F and 40% Relative Humidity

Elongation, minimum percent	1200
Durometer Hardness, Shore A, ASTM D 2240, min	15
Joint movement capability, percent	+100/-50
Tensile Strength, maximum elongation, percent	100
Peal strength, psi	25

(9) Backer Rod

Backer Rod shall be expanded closed cell polyethylene foam compatible with sealant. No bond or reaction shall occur between rod and sealant. Backer Rod shall be of sufficient width to be in compression after placement.

(10) Joint Filler

Boards for expansion joint filler and for contraction and longitudinal joints shall be of the size, shape and type indicated.

Boards shall be obtained from Redwood, Cypress, Gum, Southern Yellow Pine or Douglas Fir timber. They shall be solid heartwood and shall be free from sapwood, knots, clustered birdseye, checks and splits. Occasional sound or hollow birdseye, when not in clusters, will be permitted provided the board is free from any other defects that will impair its usefulness as a joint filler. With the exception of Redwood and Cypress, all boards shall have a creosote or pentachlorophenol treatment of 6 pounds per cubic foot. When oven dried at 230° F to a constant weight, the weight of the board per cubic foot (minus treatment), shall not be less than 20 pounds nor more than 35 pounds.

(11) Asphalt Board

Asphalt board when used as indicated shall be of required size, full depth of concrete placement and uniform thickness. When used in transverse joints, it shall conform approximately to shape of the pavement crown as indicated. Asphalt board shall consist of 2 liners of 0.016-inch asphalt impregnated paper filled with a mastic mixture of asphalt and vegetable fiber and/or mineral filler. Boards shall be smooth, flat and straight throughout and shall be sufficiently rigid to permit easy installation. Boards that crack or shatter during installing and finishing operations will not be acceptable. Board shall be furnished in lengths equal to 1/2 the pavement width or in lengths equal to the width between longitudinal joints and may be furnished in strips or scored sheets of the required shape. When tested in accordance with Texas DOT Test Method Tex-524-C the asphalt boards shall not deflect from the horizontal more than 3/4 inch in 3 1/2 inches. The asphalt board shall be placed such that they will not interfere with the bonding of the joint sealer.

(12) Load Transmission Devices for Expansion and Contraction Joints

Approved load transmission devices, when indicated, shall meet the requirements specified herein:

Smooth steel bar dowels, used when indicated, shall be of the size and type indicated and shall be open-hearth, basic oxygen or electric-furnace steel conforming to the properties specified for grade 60 in ASTM A 615. The free end of dowel bars shall be smooth and free of shearing burrs.

When indicated, one end of each dowel bar shall be encased in an approved cap having an inside diameter of 1/16 inch greater than the diameter of the dowel bar. The cap shall be of such strength, durability and design as to provide free movement of the dowel bar and shall be approved by the Engineer prior to use. One end of the cap shall be filled with a soft felt plug or shall be void in order to

permit free movement of the dowel bar for a distance equivalent to 150 percent of the width of the expansion joint used. The dowel caps and dowel bars shall be held securely in place by bar ties as indicated. Mechanical methods of implanting dowel bars in the plastic concrete may be used when approved by the Engineer.

Where required, dowel bars shall be coated with a plastic material meeting the requirements indicated.

Where red lead and oil bar coating is indicated, the red lead may be of any standard commercial grade and the oil shall be clean and no lighter than Standard No. 30 SAE grade. Approved thinner and dryer may be added to the red lead, but the material upon application shall be of such consistency that will provide a uniform and heavy coating on the bar. Where asphalt bar coating is indicated, the material may be any standard grade of oil asphalt and shall be applied hot. Cutback asphalt will not be permitted for bar coating.

(13) Metal Installing Devices for Joint Assembly

Metal installing devices for expansion and contraction joint assemblies (such as welded wire bar chairs, bar stakes and marker channels, channel caps, etc.) shall be as indicated or may be similar devices of equivalent or greater strength, approved by the Engineer, that will secure joint assembly in correct position during the placing and finishing of concrete. Load transmission devices used in joint assemblies shall be secured in position by a transverse metal brace of the type and design indicated or may be secured in position by other approved devices of equivalent or greater strength that will provide positive mechanical connection between the brace and each unit (or than by wire tie) and prevent transverse movement of each load transmission device.

(14) Steel Reinforcement

Steel reinforcing bars as required including tie bars shall be open-hearth, basic oxygen or electric-furnace new billet steel of Grade 60 or Grade 40 for concrete reinforcement as indicated. Bars that require bending shall be Grade 40 conforming to the requirements of ASTM A 615.

High yield reinforcing steel shall be either (a) open-hearth, basic oxygen or electric-furnace new billet steel conforming to ASTM A 615 Grade 60 or (b) rail steel bars for concrete reinforcement, conforming to ASTM A 616 Grade 60. Bars produced by piling method will not be accepted. High yield reinforcing steel bars shall be further identified by a special marking rolled into each bar. All reinforcing steel shall be deformed bars conforming to the requirements of pertinent ASTM Specifications.

Where prefabricated deformed wire mats are indicated or permitted, the wire shall be cold worked deformed steel wire conforming to the requirements of ASTM A 496, except that steel shall be made by open-hearth, electric-furnace or basic oxygen processes. The prefabricated deformed wire mats shall conform to the requirements of ASTM A 497, except that wires used shall be deformed and transverse wires shall project beyond the centerline of each edge longitudinal

wire as indicated. Mats that have been bent or wires dislocated or parted during shipping or project handling shall be realigned to within 1/2 inch of original horizontal plane of the mat. Mats with any portion of the wires out of vertical alignment more than 1/2 inch after realignment and/or wires dislocated or mutilated so that, in the opinion of the Engineer, they do not represent the original mat, shall be rejected. The reinforcement may be clamped or wired so that the reinforcement will retain the horizontal and vertical alignment as indicated or as approved by the Engineer. Deformed wire may be used for tie bars and load transfer bars that require bending. The nominal size, area and theoretical weight of reinforcing steel wires covered by this provision are as listed in Table II. When fabricated steel bars or rod mats are indicated, the mats shall meet requirements of ASTM A 184.

Steel wire fabric reinforcement shall be of the gage and spacing indicated and shall conform to the requirements of ASTM A 82. Longitudinal and transverse wires shall be electrically welded together at all points of intersection and the welds shall be of sufficient strength that they will not be broken during handling or placing. All welding and fabrication of fabric sheets shall conform to the requirements of ASTM A 185. Welded steel wire fabric shall be furnished in sheets as indicated and steel having been previously bundled into rolls will not be accepted. An approved hinge will be permitted in each sheet to provide for each sheet longitudinally. When wire fabric is used, it will replace only the longitudinal and transverse bars. The tie bars and load transmission units at joints will not be affected.

Table II: DIMENSIONAL REQUIREMENTS FOR DEFORMED STEEL WIRE FOR CONCRETE REINFORCEMENT

Deformed Wire Size No	Unit Weight Pounds Per Ft.	Diameter Inches	Cross-Sectional Area, Sq. inches	Perimeter Inches
Column 1	Column 2	Column 3	Column 4	Column 5
D-1	0.034	0.113	0.01	0.355
D-2	0.068	0.159	0.02	0.499
D-3	0.102	0.195	0.03	0.612
D-4	0.136	0.225	0.04	0.706
D-5	0.170	0.252	0.05	0.791
D-6	0.204	0.276	0.06	0.867
D-7	0.238	0.296	0.07	0.936
D-8	0.272	0.319	0.08	1.002
D-9	0.306	0.338	0.09	1.061
D-10	0.340	0.356	0.10	1.118
D-11	0.374	0.374	0.11	1.174
D-12	0.408	0.390	0.12	1.225
D-13	0.442	0.406	0.13	1.275
D-14	0.476	0.422	0.14	1.325
D-15	0.510	0.437	0.15	1.372
D-16	0.544	0.451	0.16	1.416
D-17	0.578	0.465	0.17	1.460
D-18	0.612	0.478	0.18	1.501
D-19	0.646	0.491	0.19	1.542
D-20	0.680	0.504	0.20	1.583
D-21	0.714	0.517	0.21	1.624
D-22	0.748	0.529	0.22	1.662
D-23	0.782	0.541	0.23	1.700
D-24	0.816	0.553	0.24	1.737
D-25	0.850	0.564	0.25	1.772
D-26	0.884	0.575	0.26	1.806
D-27	0.918	0.586	0.27	1.841
D-28	0.952	0.597	0.28	1.876
D-29	0.986	0.608	0.29	1.910
D-30	1.020	0.618	0.30	1.942
D-31	1.054	0.628	0.31	1.973

- Col. 1: The number following the prefix D identifies the nominal cross sectional area of the deformed wire in hundredths of a square inch. Fractional sizes are also available between the sizes listed.
- Col. 2: The unit weight in pounds per foot is obtained by multiplying the cross sectional area in square inches by 3.4.
- Col. 3: The nominal diameter of a deformed wire is equivalent to the diameter of a plain wire having the same weight per foot as the deformed wire.
- Col. 4: The cross sectional area is based on the nominal diameter. The area in square inches may be calculated by dividing the weight per lineal inch of specimen in pounds by 0.2833 (weight of 1 cubic inch of steel) or by dividing the weight per lineal foot of specimen in pounds by 3.4 (weight of steel 1 inch square and 1 foot long).

(15) Polyethylene Film

Polyethylene film shall be opaque pigmented white in color and shall be manufactured from virgin resin without additives or scrap. It shall be sufficiently strong and tough to permit its use under the conditions existing on street paving work without being torn or otherwise rendered unfit for the purpose during the curing period. The film shall have a minimum thickness of 4 mils (0.004 inch), shall have a minimum tensile strength of 1,700 psi at 77° F in the longitudinal direction and 1,200 psi at 77° F in the transverse direction and shall have a minimum elongation of 200 percent at 77° F in the longitudinal direction and 150 percent at 77° F in the transverse direction. The permissible percent moisture loss shall not exceed 2 percent after 24 hours and 4 percent after 72 hours. Tests for tensile strength and elongation will be conducted in accordance with ASTM Designation: D 882, Method A. Tests for moisture retention will be conducted in accordance with ASTM Designation: C 156.

(16) Membrane Curing Compound

Membrane curing compound shall conform to Item No. 409, "Membrane Curing", Type 2 white pigmented.

(17) Asphalt Curing

Where asphalt is to be placed on a concrete base, asphalt shall be used for curing concrete base, the material shall conform to Item No. 301, "Asphalts, Oils and Emulsions" for RS-2 or RS-2h or as indicated.

360.3 Equipment

(1) General

All equipment necessary for construction of this item shall be on the Project and shall be approved by Engineer as to conditions before the Contractor will be permitted to begin construction operations on which the equipment is to be used. When approved by the Engineer in writing, a commercial or independently

operated batching plant for measuring materials outside limits of the project may be used.

(2) Mixer

The mixer furnished may be either a paving mixer (operated at site of construction or centrally located), a stationary mixer (central mixer) or a paving mixer (truck mounted) that will produce adequately mixed concrete meeting the specified requirements. The mixer, or mixers, shall conform to the following requirements:

- (a) Each mixer shall have attached in a prominent place a manufacturer's plate showing rated capacity of the drum in terms of volume of mixed concrete and the recommended speed of rotation of the mixing drum or blades.
- (b) The stationary mixer (central mixer) or truck mounted paving mixer shall be operated at the manufacturer's recommended speed.
- (c) The size of the paving mixer shall not be less than that of a 27-E paver, as established by the Mixer Manufacturer's Bureau of Associated General Contractors. The paving mixer shall be operated at a drum speed of not less than 16 revolutions per minute and not more than 22 revolutions per minute. Pickup and throw over blades in the drum of the mixer shall be replaced when worn down 3/4 inch or more.
- (d) Each truck mounted paving mixer shall be approved by the Engineer prior to use on the project. It shall be classified as a "paving mixer" by the manufacturer and shall be so designed that a uniform and low slump concrete (approximately 1 1/2 inch slump) can be mixed without aggregate size segregation. The mixer shall be capable of discharging the low slump concrete at a speed of 10 seconds per cubic yard or faster.
- (e) Each mixer shall be equipped with an approved automatic device for satisfactorily timing the mix and locking the discharging device in order to prevent the discharging of the mixer before the end of the required mixing period. This timing device shall operate a sounding device to signal plainly the completion of the mixing time. When permitted by the Engineer a light signal device may be used.
- (f) Multiple drum mixers will be permitted provided their operation is properly synchronized. The mixing time shall be determined exclusive of the time required to transfer concrete from one drum to the next drum.
- (g) Each mixer shall be equipped with a water-measuring device so constructed that it will measure the water within 1 percent of the total amount required for each batch. Unless the water is to be weighed, the water measuring equipment shall include an auxiliary tank with a capacity greater than that of the measuring tank and from which the measuring tank will be filled by gravity flow. The measuring tank shall be open to the atmosphere and shall be so placed and constructed that the water for a batch can be discharged into a calibrated tank or weighing device for

checking the accuracy of water measurement without seriously delaying the paving operations. The Contractor shall have a calibrated tank or weighing device available at all times at a location satisfactory to the Engineer.

- (h) If a paving mixer is furnished and operated at the site of construction, it shall be equipped with a power controlled boom and bucket, so designed as to permit uniform distribution of the concrete for the full width between pavement forms. Alternate equipment for distributing concrete may be substituted when approved by the Engineer in writing, provided uniform distribution is obtained without segregation.
- (i) If central mixed concrete is used on the project, the Contractor shall provide equipment designed to provide uniform distribution for the concrete for the full width between pavement forms without segregation.

(3) Transit-mix Trucks

When transit-mix (ready-mix) concrete is used, additional mortar (1 sack cement, 3 parts sand and sufficient water) shall be added to the batch to coat the drum of the mixer or agitator truck. This shall be required for every load of concrete. The mixing speed shall be attained as soon as all ingredients are in the mixer. Each complete batch (containing all the required ingredients) shall be mixed not less than 70 nor more than 100 revolutions of the drum at mixing speed.

A portion of the mixing water, required by the batch design to produce the desired slump, may be withheld and added at the job site, but only with permission of the Engineer and under his supervision. When water is added at the job site, 25 revolutions (minimum) at mixing speed, will be required to flush down the blades after charging shall be accurately measured and included in the quantity of mixing water. The introduction of the initial mixing water, except blade wash down water and that permitted in this Article shall be prior to or simultaneous with the charging of the aggregates and cementitious material.

Mixing and agitating speed shall be as designated by the mixer manufacturer. All revolutions after prescribed mixing shall be at agitating speed. Except for short periods of time during discharge, the drum shall be kept in continuous motion from the time the mixing is started until the discharge is completed.

Additional mortar, consisting of 1 sack cement, 3 parts sand and sufficient water, shall be added to the batch to coat the drum of the transit mixer or agitator truck. This shall be required for every load of concrete.

The loading of transit-mixers shall not exceed 63 percent of the drum volume. When used as an agitator only, the loading of truck mixers shall not exceed 80 percent of the drum volume.

The batching plant and transit-mix trucks shall operate under the following system:

- (a) A ticket system will be used that includes a copy for the construction inspector. The ticket will have machine stamped time/date of

water/cement batch; weight of cement, fly ash (if applicable), water, sand and aggregates; exact nomenclature and quantities of admixture. Any item missing or incomplete on the ticket will be cause for rejection. Coded readouts may be used if approved in advance by the Engineer.

- (b) Sufficient trucks will be available to support continuous placements. The Contractor will satisfy the Engineer that adequate standby trucks are available to support monolithic placement when required.
- (c) A portion of the mixing water, required by the batch design to produce the desired slump, may be withheld and added at the job site, but only with the permission of the Engineer and under the Inspector's observation. When water is added under these conditions, it will be thoroughly mixed before any slump or strength beam samples are taken.

(4) Hauling Equipment

Batch hauling equipment for the transportation of measured materials from the batching plant to the mixer shall be equipped with tight covers, which shall be used to prevent excessive evaporation of moisture or any loss of material.

If a central mixer is used, concrete may be transported to the point of delivery in truck agitators or non-agitating trucks.

If a truck mounted paving mixer is used, it may be used to transport the concrete after mixing is complete.

If non-agitator trucks are used they shall conform to the following requirements:

The bed of non-agitating hauling equipment shall be a smooth, mortar-tight, metal container. The hauling equipment shall be capable of delivering the concrete to the work site in a thoroughly mixed and uniform mass and capable of discharging the concrete at a satisfactory controlled rate without segregation. If in the opinion of the Engineer any appreciable segregation or accumulation of excess water and/or mortar occurs on the surface of the concrete, this may be cause for rejection and this method of transporting the concrete to the point of delivery shall be suspended as directed by the Engineer.

(5) Subgrade or Subbase Planer and Templates

Unless a stabilized subbase is provided, an approved subbase planer shall be provided, mounted on visible rollers riding on the forms and having adjustable cutting blades which shall trim the subgrade to the exact section as indicated. The planer frame shall be heavy enough to remain on the forms at all times and shall be of such strength and rigidity that, under a test made by changing the support from the wheels to the center, it shall not develop a deflection for more than 1/8 inch. Tractive power equipment used to pull the planer shall not be such as to produce ruts or indentations in the subgrade.

When the slip form method of paving is to be used, the subgrade planer will be operated on a prepared track grade or controlled by an electronic sensor system operated from a string line that establishes the horizontal alignment and the elevation of the subbase.

A template for checking the contour of the subbase shall be provided and operated by the Contractor. The template shall rest upon the side forms and shall be of such strength and rigidity that, under a test made by changing the support to the center, it shall not show a deflection of more than 1/8 inch. It shall be provided with accurately adjustable rods projecting downward to the subgrade at 1-foot intervals and these rods shall be adjusted to the required cross section of the bottom of the slab when the template is resting upon the side forms. Where stabilized subbase is provided, use of a scratch template will be required.

(6) Forms

Side forms shall be of metal of approved cross section. The preferred depth of the form shall be equal to the required edge thickness of the pavement. Forms with depth greater than the required edge thickness of the pavement will be permitted.

The length of form sections shall not be 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 be of 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, the impact and vibration of the spreading and finishing machinery. In no case shall the base be less than 6 inches for a form 6 inches or more in height. The forms shall be free from warps, bends or kinks and shall be sufficiently true to provide a reasonably straight edge on the concrete. The top of each form section, when tested with a straightedge shall conform to the requirements specified for the surface of the completed pavement. Sufficient forms shall be provided for satisfactory prosecution of the work.

Outside curb forms shall be of wood or metal of a section satisfactory to the Engineer, straight, free of warp and shall be in a depth at least equal to the depth of the curb. They shall be mounted on the paving forms and securely attached thereto and maintained in true position during the placing of the concrete. Inside curb forms, if required, shall be of approved material and of such design as to provide the curb required and shall be rigidly attached to the outside forms.

(7) Concrete Spreader

Use of concrete spreader shall be required and it shall be a self-propelled machine having sufficient power and traction to spread and strike off concrete without slippage on the forms. It shall be equipped with a power driven device for spreading the concrete uniformly between the forms. The spreading device may be either a reciprocating blade, a screw conveyer or a belt conveyer. The spreader shall be capable of striking off the surface of the concrete between the forms in the longitudinal direction of the slab at any required elevation.

Mechanically operated concrete spreaders of other designs, which uniformly distribute the concrete with a minimum of segregation, may be used when approved by the Engineer.

(8) Slipform Paver

With prior approval, the Contractor may place concrete with slip form paver. This paver shall be equipped with a longitudinal trans-angular finishing float adjustable to crown and grade and be satisfactory to the Engineer. The float shall extend across the pavement practically to the side forms and/or the edge of slab. A "string line" shall be used to provide grade control for the paver.

(9) Mechanical Vibratory Equipment

All concrete placed for pavement shall be consolidated by approved mechanical vibrators operated ahead of the transverse finishing machine and designed to vibrate the concrete internally and/or from the surface. Vibratory members shall extend across the pavement practically to, but shall not come in contact with the side forms. Mechanically operated vibrators shall be mounted in such manner as not to interfere with transverse or longitudinal joints. The internal-type vibrators shall be spaced at not more than 24 inches and shall be equipped with synchronized vibratory units. Separate vibratory units shall be spaced at sufficiently close intervals to provide uniform vibration and consolidation to the entire width of the pavement. The frequency in air of the interval spud type vibratory units shall be not less than 8,000 cycles per minute and not less than 5,000 cycles per minute for tube types and the method of operation shall be as directed by the Engineer. The Contractor shall have a satisfactory tachometer available for checking the vibratory elements.

The pavement vibrators shall not be used to level or spread the concrete but shall be used only for purposes of consolidation. The vibrators will not be operated where the surface of the concrete, as spread, is below the elevation of the finished surface of the pavement, except for the first lift of concrete where double strike off method of placement is employed and the vibrators shall not be operated for more than 15 seconds while the machine upon which they are installed is standing still.

The pan type vibratory units shall apply the vibrating impulses directly to the surface of the concrete. The operating frequency shall be not less than 3,500 cycles nor more than 4,200 cycles per minute in air. The Contractor shall have a satisfactory tachometer available for checking the speed of the vibratory elements.

Approved hand manipulated mechanical vibrators shall be furnished in the number required for provision of proper consolidation of the concrete along forms, at joints and in areas not covered by mechanically controlled vibrators. These vibrators shall be sufficiently rigid to insure control of the operating position of the vibrating head.

Complete and satisfactory consolidation of the concrete pavement is a most important requirement of this specification. Cores taken shall be carefully examined for voids, honeycombing or other evidence of incomplete consolidation. If such evidence is present, changes in the consolidation procedures and/or equipment will be made to insure satisfactory consolidation.

(10) Finishing Equipment

(a) Transverse Finishing Machine

The Transverse finishing machine shall be provided with 2 screeds accurately adjusted to the crown of the pavement, shall be self-propelled and mounted in a substantial frame equipped to ride on the forms, or may be slip form finished, and shall be so designed and operated as to strike off and consolidate the concrete.

(b) Longitudinal Finishing

A transverse drag float may be used in lieu of the longitudinal finishing machine with the Engineer's approval. Finishing machines shall be maintained in a tight and good operating condition, accurately adjusted to the required crown or profile and free from deflection, wobble or vibration tending to affect the precision of finish. Machines failing to meet these requirements will be rejected by the Engineer and the Contractor shall provide approved equipment.

Where hand finishing is permitted under this specification, the Contractor shall provide a strike template and a tamping template both of 4 by 10 inch lumber or equivalent metal section and at least 2 feet longer than the width of the pavement. Both templates to conform to the crown section of the pavement and the tamp, if of wood, shall have a steel face not less than 3/8 inch in thickness. The Contractor shall also provide a longitudinal float of approved design and not less than 14 feet in length.

The Contractor shall furnish and maintain at least two standard 10-foot steel straightedges on the work site at all times during the paving operations. The Contractor shall operate same in the presence of the Engineer.

The Contractor shall furnish a sufficient number of bridges to ride on the forms and span the pavement for finishing operations and for the installation and finishing of joints. All necessary finishing and edging tools shall be furnished as may be required to complete the pavement as indicated.

360.4 Proportioning of Concrete

(1) Proportions

Concrete shall be composed of Cementitious Materials, fine aggregate, coarse aggregate, mineral filler and/or admixture if used and water, mixed in the proportions designated by the approved Mix Design and in the manner set forth in this specification. On the basis of job and laboratory investigations of the proposed materials, the Contractor will fix proportions by weight of water, coarse aggregate, fine aggregate, cementitious materials, admixture and mineral filler where required, in order to produce concrete of the specified strength and workability for the actual delivery time and site conditions to be encountered. Where curbs are placed separately, the Engineer may allow aggregate gradation

conforming to Class A Concrete, Item No. 403, "Concrete for Structures".

(2) Concrete Strength

The concrete mix shall be designed to produce a concrete with the following requirements:

CONCRETE PAVEMENT		
Item	Test	Value
Entrained Air	Tex-416-A	3 to 6 percent
Water-Cement Ratio gal./sack, Maximum		6.25
Sacks Cement, Minimum (94 pounds ea)		6 per cubic yard
Coarse Aggregate Factor		0.65 min - 0.85 max.
Flexural Strength after 7 Day, psi	Tex-410-A & C-11	650
Flexural Strength after 28 day, psi	Tex-410-A & C-11	700
Maximum Concrete Mix Temperature F		95
Retarder: Regular Concrete increase in time over 360.6(3) , minutes, Maximum		60

HIGH EARLY STRENGTH CONCRETE		
Item	Test	Value
Cement Type		III
Entrained Air	Tex-416-A	3 to 6 percent
Water-Cement Ratio gal./sack, Maximum		6.25
Sacks Cement, Minimum (94 pounds)		7 per cubic yard
Coarse Aggregate Factor		0.65 min-0.85 max
Slump, inches	Tex-415-A	1/2 to 2
Flexural Strength, after 24 hours, psi	Tex-420-A & C-11	400
Flexural Strength, after 3 days, psi	Tex-420 A & C-11	500
Flexural Strength, after 7 Days	Tex-420-A & C-11	700
Flexural Strength, after 28 Days	Tex-420-A & C-11	750
Maximum Concrete Mix, Temperature F		95

The Contractor may submit a mix design using high range water reducing admixtures conforming to Item No. 405, "Concrete Admixtures" in lieu of the concrete pavement mix specified and shall meet the following requirements:

HIGH RANGE WATER REDUCING ADMIXTURES: SUPERPLASTERIZER CONFORMING TO SECTION 405, "CONCRETE ADMIXTURES"		
Item	Test	Value
Entrained Air	Tex-416-A	3 to 6 percent
Water-Cement Ratio, gal./sack, Maximum		6.25
Sacks Cement, Minimum (94 pounds)		6 per cubic yard
Coarse Aggregate Factor		0.65 min. - 0.85 max.
Slump, inches before Admixture	Tex-415-A	1/2 to 2
Slump, Inches after Admixture	Tex-415-A	4 to 10
Flexural Strength, after 3 days, psi	Tex-420-A & C-11	550
Flexural Strength, after 7 days, psi	Tex-420-A & C-11	700
Flexural Strength, after 28 days, psi	Tex-420-A & C-11	750
Maximum Concrete Mix, Temperature, F		100
Retarder, Regular Concrete Over 360.6(3), Minutes, Maximum		120

High range water reducing admixtures shall be capable of maintaining the original slump until placement and screeding, which may be 2 hours, without the addition of water, additional admixture or other retempering or remixing techniques.

(3) Workability of Concrete

Concrete shall be uniformly plastic, cohesive and workable. Workable concrete is defined as concrete which can be placed without honeycomb and without voids in the surface of the pavement after the specified finishing machine has been over a given area twice. Workability shall be obtained without producing a condition such that free water appears on the surface of the slab when being finished as specified. Where water appears on the surface of the concrete after finishing and this condition cannot be corrected by reasonable adjustment in the batch design, the bleeding to be immediately corrected by one of the following measures or a combination of two or more of the following listed measures:

- (a) Redesign of the batch.
- (b) Addition of mineral filler to fine aggregates.
- (c) Increase of cement content.
- (d) Use of an approved air entraining agent or approved admixture.

In the event that the measures taken do not eliminate the bleeding immediately, concrete placement operations will be suspended, as directed by the Engineer, by placing a bulkhead or "header" as indicated and according to applicable requirements for intentional stoppage of placement in Item No. 360, "Concrete Pavement" of this specification and will remain suspended until such time as additional trial mixes demonstrate that a non-bleeding batch design has been

achieved. Failing to achieve a satisfactory laboratory batch design the Contractor will be required to use different materials and to submit samples thereof for additional trial mixes and pilot beams.

The mix will be designed with the intention of producing concrete, which will have a slump of 1 1/2 inches. The slump shall not be less than 1/2 inch nor more than 2 inches.

(4) Mix Design

The Contractor shall perform at his own expense and be responsible for the design of the concrete mix. The mix design shall be prepared and sealed by a person qualified and experienced in such work with established proportions on the basis either of laboratory trial batches or of field experience with the materials to be employed.

When ice is used to lower the concrete temperature during hot weather, concrete placement (Section 13 of Standard Specification Item No. 410, "Concrete Structures"), the Contractor shall furnish a mix design (Section 6 of Standard Specification Item No. 403, "Concrete for Structures") acceptable to the Engineer for class of concrete specified. The addition of ice shall not exceed 50 percent of the total mix water weight.

Complete concrete mix design data shall be submitted to the Engineer for approval at least 10 days before concrete placement begins. Submittal of the mix shall be accompanied by such test data and certifications as may be necessary to demonstrate compliance with specification requirements. Approval of this mix design will in no way relieve the Contractor of responsibility for the quality of the concrete.

It shall also be the responsibility of the Contractor to determine and measure batch quantity of each ingredient, including water, not only for batch designs but for all concrete produced for the project, so that the mix conforms to these specifications.

Trial batches shall be made and tested using all the proposed ingredients prior to the placing of concrete and also when the aggregate and/or type, brand or source of cement or admixture is changed. When the brand and/or source of cement only is changed, the Engineer may waive trial batches only if a prior record of satisfactory performance of the cement has been established.

Mix designs used successfully on previous or concurrent jobs may be approved by the Engineer without trial batches if it is shown that there is no substantial change in any of the proposed ingredients.

The Contractor shall prepare concrete test beams of each mix design, cure and test at the age of 7 days. From these preliminary tests the water-cement ratio required to produce concrete of the specified strength will be selected by the Contractor for approval by the Engineer. The Contractor may at any time present in writing a suggested mix design and if the Engineer concurs with the suggested design, the Contractor shall conduct trial batches necessary to determine its acceptability under these specification requirements.

The Contractor shall furnish and operate the mixer approved for use on this project unless the concrete is to be furnished from a transit mix (ready-mix) plant. When mixing the concrete to be used in making the preliminary test specimens, a minimum 1 cubic yard batch shall be mixed or a batch of sufficient size to afford proper mixing, whichever is the greater. In lieu of the above mixer and procedure, the Contractor may furnish a portable mixer of sufficient rated capacity to mix a minimum 3-sack batch; in which case, the batch mixed for the preliminary test shall not be less than the rated capacity of the mixer furnished. A coating batch will be mixed prior to mixing for test beams.

No additional compensation to be allowed for equipment, materials or labor involved in making job mix design test specimens.

After the mix proportions and water-cement ratio required to produce concrete of the specified strength have been determined, placing of the concrete may be started. The strength of the concrete in the completed pavement will be determined by flexural strength test specimens made, cured and tested as provided in Texas DOT Bulletin C-11. Modifications of the mix design may be requested by the Contractor on basis of conformity of the strength of these test specimens with the requirements and intent of this specification.

Changes in the water-cement ratio and the mix design, including an increase in cement factor if necessary, will be made when the average 7 day flexural strength of the concrete, as indicated by the last 10 flexural strength values (modulus of rupture) obtained from tests of beams made from concrete of the same water-cement ratio, departs from the desired minimum average strength by more than 4 percent.

(5) Construction Testing:

Straightedge surface testing to be carried out as prescribed above.

The Engineer shall take test beams for flexural strength values on a random basis. A test to consist of the average of 2 beams for regular concrete and 4 beams for high early strength concrete and high range water reducing admixture concrete. Tests shall be made for each 500 square yards constructed, in accordance with TxDOT Bulletin C-11. Additional tests may be taken as determined by the concrete placement conditions or for adequately determining the strength of concrete where the early opening of the pavement to traffic is dependent upon concrete strength tests. No extra compensation will be allowed for materials and work involved in fulfilling these requirements.

360.5 Construction Methods

(1) Preparation of Subgrade

Where stabilized subbase is not provided, the subgrade shall be excavated as required, all unstable or otherwise objectionable material removed and all holes, ruts and depressions filled with approved material and compacted. Rolling and sprinkling shall be performed when and to the extent required and the roadbed shall be completed to or above the plane of the typical sections, lines and grades

indicated or as established by the Engineer. The subgrade shall be proof rolled and any soft areas shall be repaired before the forms are placed. In the event that the proof rolled subgrade is exposed to rainfall or other conditions, which may soften the subgrade, corrective measures shall be taken and the subgrade shall be proof rolled again.

The subgrade planer shall be operated from approved forms immediately ahead of paving operations and the subgrade shall be finished to the exact section of the bottom of the pavement as indicated. Where traveling form pavers are used, the subgrade planer shall operate on a prepared track grade or be controlled by electronic sensors operating from a stringline that establishes line and grade. It shall be tested with the approved template, operated and maintained by the Contractor. The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the pavement is placed and shall be kept thoroughly wetted down sufficiently in advance of placing any pavement to insure its being in a firm and moist condition for at least 2 inches below the prepared surface. Sufficient subgrade shall always be prepared in advance to insure satisfactory prosecution of the work.

No equipment or hauling shall be permitted on the prepared subgrade, except by special permission of the Engineer, which will be granted only in exceptional cases and only where suitable protection in the form of 2-ply timber mats or other approved material is provided.

(2) Placing and Removing Forms

The subgrade under the forms shall be firm and cut true to grade so that each form section when placed will be firmly in contact for its whole length and base width and exactly at the established grade. Any subgrade under the forms below established grade shall be corrected, using suitable material, placed, sprinkled and rolled as directed. Forms shall be staked with at least 3 pins for each 10-foot section. A pin shall be placed at each side of every joint. Form sections shall be tightly joined and keyed to prevent relative displacement. Forms shall be cleaned and oiled each time they are used.

Forms shall be set for a sufficient distance in advance of the point where concrete is being placed to permit a finished and approved subgrade length of not less than 300 feet ahead of the mixer. Conformity of the grade and alignment of forms shall be checked immediately prior to placing concrete and necessary corrections made by the Contractor. Where any form has been disturbed or any subgrade becomes unstable, the form shall be reset and rechecked. In exceptional cases, the Engineer may require suitable stakes driven to the grade of the bottom of the forms to afford additional support. Sufficient stability of forms to support the equipment operated and to withstand its vibration without springing or settlement shall be required. If forms settle and/or deflect over 1/8 inch under finishing operations, paving operations shall be stopped and the forms shall be reset to line and grade.

Forms shall be leveled using cement-stabilized material containing not less than 1 1/2 sacks of cement per ton of mix as placed. The aggregate gradation and

water content shall be determined by the Contractor. The cement-stabilized material shall be sufficiently plastic to insure filling voids underneath the paving forms. Paving equipment will not be permitted on the forms until the cement-stabilized material has cured for at least 12 hours.

Forms shall remain in place for not less than 8 hours after the concrete has been placed. Forms shall be carefully removed in such a manner that little or no damage will be done to the edge of the pavement. Any damage resulting from this operation shall be immediately repaired. After the forms have been removed, the ends of all joints shall be cleaned and any honeycombed areas pointed up with approved mortar and the surfaces protected with curing material conforming to Item No. 409, "Membrane Curing".

Immediately after pointing is complete, the form trench, if used, shall be filled with granular material or earth from the shoulders in such manner as to shed water from rainfall and prevent curing material from washing away from the edge of pavement. On completion of the required curing, the subgrade or shoulders adjacent to the pavement shall be placed and compacted in condition to maintain drainage.

360.6 Concrete Mixing and Placing

(1) Mixing Methods

The concrete shall be mixed in a mixer conforming to the requirements of this item.

(2) Mixing

The aggregates, mineral filler if required, cementitious materials and water shall be measured separately, introduced into the mixer and mixed for a period of not less than 50 seconds nor more than 90 seconds, measured from the time the last aggregate enters the drum to the time discharge of the concrete begins. The required water shall be introduced into the mixing drum during the first 15 seconds of mixing. The entire contents of the drum shall be discharged before any materials of the succeeding batch are introduced.

The Engineer may increase the minimum mixing time to that necessary to produce thoroughly mixed concrete based on inspection or appropriate uniformity tests. The mixing time may be varied at any time as necessary to produce acceptable concrete.

If a central mixer is used, the concrete shall be discharged into the specified hauling equipment and delivered to the road site. If truck agitators are used, the concrete shall be continuously agitated at not less than 1 nor more than 6 rpm as directed by the Engineer.

The maximum size of the concrete batch, absolute volume, shall not exceed 120 percent of the rated size of the mixer (40.8 cubic feet maximum batch for 34 cubic foot paver). Spilling of material from the mixer drum shall be corrected by reducing the size of the batch. Retempering or remixing of concrete will not be permitted.

The initial batch of concrete mixed after each time the mixer is washed out shall be enriched by additional mortar. The additional mortar shall be 1 sack of cement and 3 parts of sand.

When transit-mix (ready-mix) concrete is permitted, the batching plant shall meet the requirements of Item 403, "Concrete for Structures".

(3) Placing

Unless otherwise indicated, the concrete may be placed by using forms or by use of a slipform paver. Any concrete not placed as herein prescribed within 30 minutes after mixing shall be rejected and disposed of as directed except as provided otherwise herein. If in the opinion of the Engineer, the temperature, wind and/or humidity conditions are such that the quality of concrete will not be adversely affected, the specified placing time may be extended by a maximum of 45 minutes. Concrete with high range water reducing admixture shall not be placed after the slump has dropped by 3 inches or more. Except by specific written authorization of the Engineer, concrete shall not be placed when the temperature is below 40 F and falling but may be placed when the temperature is above 35 F and rising, the temperature being taken in the shade and away from artificial heat.

When the temperature of the air is above 85 F, an approved retarding agent will be required in concrete. The maximum temperature of all regular concrete placed shall not exceed 95 F, unless otherwise specified.

When concrete is being placed in cold weather, the Contractor shall have available a sufficient supply of an approved covering material to immediately protect concrete if the air temperature falls to 32 F or below, before concrete has been placed 4 hours. Such protection shall remain in place during the period the temperature continues below 32 F or for a period of not more than 5 days. Neither salt nor other chemical admixtures shall be added to the concrete to prevent freezing. The Contractor shall be responsible for the quality and strength of concrete under cold weather conditions and any concrete damaged by freezing shall be removed and replaced at his expense. Concrete shall not be placed before sunrise and shall not be placed later than will permit finishing of the pavement during sufficient natural light.

Concrete shall be placed only on approved subgrade or subbase and unless otherwise indicated, the full width of the pavement shall be constructed monolithically. The concrete shall be deposited on the subgrade or subbase in such manner as to require as little rehandling as possible. Where hand spreading is necessary, concrete shall be distributed to the required depth by use of shovels. The use of rakes will not be permitted. Workmen will not be permitted to walk in the concrete with any earth or foreign material on their boots or shoes. The placing of concrete shall be rapid and continuous.

When the concrete is to be placed in separate lanes, the junction line shall not deviate from the true line more than 1/2 inch at any point and shall be finished as indicated.

The mixer shall not be located on completed pavement, except as herein provided, but may be located on the subgrade of that lane of the pavement being constructed, as provided under "Preparation of Subgrade". When limited space, in the opinion of the Engineer, requires operation of the mixer on completed pavement, the mixer may be so operated provided the concrete has attained the minimum average flexural strength required and provided suitable protection to the pavement in the form of 2 ply timber mats or otherwise approved material is provided.

Concrete shall be distributed to such depth that when consolidated and finished, the slab thickness indicated will be obtained at all points and the surface shall not, at any point, be below established grade. Special care shall be exercised in placing and spading concrete against forms and at all joints to prevent the forming of honeycombs and voids.

Concrete for the monolithic curbs shall be the same as for the pavement and if carried back from the paving mixer shall be placed within 20 minutes after being mixed. It may be placed from the separate mixer, if desired, but in any case must be placed while the pavement concrete is still plastic. When sawed joints are used, curbs shall be doweled as indicated and poured after sawing. Curbs doweled on and placed separately may be placed with an extrusion machine.

If a central mixer or batcher is used, the Contractor shall provide a system satisfactory to the Engineer for determining that concrete delivered to the road meets the specified requirements for mixing and time of placing.

Unless otherwise indicated, 2 mixers or transit mixers will be required where the double strike off method is employed.

(4) Reinforcing Steel and Joint Assemblies

All reinforcing steel, including steel, welded wire fabric reinforcement, tie bars, dowel bars and load transmission devices used in accordance with plan provisions shall be accurately placed and secured in position in accordance with details indicated. Reinforcing bars shall be securely wired together at alternate intersections, following a pattern approved by the Engineer and at all splices and shall be securely wired to each dowel intersected. When wire fabric is used, it shall replace only the longitudinal and transverse bars and shall be securely wired together at all splices and to each dowel intersected. When welded wire fabric is selected, the Contractor shall pour the lower half of the slab, place the welded wire fabric and place the remaining concrete. Tie bars shall be installed in the required position by the method and device indicated. Bar coating indicated and of material specified, shall be completed and the bars and coating shall be free of dirt or other foreign matter at the time of installation in the concrete.

Tightly adhered scale or rust which resists removal by vigorous wire brushing need not be removed except that excessive loss of section to the reinforcement due to rust shall be cause for rejection. Excessive loss of section shall be defined as loss of section to the extent that the reinforcement will no longer meet the physical requirements for the size and grade of steel specified.

Where an assembly of parts at pavement joints is indicated, the assembly shall be completed, placed at required location and elevated and all parts rigidly secured in required position by the method and devices indicated. Dowel bars shall be accurately installed in joint assemblies as indicated, each parallel to the pavement surface and to the center line of the pavement and shall be rigidly secured in the required position by such means as indicated that will prevent their displacement during placing and finishing of the concrete. Unless specifically authorized by the Engineer in writing, the load transmission devices shall be accurately installed in joint assemblies indicated, each unit vertical with its length parallel to the center line of the pavement and all units shall be rigidly secured in required position by such means as indicated that will prevent their displacement during placing and finishing of the concrete. Header boards, joint filler and other material used for forming joints shall be accurately notched to receive each load transmission device. All load transmission devices shall be free of rust and clean when installed in the concrete.

The Contractor has the option of substituting welded wire fabric in place of reinforcement bars. The welded wire fabric selected shall have an area and distribution of steel at least equal to the plan requirements. The Contractor shall submit the proposed design to the Engineer for approval before any material is ordered.

If welded wire fabric is used, the entire width of the bottom layer of concrete shall be struck off to conform to the cross section and elevation indicated. The reinforcement shall then be placed immediately upon the concrete, after which the top layer of concrete shall be placed, struck off and screeded. Any portion of the bottom layer of concrete which has been placed more than 15 minutes without being covered with the top layer of concrete shall be removed and replaced with freshly mixed concrete at the Contractor's expense.

(5) Joints

(a) General

All transverse and longitudinal joints when required in the pavement shall be of the types indicated and shall be at required location, on required alignment, in required relationship to tie bars and joint assemblies and in accordance with details indicated. When no transverse joints are indicated, joints shall not exceed 40 feet. Such stakes, braces, brackets or other devices shall be used as necessary to keep the entire joint assembly in true vertical and horizontal position. Where concrete base is overlaid by asphaltic concrete, the joints to be prepared as specified herein, but joint sealing will not be required unless indicated.

If necessary for proper installation of the sealer, excessive spalling of the joint groove shall be repaired to the satisfaction of the Engineer.

Careful workmanship shall be exercised in the construction of all joints to insure that the concrete sections are completely separated by an open joint or by the joint materials and to insure that the joints will be true to the outline indicated. The Contractor shall install joint materials, which will function as a compatible system. Joint sealer shall not be placed where a bond breaker is present.

Green concrete or wet sawed joints are permitted provided the Contractor cleans the joint within 5 minutes after cutting with a 3000 psi water blast followed by a minimum of 7 day cure and sand blast the saw cut immediately prior to placing joint sealer.

Dry sawed joints are permitted provided the Contractor sand blasts the saw cut immediately prior to placing joint sealer.

(b) Expansion Joints

Transverse expansion joints shall be formed perpendicular to the centerline and surface of pavement and shall be constructed in accordance with the sequence of operations indicated. After the transverse finishing machine and before the longitudinal finishing machine have passed over the joint, the Contractor shall test the joint filler for correctness of position and make any required adjustment in the position of the filler and shall install the joint seal space form as indicated. After removal of the joint seal form as indicated, the joint seal space above the joint filler shall be thoroughly sandblasted or machine routed to remove all projecting concrete, laitance, dirt or foreign matter. The concrete faces of the joint seal space shall be left true to line and section throughout the entire length of the joint. On completion of curing of the pavement, the joint sealing filler of the type specified shall be placed as indicated. The faces of the joint seal space shall be clean and surface dry at the time joint sealing filler is placed. On completion of the joint seal, the pavement adjacent to the joint shall be left free of joint sealing material. The joint seal space shall be exactly above and not narrower than the joint filler with no concrete overhangings.

(c) Weakened Plane Joints

Weakened plane joints shall consist of transverse contraction joints and longitudinal joints and shall be formed or sawed as indicated. When the joints are sawed, the saw shall be power driven, shall be manufactured especially for the purpose of sawing concrete and shall be capable of performing the work. Saw blades shall be as indicated. Tracks adequately anchored, chalk, string line or other approved methods shall be used to provide true alignment of the joints. The concrete saw shall be maintained in good operating condition and the Contractor shall keep a

standby power saw on the project at all times when concrete operations are under way.

If membrane curing is used, the portion of the seal, which has been disturbed by sawing operations, shall be restored by the Contractor by spraying the areas with additional curing seal.

Forming, finishing and sealing of the joint seal space shall conform to this item, described above and details indicated.

(d) Contraction Joints

Transverse contraction joints shall be formed or sawed joints perpendicular to the centerline and surface of the pavement and shall be constructed by the method and in the sequence of operations as indicated. Where sawed joints are used, contraction joints at intervals indicated shall be sawed as soon as sawing can be accomplished without damage to the pavement and before 24 hours after the concrete has been placed, the exact time to be approved by the Engineer. The remaining contraction joints shall be sawed in a uniform pattern as directed by the Engineer and they shall be completed before uncontrolled cracking of the pavement takes place. All joints shall be completed before placing concrete in succeeding lanes and before permitting traffic to use the pavement.

(e) Longitudinal Joints

Longitudinal joints shall be of the type or alternate types indicated and shall be constructed of specified materials in accordance with provisions indicated. Longitudinal joints shall be constructed accurately to required lines, shall be perpendicular to the pavement surface at the joint and the pavement surface over and adjacent to the joint shall be finished as specified.

Longitudinal joints shall be sawed as soon as sawing can be accomplished without damage to the pavement. Sawing shall not cause damage to the pavement and the groove shall be cut with a minimum of spalling. No traffic (including construction traffic) shall be permitted on pavement until the longitudinal joint is cut.

(f) Construction Joints

Intentional stoppage of the placing of the concrete shall be at either an expansion joint or at a weakened plane joint. The following provisions shall govern for each type of joint at which the placing of concrete is stopped:

1. When the placing of concrete is stopped at an expansion joint, the complete joint assembly shall be installed and rigidly secured in required position as indicated. A bulkhead of sufficient cross sectional area to prevent deflection, accurately notched to receive the load transmission devices or dowels, as the case may be, and

shaped accurately to the cross section of the pavement shall be provided and installed as a back-up for the joint filler and rigidly secured in required position to permit accurate finishing of the concrete up to the joint. After the concrete has been finished to the joint, formation of the joint seal space and finishing of the joint shall be executed as specified herein and as indicated. The backup bulkhead shall remain in place until immediately prior to the time when concrete placement is resumed, then it shall be carefully removed in such manner that no element of the joint assembly will be disturbed. The exposed portion of the joint assembly shall be free of adherent concrete, dirt or other material at the time placing of concrete is resumed.

2. When placing of concrete is stopped at a weakened plane joint, all applicable provisions of paragraph (1) above shall apply in addition to the following requirement:

The face of the bulkhead adjoining the slab end shall be notched and grooved to fit the exposed half section of the joint assembly and shall be shaped to form the slab end at the center of the joint as indicated. The 1/2 width of joint seal space may be formed by a strip of required section placed and removed as indicated for construction of transverse contraction joints. The Contractor shall have available a bulkhead shaped to section of the pavement. This bulkhead must be drilled to permit the continuation of all longitudinal reinforcing steel through the construction joint and shall be of sufficient section and strength to prevent deflection.

3. When load transmission devices are not provided in the design, intentional stopping of placement of concrete shall occur in the middle of a slab. Provisions shall be made to provide a bulkhead, which will accommodate tie bars of the same length, size and spacing as tie bars used for the longitudinal joints. When the concrete placement is resumed, the bulkhead shall be removed without bending tie bars or damaging the concrete. The joint seal space and sealer shall be the same as for longitudinal joints.

Immediately upon the unintended stoppage of the placing of concrete, the Contractor shall place the available concrete to a line and install the above-described bulkhead at right angles to the centerline of the pavement, perpendicular to the surface and at the required elevation. Concrete shall be placed and finished to this bulkhead. Any concrete remaining on the subgrade ahead shall be removed and disposed of as directed by the Engineer. When placing of concrete is resumed before the concrete has set to the extent that the concrete will stand on removal of the bulkhead, the new concrete shall be rodded with the first. An edge created by a construction joint of this type shall have a joint seal space and shall be sealed as required for contraction joints.

(6) Joint Sealers

(a) Class 2 Materials

This material shall conform to Item 313, "Rubber Asphalt Joint and Crack Sealant".

For placement in vertical joints (curb faces, etc.) either of the following procedures may be used.

- (1) An amount of the mixed material may be set aside until partial curing has taken place and carefully trowelled into the joint with a suitable tool.
- (2) The portion of the joint in the roadway shall be poured and cured. The vertical curb faces shall then be taped or formed and the material poured into the vertical joint from the top.

(b) Class 5 Material

This material together with backer rods shall be applied as indicated in accordance with manufacturer's recommendations.

(7) Asphalt Board

Premolded materials, wherever used, shall be anchored to the concrete on one side of the joint by means of copper wire or nails not lighter than No. 12 B and S gage. Such anchorage shall be sufficient to overcome the tendency of the material to fall out of the joint. The Contractor shall not contaminate joints to receive Class 5 Joint Material with asphalt from the asphalt board.

(8) Curbs

The curb shall be constructed in lengths equal to the adjoining pavement slab lengths and expansion joints shall be provided in the curb opposite each transverse expansion joint in the pavement. Expansion joint material shall be of the same thickness, type and quality as indicated for the pavement and shall be of the section as indicated for the curb. All expansion joints shall be carried through the curb, sidewalk and retaining walls when these items are indicated.

When sawed joints are provided for the pavement, the curb placement shall be delayed until all transverse joints have been sawed. To provide bond for the curb, dowel bars shall be placed as indicated while the pavement concrete is still plastic.

Weakened plane joints shall be formed in monolithic curbs at a spacing to coincide with the joints in the concrete pavement. The joints shall be formed by inserting in the curb an asphaltic board strip cut to conform to the shape of the curb. When the concrete is sufficiently set, the joint on the top and face of curb shall be grooved with an approved type of grooving tool.

A finish coat of mortar shall be applied on the exposed surfaces of the monolithic curbs. The mortar shall be composed of 1 part of Portland Cement and 2 parts of fine aggregate. A mortar coat will not be required for extruded curbs.

The curb face, lower radius and top of curb shall be plastered with the sand-cement mortar. The mortar shall be applied with a template or "mule" made to conform to the curb dimensions as indicated. All exposed surfaces of the curb shall be finished with a steel trowel and brushed to a smooth and uniform surface. The mortar finish as required shall be subsidiary to this item.

(9) Machine Finishing

All concrete pavement shall be finished mechanically with approved self-propelled machines, except as herein provided. Hand finishing will be permitted on the transition from a crowned section to a superelevated section without crown on curves, on straight line superelevation sections less than 300 feet in length, on that portion of a widened pavement outside normal pavement width, on sections where the pavement width is not uniform, or on isolated, narrow in width or required monolithic widths greater than that of available finishing machines.

Machine finishing of pavement shall include the use of power-driven vibrators, power-driven transverse strike off and screed or such alternate equipment as may be substituted and approved under this item.

All concrete pavement shall be consolidated by a mechanical vibrator. As soon as concrete has been spread between the forms, the approved mechanical vibrator shall be operated to consolidate the concrete and remove all voids. Hand manipulated vibrators shall be used for areas not covered by the mechanical vibratory unit.

The transverse finishing machine shall first be operated to compact and finish pavement to the required section and grade, without surface voids. The machine shall be operated over each area as many times and at such intervals as directed. At least 2 trips will be required and the last trip over a given area shall be a continuous run of not less than 40 feet. After completion of finishing with the transverse finishing machine, a transverse drag float may be used.

The consistency of the concrete as placed should allow completion of finishing operations without the addition of water to the surface. When field conditions are such that additional moisture is needed for the final concrete surface finishing operation, the required water shall be applied to surface by fog spray only and shall be held to a minimum.

After finishing is complete and the concrete still workable, the surface shall be tested by the Contractor for trueness with an approved 10 foot straightedge. The straightedge shall be operated from the side of the pavement, placed parallel to the pavement centerline and passed across the slab to reveal any high spots or depressions. The straightedge shall be advanced along the pavement in successive stages of not more than 1/2 its length. Practically perfect contact of the straightedge with the surface will be required and the pavement shall be leveled to this condition, in order to insure conformity with the surface test required below after the pavement has fully hardened. Any correction of the surface required shall be accomplished by adding concrete if required and by

operating the longitudinal float over the area. The surface test with the straightedge shall then be repeated.

For one lane pavement placement and uniform widening, the equipment for machine finishing of concrete pavement shall be as directed by the Engineer but shall not exceed requirements of these specifications. After completion of the straightedge operation, as soon as construction operations permit, texture shall be applied with 1/8 inch wide metal tines with clear spacing between the tines being not less than 1/4 inch nor more than 1/2 inch.

If approved by the Engineer, other equipment and methods may be used, provided that a surface texture meeting the specified requirements is obtained. The texture shall be applied transversely. It is the intent that the average depth resulting from the number of tests directed by the Engineer be not less than 0.060 inch with a minimum texture depth of 0.050 inch for any one test when tested in accordance with Texas DOT Test Method Tex-436-A. Should the texture depth fall below that intended, the finishing procedures shall be revised to produce the desired texture.

(a) Emergency Procedures

The Contractor shall have available at all times hand rakes with tines for the purpose of providing textures in the event of equipment breakdown.

The Contractor also shall have available a conventional garden spray type can containing a commercially available monomolecular film compound. This shall be applied in the case of equipment breakdown or other emergencies to prevent the pavement from drying too rapidly. The use of this product will give the Contractor additional time to provide adequate texturing.

After completion of texturing and about the time the concrete becomes hard, the edge of the slab and joints shall be carefully finished with an edger in a workmanlike manner and the pavement shall be left smooth and true to line.

(10) Hand Finishing

Hand finishing shall be resorted to only in those conditions provided for above and upon specific authorization by the Engineer. When hand finishing is permitted, concrete shall be struck off with an approved strike off screed to such elevation that when consolidated and finished the surface of the pavement will conform to the required section and grade. The strike template shall be moved forward with a combined transverse and longitudinal motion in the direction work is progressing, maintaining the template in contact with the forms and maintaining a slight excess of material in front of the cutting edge. The Concrete shall then be tamped with an approved tamping template to compact the concrete thoroughly and eliminate surface voids and the surface screed to required section.

After completion of a strike off, consolidation and transverse screeding, a hand-operated longitudinal float shall be operated to test and level the surface to the required grade.

Workmen shall operate the float from approved bridges riding on the forms and spanning the pavement. The longitudinal float shall be held in contact with the surface and parallel to the centerline and operated with short longitudinal strokes while being passed from one side of the pavement to the other. If contact with the pavement is not made at all points, additional concrete shall be placed, if required, and the screed and float shall be used to produce a satisfactory surface. Care shall be exercised to keep the ends of the float from digging into the surface of the pavement. After a section has been smoothed so that the float maintains contact with the surface at all points in being passed from one side to the other, the bridges may be moved forward half the length of the float and the operations repeated.

Other operations and surface tests shall be as required for machine finishing.

(11) Surface Testing:

After the concrete has been placed 12 hours or more, the Engineer or designated representative will test the surface of the pavement with a 10-foot straightedge placed parallel to the centerline. Unless specified otherwise, the surface shall not vary from the straightedge by more than 1/16 inch per foot from the nearest point of contact and in no case shall the maximum ordinate from a straightedge to the pavement be greater than 1/8 inch. Any high spots causing a departure from the straightedge in excess of that specified shall be ground down by the Contractor to meet the surface test requirements. Where the texture of the pavement is removed by extensive grinding, the texture shall be restored by grooving the concrete to meet the surface finishing specifications.

(12) Curing

All concrete pavement shall be cured by protecting it against loss of moisture for a period of not less than 72 hours from the beginning of the curing operations. Immediately after finishing operations have been completed, the entire surface of the newly laid concrete shall be covered and cured in accordance with the requirements specified for whichever of the following methods the Contractor may elect. Newly laid concrete base to be overlaid by asphaltic concrete shall not be cured by "Membrane Curing" and surfaces not to be overlaid by asphaltic concrete shall not be cured by "Asphalt Curing". In all cases in which curing requires the use of water, the curing shall have prior right to water supply or supplies. Failure to provide sufficient cover material of the type the Contractor elects to use, failure to maintain saturation in wet curing methods, lack of water to adequately take care of both curing and other requirements or other failures to comply with curing requirements shall be cause for immediate suspension of concreting operations. The covering material used in curing shall be removed as necessary to saw joints or to comply with the requirements for "Surface Test". The concrete surface shall be maintained wet with a water spray if indicated and

the covering material replaced immediately on completion of sawing and testing and any required surface correction.

(a) Waterproofed Paper Curing

Immediately after the finishing of the surface has been completed and the concrete has taken its initial set, it shall be wetted with water applied in the form of a fine spray and covered with waterproofed paper so placed and weighted as to cause it to remain in intimate contact with the surface. Waterproofed paper used for the curing of concrete pavement shall be of a type and quality approved by the Engineer. It shall be sufficiently strong and tough to permit its use under the conditions existing on street paving work without being torn or otherwise rendered unfit for the purpose during the curing period. The paper covering shall be maintained in place continuously for not less than the specified curing period.

The waterproofed paper shall be prepared to form blankets of sufficient width to cover the entire surface and both edges of the pavement slab and such blankets shall not be more than 60 feet in length. All joints in the blankets occasioned by joining paper sheets shall lap not less than 5 inches and shall be securely sealed with asphalt cement having a melting point of approximately 180 F. Blankets shall be placed to secure an overlap of at least 12 inches and this lap securely weighted to form a closed joint.

The waterproofed paper blankets shall be adequately weighted to prevent displacement or billowing due to wind and the paper folded down over the side of the pavement shall be secured by a continuous bank of earth. Plowing of this windrow into place will not be permitted.

All tears or holes appearing in the paper during the curing period shall be immediately repaired by cementing patches over such defects. It shall be the Contractor's responsibility to prevent damage to paper blankets, which would affect their serviceability and effectiveness as a concrete curing method. Blankets may be rejected by the Engineer at any time when, in his opinion, they do not provide an airtight covering.

Paper blankets rejected on account of pinholes or minor tears may be continued in service by folding the blanket over lengthwise, first thoroughly spraying 1/2 the blanket with the asphalt cement used for seams. The 2 thicknesses shall be firmly pressed together and well cemented. Blankets shall be of a width sufficient to cover the pavement surface and both edges. Doubled blankets may be rejected for the same cause as provided for single blankets. All paper blankets rejected by the

Engineer shall be immediately marked by the Contractor for identification and then destroyed or stored entirely separate from approved blankets.

No walking on paper shall be permitted at any time and, in locations where pedestrian traffic cannot be entirely controlled, the Contractor shall provide

walkways and barricades or shall substitute other permissible curing methods on such sections of pavement.

(b) Polyethylene Film Curing

Immediately after the finishing of the surface has been completed and the concrete has taken its initial set, it shall be wetted with water applied in the form of a fine spray and covered with the polyethylene film so placed and weighted as to cause it to remain in intimate contact with the surface. The polyethylene film covering shall be maintained in place continuously for not less than the specified curing period.

The film shall be prepared to form blankets of sufficient width to cover the entire surface and both edges of the pavement slab. All joints in the blankets occasioned by joining film sheets shall lap not less than 12 inches. All joints shall be sealed in a manner acceptable to the Engineer to provide a moisture-proof lap.

The polyethylene film blankets shall be adequately weighted to prevent displacement or billowing due to wind and the film folded down over the side of the pavement shall be secured by a continuous bank of earth. Plowing of this windrow into place not to be permitted.

All tears or holes appearing in the polyethylene film during the curing period shall be immediately repaired by placing acceptable moisture proof patches over such defects or by replacing the blankets. It shall be the Contractor's responsibility to prevent damage to the film blankets, which would affect their serviceability and effectiveness as a concrete curing method. Blankets may be rejected by the Engineer at any time when, in his opinion, they do not provide an airtight covering.

Polyethylene film blankets rejected on account of pinholes or minor tears may be continued in service when repaired to an airtight condition. All polyethylene film blankets rejected by the Engineer shall be immediately marked by the Contractor for identification and then destroyed or stored entirely separate from approved blankets.

Should the film blanket be damaged or torn for any cause during the first 72 hours of the curing period such damage shall be repaired immediately.

(c) Membrane Curing

Immediately after the finishing of pavement has been completed and after the free surface moisture has disappeared, the pavement shall be sprayed uniformly with a curing compound. Membrane curing shall conform to Item No. 409, "Membrane Curing", Type 2 white pigmented. Should the film of compound be damaged from any cause before the expiration of 72 hours after original application, the damaged portions shall be repaired with additional compound. Unless otherwise indicated, membrane curing shall be used when the concrete (except that concrete to be used as a base) is placed with a slip form paver.

(d) Asphalt Curing

Where emulsified asphalt is used for curing concrete base, the material shall conform to Item No. 301, "Asphalts, Oils and Emulsions", for the type and grade shown on the plans. The rate of application may vary between the limits of 1 gallon per 180 square feet and 1 gallon per 90 square feet. The rate of application will be determined by the Engineer, after observation of sections where amounts varying between the above limits have been applied. If it is found necessary to add water to the emulsion for the proper distribution through the spray, this may be done upon approval of the Engineer. When the emulsion is diluted with water the amount of the applied mixture shall be increased to give a coverage of the original emulsion between the limits as set out herein. Care shall be taken to properly mix the emulsion and water and to keep the mixture well agitated during application.

(13) Protection of Pavement

The Contractor shall erect and maintain the barricades indicated and such other standard and approved devices as will exclude public traffic and traffic of the Contractor's employees and agents from the newly placed pavement for a minimum of 14 days. Portions of the roadway or crossings of the roadbed required to be maintained open for use by traffic shall not be obstructed by above required barricades. Crossings of the pavement indicated or by construction sequence, during the period prior to opening to traffic as herein indicated, shall be provided with an adequate and substantial bridge approved by the Engineer.

Curb shall be backfilled to the full height of the concrete, tamped and sloped as indicated or as directed by the Engineer. The top 4 inches of backfill shall be of clean, friable soil capable of supporting plant life. This material shall also be free of stones and all other debris.

(14) Opening Pavement to Traffic

The pavement shall be closed to traffic, including vehicles of the Contractor, until the concrete is at least 14 days old and has attained an average modulus of rupture acceptable to the Engineer. This period of closure to traffic may be extended if, in the opinion of the Engineer, weather or other conditions make it advisable to provide an extension of the time of protection.

At the end of the 14 day period and as long thereafter as ordered by the Engineer and if so desired by the Contractor, the pavement may be opened for use by vehicles of the Contractor provided the gross weight (vehicle plus load) of such vehicles does not exceed 14,000 pounds. Such opening, however, shall in no manner relieve the Contractor from his responsibility for the work. On those sections of the pavement thus opened to traffic, all joints shall first be sealed, the pavement cleaned and topsoil placed against the pavement edges or behind the curb where turf or vegetation is to be established before permitting vehicles thereon.

After the concrete in any section is 14 days old or as long thereafter as ordered by the Engineer, such section of pavement may be opened to all traffic indicated or when so directed by the Engineer. On those sections of the pavement thus opened to traffic, all joints shall first be sealed, the pavement cleaned and 4 inches of top soil placed against the pavement edges and all other work performed as required for the safety of traffic.

Such opening, however, shall in no manner relieve the Contractor from his responsibility for the work.

When High Early Strength Concrete, resulting from the use of Type III cement as indicated is used, the pavement may be opened to all traffic after the concrete is 7 days old or as long thereafter as ordered by the Engineer, subject to the same provisions governing the opening after 14 days as above indicated.

Where the Contractor desires to move any equipment not licensed for operation on public streets, on or across any pavement opened to traffic, he shall protect the pavement from damage by means of 2 ply timber mats of 2 inch stock or runways of heavier material laid on a layer of earth, all as approved by the Engineer.

(a) Emergency Opening to Traffic

The Engineer may require the opening of pavement to traffic prior to the minimum time specified above under conditions of emergency, which in his opinion require such action in the interest of the public. In no case will the Engineer order opening of the pavement to traffic within less than 72 hours after the last concrete in the section is placed. The Contractor shall remove all obstructing materials, place earth against pavement edges and perform other work involved in providing for the safety of traffic as required by the Engineer in ordering emergency opening. Orders for emergency opening of the pavement to traffic will be issued by the Engineer in writing.

360.7 Penalty for Deficient Pavement Thickness or Strength

The adjustment in unit prices provided for in this item will apply only when measurement for payment is by the square yard.

It is the intent of this specification that the pavement be constructed in strict conformity with the thickness, strength and typical sections indicated. Where any pavement is found not so constructed, the following rules relative to adjustment of payment for acceptable pavement and to replacement of faulty pavement shall govern.

(1) Pavement

The pavement will be core drilled after any grinding operations have been completed for surface corrections prior to final acceptance. Locations of core tests may be selected by the Engineer; however, spacing interval for core tests, as specified herein, shall be maintained. The thickness of the pavement will be determined by measurement of the cores in accordance with Texas DOT Test Method Tex-424-A.

For the purpose of establishing an adjusted unit price for pavement, units to be considered separately are defined as 1000 linear feet of pavement in each traffic lane starting at the end of the pavement bearing the smaller station number. The last unit in each lane shall be 1000 feet plus the fractional part of 1000 feet remaining. Traffic lane width will be as shown on typical sections and pavement design standards.

For the purpose of establishing an adjusted unit price for ramps, widening, acceleration and deceleration lanes that are machine placed, isolated pavements of traffic lane width but less than 1000 feet in length and other areas designated by the Engineer, units will be considered separately and are defined as 1000 square yards of pavement or fraction thereof.

One core will be taken at the location selected by the Engineer or at random in each unit. When the measurement of the core from any unit is not deficient more than 0.2 inches from the plan thickness, full payment will be made. When the measurement of the core from any unit is deficient more than 0.2 inch but not more than 0.75 inch from the plan thickness, 2 additional cores will be taken from the unit and the average of the 3 cores determined. The 2 additional cores from any 1000-foot unit will be taken at intervals of not less than 300 feet. The 2 additional cores from any 1000 square yard unit will be taken at locations such that the pavement in the unit will be well represented. If the average measurement of these 3 cores is not deficient more than 0.2 inches from the plan thickness, full payment will be made. If the average thickness of the 3 cores is deficient by more than 0.2 inch but not more than 0.75 inch from the indicated thickness, an adjusted unit price as provided below will be paid for the areas represented by these cores.

In calculating the average thickness of the pavement, measurements which are in excess of the specified thickness by more than 0.2 inch will be considered as the specified thickness plus 0.2 inch and measurements which are less than the specified thickness by more than 0.75 inch will be considered as the specified thickness less 0.75 inch.

When the measurement of any core is less than the specified thickness by more than 0.75 inch, the actual thickness of pavement in this area will be determined by taking additional cores at 10 foot intervals parallel to the center line in each direction from the deficient core until, in each direction, a core is taken which is not deficient by more than 0.75 inch. Exploratory cores for deficient thickness will not be used in averages for adjusted unit price. Exploratory cores are to be used only to determine the length of pavement in a unit that is to be left in place without pay and/or removed and replaced as provided herein.

For new Concrete Pavement roadways, and for Concrete Pavement rehabilitation and overlay projects, if cracks develop in the pavement surface within the one year warranty period, the Contractor shall seal the cracks in accordance with Item 313, "Rubber Asphalt Joint and Crack Sealer", or perform other corrective measures as directed by the Engineer, at the sole expense of the Contractor.

For new Concrete Pavement roadways constructed in accordance with the plans and specifications, if cracks greater than or equal to 1/4 inch in width develop in the pavement surface within the one year warranty period, complete replacement of pavement sections as directed by the Engineer shall be performed by the Contractor at no additional expense to the City.

Irrespective of an acceptable overall project average for any or all of the Pay-Adjustment Acceptance Factors, limited substandard portions of the work, as determined by the Engineer, shall be remedied or removed and replaced to the satisfaction thereof.

(2) Price Adjustments

After any grinding or milling operations have been completed to meet the surface-testing requirement of this specification, if average thickness of pavement is deficient in thickness by more than 0.2 inch, but not more than 0.75 inch, payment will be made at an adjusted price as specified in the following table:

Concrete Pavement Deficiency	
Deficiency in Thickness Determined by Cores, Inches	Proportional Part of Contract Price Allowed
0.00 to 0.20	100 percent
0.21 to 0.30	80 percent
0.31 to 0.40	72 percent
0.41 to 0.50	68 percent
0.51 to 0.75	57 percent

Any area of pavement found deficient in thickness by more than 0.75 inch but not more than 1 inch or 1/8 of the indicated thickness, whichever is greater, shall be evaluated by the Engineer. If, in the judgment of the Engineer, the area of such deficiency should not be removed and replaced, there will be no payment for the area retained. If, in the judgment of the Engineer, the area of such deficiency warrants removal, the area shall be removed and replaced at the Contractor's entire expense, with concrete of the thickness indicated.

Any area of pavement found deficient in thickness by more than 1 inch or more than 1/8 of the indicated thickness, whichever is greater, shall be removed and replaced, at the Contractor's entire expense, with concrete of the thickness indicated.

No additional payment over the Contract unit price will be made for any pavement of a thickness exceeding that indicated.

360.8 Measurement

- (1) When indicated, concrete pavement will be measured by the square yard of surface area of completed and accepted work. The surface area shall be so

measured to also include that portion of pavement slab extending beneath the curb. When concrete pavement is to be measured by the square yard and monolithic curb is required, measurements for "Monolithic Curb" will be by the linear foot complete in place.

- (2) When indicated, concrete pavement, including monolithic curb when required, will be measured by the cubic yard of absolute volume of materials entering the mixture.

360.9 Payment

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit price bid for "Concrete Pavement", of the depth indicated, "Concrete Pavement (High Early Strength)" of the depth indicated and "Monolithic Curb" of the type indicated (when pavement is measured by the square yard), as required or adjusted unit price for pavement of deficient thickness as provided under "Deficient Pavement Thickness", which price shall be full compensation for shaping and fine grading the roadbed, including furnishing and applying all water required; for furnishing, loading and unloading, storing, hauling and handling all concrete ingredients, including all freight and royalty involved; for placing and adjusting forms, including supporting material or preparing track grade; for mixing, placing, finishing, sawing, cleaning and sealing joints and curing all concrete; for furnishing and installing all reinforcing steel; for furnishing all materials for sealing joints and placing longitudinal, expansion and weakened plane joints, including all steel dowel caps and load transmission devices required and wire and devices for placing, holding and supporting steel bars, load transmission devices and joint filler material in proper position, for coating steel bars and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Excavation required by this item in the preparation of the subgrade and for completion of the parkway will be measured and paid for in accordance with provisions governing the Items of "Street Excavation" and "Borrow", respectively, with provision that yardage to be measured and paid for once only, regardless of manipulations involved. Measurement of subgrade excavation for payment shall be limited to a total width of that of pavement plus 1 foot on each side.

Sprinkling and rolling required for the compaction of the rough subgrade in advance of fine grading will be measured and paid for as indicated in the governing items of excavation. Maintenance of a moist condition of the subgrade in advance of fine grading and concrete placing will not be paid for directly but shall be considered subsidiary work, as provided above.

Payment will be made under one of the following:

In. Concrete Pavement	Per Square Yard.
In. Concrete Pavement (High Early Strength)	Per Square Yard.
In. Concrete Pavement (High Range Water Reducing Admixture)	Per Square Yard.
Monolithic Curb	Per Linear Foot.
Concrete Pavement Including Monolithic Curb	Per Cubic Yard.

End

Ref: [403](#), [405](#), [409](#), [410](#)