

Summary of Administrative Revisions to Standard Specifications

400 Series

Section	Description of Revision
ALL	<ul style="list-style-type: none"> • Formatting in accordance with CSI standards <ul style="list-style-type: none"> ○ All Paragraphs identified by a letter <ul style="list-style-type: none"> ▪ Sub-paragraphs identified by a number • Replace pronouns with appropriate noun references • Delete number word references and retain numeric number only • Modify grammar structure for clarity • Edit cross-references • Delete references to self (Uniform Standard Specifications) • Delete metric units • Delete references to design and procedural guidelines • Delete references to codes and standards that do not specifically relate to the section
403-2	<ul style="list-style-type: none"> • Deleted Section 403-2 and added new Section 413 "Plantmix Bituminous Gap-Graded Surface."
408	<ul style="list-style-type: none"> • Section 408 had two major subsections: 408-1 "Chip Seal" and 408-2 "Slurry Seal / Micro-Surfacing". <ul style="list-style-type: none"> ○ Renamed Section 408 "Pavement Surface Treatment - Chip Seal" and removed all of the 408-2 subsections. ○ Added New Section 412 "Pavement Treatment Surface - Slurry Seal / Micro-Surfacing."

SECTION 400**ASPHALT RUBBER PAVEMENT SURFACE**

DESCRIPTION

400.01.01 GENERAL

- A. The work shall consist of placing one or more surfaces of compacted asphalt rubber pavement overlay on an existing bituminous surface or on a prepared aggregate base course.
- B. The asphalt rubber pavement mix shall consist of a surface course composed of mineral aggregate along with a reacted asphalt rubber binder.
- C. The reacted asphalt rubber binder shall consist of asphalt cement, crumb rubber modifier, and other additives if required.
- D. The asphalt rubber pavement mixture shall be prepared in a central mixing plant and placed in accordance with these specifications.

~~The following table references the components of the rubberized asphalt concrete to their respective sections of these specifications.~~

~~Table 1 – Specification Reference Sections~~

Item	Specification Section
Asphalt Rubber Pavement	400.02.01
1)Mineral Aggregate	400.02.02
2)Asphalt Rubber Binder	400.02.03
a)Asphalt Cement	400.02.04
b)Crumb Rubber Modifier	400.02.05
c)Admixture	400.02.06
Quality Control and Liquidated Damages	400.03.16

- E. Rubberized asphalt concrete shall conform to these specifications and to the lines, grades, thickness, and typical cross-sections shown on the plans.
- F. All mix designs shall be performed by the Contractor.

MATERIAL

400.02.01 ASPHALT RUBBER PAVEMENT MIX REQUIREMENTS

- A. Asphalt rubber pavement shall conform to the following requirements:

Table 21 – Asphalt Rubber Pavement Mix Requirements

Parameter	Requirement
Marshall Stability, 75 blows, lbs, min.	1,200
Flow, 0.01 inch, min.	16
Percent air voids	3-5
Voids in mineral aggregate min. percent	19
Compaction number of blows each end of test specimen	75
Asphalt rubber binder content percent range	7.5-8.5

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- B. For bidding purposes, the percent of asphalt rubber binder in the mix shall be ~~eight (8)~~ percent. The exact amount of asphalt rubber binder in the mix shall be determined by the Contractor's mix design.
- C. The Contractor shall submit ~~five (5)~~ copies of an asphalt rubber pavement mix design ~~fifteen (15)~~ days prior to production of the asphalt rubber hot mix.
1. The mix design shall conform to the mix design requirements as shown in ~~the~~ Table 1 above.
 2. Asphalt rubber pavement mix design ~~will~~shall be performed in accordance with AASHTO ~~T-245~~ (modified), and test specimens compacted at 295 degrees F \pm 5 degrees F (75 blows) and in accordance with the Asphalt Institute MS-2, ~~May 1984 Edition latest edition, procedure,~~ Marshall Method.
- D. The mix design ~~must~~shall include all tests and product certifications specified herein and shall also contain information on the following items:
1. ~~1)~~ Aggregate:
 - a. ~~a)~~ Source.
 - b. ~~b)~~ Gradation.
 - c. ~~c)~~ Blend Percentages.
 - d. ~~d)~~ Mixture gradation.
 2. ~~2)~~ Asphalt-Rubber Binder:
 - a. ~~a)~~ Source, grade, and percent of asphalt cement.
 - b. ~~b)~~ Source, grade, and percent of crumb rubber modifier.
 - c. ~~c)~~ Type and amount of admixture.
 3. ~~3)~~ Recommended asphalt-rubber binder content by both weight of total mix and weight of dry aggregate.
 4. ~~4)~~ Recommended mixture production temperature.
 5. ~~5)~~ Recommended lay down temperature.
 6. ~~6)~~ Density requirement.
 7. ~~7)~~ Anti-stripping agent (if required).
 8. ~~8)~~ The results of all testing.
 9. ~~9)~~ Admixtures:
 - a. ~~a)~~ Source and percentage.
 - b. ~~b)~~ By weight of aggregate.
 10. ~~10)~~ Bulk density.
 11. ~~11)~~ Percent effective air voids.
 12. ~~12)~~ Specific gravity of aggregates.
- E. The ~~entity~~ Engineer will review the mix design proposal to ~~assure~~ensure that it contains all required information. If it does not, it will be returned for further action and re-submission by the Contractor.

400.02.02 MINERAL AGGREGATE

- A. The aggregate for the asphalt rubber pavement mixture shall meet the following requirements:
1. ~~1)~~ Minimum sand equivalent value shall be 65 percent.
 2. ~~2)~~ Rock and gravel shall be clean, hard, sound, durable, and uniform in quality and free of any detrimental quantity of soft, friable, thin, elongated, or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance.
 3. ~~3)~~ Water absorption of the combined aggregates shall not exceed ~~three (3)~~ percent. Water absorption ~~is to shall~~ be determined separately for each aggregate material proposed for use. For fine fractions (minus No. ~~4~~) water absorption shall not exceed ~~three (3)~~ percent. For ~~course coarse~~ fractions, water absorption shall not exceed ~~three (3)~~ percent.
 4. ~~4)~~ L.A. abrasion limits for each aggregate proposed for use shall be as follows:
 - a. Maximum: ~~Nine (9)~~ percent abrasion at ~~one hundred (100)~~ revolutions.
 - b. Maximum: ~~Thirty five (35)~~ percent abrasion at ~~five hundred (500)~~ revolutions.
 5. ~~5)~~ Recycled aggregates will not be permitted.
 6. ~~6)~~ The gradation shall be as follows:

Table 32 – Aggregate Gradation

Sieve Size	Percent Passing
1"-inch (24 mm)	100
3/4"-inch (18 mm)	90-100
1/2"-inch (12 mm)	65-85
3/8"-inch (9 mm)	60-70
#No. 4 (4.75 mm)	22-42
#No. 8 (2.36 mm)	15-25
#No. 30 (600 um)	5-15
#No. 200 (75 um)	3-7

400.02.03 ASPHALT RUBBER BINDER

- A. The asphalt-~~rubber~~ binder shall be a uniform reacted mixture of compatible paving grade asphalt cement, granulated reclaimed crumb rubber, and anti-stripping agent if necessary.
- B. The asphalt-~~rubber~~ binder shall meet the following physical parameters when reacted with the asphalt cement at 375° ~~degrees~~ F, (~~±25° degrees~~ F) for a minimum of ~~thirty (30)~~ minutes:

Table 43 – Asphalt Rubber Binder Requirements

Parameter	Test Method	Requirement
Rotational Viscosity; 350-°F; Pascal seconds, Haake type viscometer ¹	--	1.5-4.0
Penetration, 39.2-°F, 200g, 60 sec.; 1/10 mm	ASTM D5	10 Minimum
Penetration, 77-°F, 100g, 5 sec.; 1/10 mm	ASTM D5	25-75
Softening Point, °F	ASTM D36	135° Minimum

Table 43 – Asphalt Rubber Binder Requirements

Parameter	Test Method	Requirement
Resilience, 77-°F	ASTM- D3407 D5329	20% Minimum
Ductility, 39.2-°F, 1 CPM	ASTM D113	5 Minimum

¹ The viscometer used ~~must~~ shall be correlated to a Haake Viscometer, Model VT-04, Rotor No. 1.

- C. The Contractor shall provide documentation that the Haake Viscometer has been ~~correlated~~ calibrated (2-point minimum) within ~~six (6)~~ months prior to use on the project.
- D. The percentage of crumb rubber modifier shall be ~~twenty (20)~~ percent plus or minus ~~three (3)~~ percent by weight of total asphalt rubber mixture.
- E. ~~The~~ The exact crumb rubber content shall be determined by the asphalt rubber binder mix design prepared by the Contractor.

400.02.04 ASPHALTIC CEMENT

- A. Asphalt cement shall be grade AC-20.
- B. The exact amount shall be determined by the Contractor's mix design and shall be approved by the ~~entity~~ Engineer.

400.02.05 CRUMB RUBBER MODIFIER

- A. Rubber shall be a recycled vulcanized rubber produced primarily from the processing of scrap tires.
- B. Gradation of the rubber shall be in accordance with ~~ASTM~~ ASTM -C-136 (dry sieve only) using ~~fifty (50)~~ grams \pm ~~one (1)~~ gram.
- C. Samples shall meet the following requirements:

Table 54 – Crumb Rubber Modifier Gradation

Sieve Size	Percent Passing
#No. <u>#No.</u> 10	100
#No. <u>#No.</u> 16	75-100
#No. <u>#No.</u> 30	25-60
#No. <u>#No.</u> 50	0-20
#No. <u>#No.</u> 200	0-5

- D. The use of rubber of multiple types from multiple sources is acceptable provided that the overall blend of rubber meets the above gradation requirements.
- E. The ground rubber shall have a specific gravity of 1.15 (\pm 0.05) and shall be substantially free of loose fabric, wire, and other contaminants.
 - 1. However, up to ~~four (4)~~ percent (by weight of rubber) calcium carbonate may be included to prevent rubber particles from sticking together.
 - 2. The rubber shall be dry so as to be free flowing and not produce foaming when blended with hot asphalt cement.
 - 3. The length of the individual rubber particles shall not exceed 3/16 inch.
- F. Fiber content in the rubber shall be less ~~then~~ than 0.1 percent by weight.
- G. The moisture content in the rubber shall be less than 0.75 percent by weight.

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- H. Mineral contaminant in the rubber shall not be greater than 0.25-percent by weight, as determined after separating a ~~fifty (50)-~~gram rubber sample in a ~~one-~~1-liter glass beaker of water.
- I. The rubber shall contain no visible metal particles, as indicated by a thorough stirring of a ~~fifty (50)-~~gram sample with a magnet, and shall conform to the chemical analysis in ~~the~~ Table 5: ~~below~~.

Table 65 – Crumb Rubber Modifier Chemical Analysis Requirements

Test	Test Method	Requirement
Acetone Extract	ASTM D-297	6%-16%
Ash Content	ASTM D-297	0%-8%
Carbon Black Content	ASTM D-297	28%-38%
Rubber Hydrocarbon	ASTM D-297	42%-65%
Natural Rubber Content	ASTM D-297	22%-39%

- J. Certification that the ground rubber meets or exceeds the requirements as set forth in these specifications shall be provided ~~by~~from the rubber supplier.

400.02.06 ADMIXTURE

- A. If required by the job mix formula to produce appropriate water resistance and ~~assure~~ ensure proper adhesion and/or coating of aggregate, an anti-stripping agent shall be incorporated into the mineral aggregate.
- B. The admixture shall be either hydrated lime (ASTM-C-1097) or Portland Cement II (ASTM C-150).
- C. The amount needed for the admixture shall be as determined by the Contractor's mix design.

400.02.07 MIX DESIGN REQUIREMENTS

- A. The mix designs ~~must~~shall be performed by a Nevada registered professional engineer knowledgeable in asphalt mix design. The laboratory used to prepare the mix design ~~can~~may be the Contractor's laboratory or an independent geotechnical-materials laboratory provided the laboratory ~~complies~~ complies with the following:
1. The lab is, at the time of submittal, and remains, certified by the National Bureau of ~~standards~~ Standards in the National Voluntary Laboratory Accreditation Program (NVLAP) for ~~construction~~ Construction Services (ASPHALT) or the AASHTO Accreditation Plan (AAP).
 2. ~~A~~ copy of the certification will be required with each submittal as described above.
- B. The asphalt rubber binder mix design shall be a ~~twenty four (24)-~~hour design.

CONSTRUCTION

400.03.01 ASPHALT -RUBBER BINDER MIXING AND PRODUCTION EQUIPMENT

- A. All equipment utilized in production and proportioning of the asphalt--rubber binder shall be as described ~~as follows:~~in this subsection.
- B. ~~1)~~—An asphalt heating tank with a hot oil heat transfer system or retort heating system capable of heating asphalt cement to the necessary temperature for blending with the

granulated rubber. This unit shall be capable of heating a minimum of ~~three thousand (3,000)~~ gallons of asphalt cement.

- C. ~~2)~~—An asphalt_-rubber binder mechanical blender with a ~~2-two~~ stage continuous mixing process capable of producing a homogenous mixture of asphalt cement and ground rubber, at the mix design specified ratios, as directed by the ~~entity~~-Engineer.
1. This unit shall be equipped with a ground rubber feed system capable of supplying the asphalt cement feed system so as not to interrupt the continuity of the blending process.
 2. A separate asphalt cement feed pump and finished product pump are required.
 3. This unit shall have both an asphalt cement totalizing meter in gallons and a flow rate meter in gallons per minute.
- D. ~~3)~~—An asphalt_-rubber binder storage tank equipped with a heating system to maintain the proper temperature for pumping and adding of the binder to the aggregate and an internal mixing unit within the storage vessel capable of maintaining a proper mixture of asphalt cement and ground rubber.
- E. ~~4)~~—An asphalt_-rubber binder supply system equipped with a pump and metering device capable of adding the binder by volume to the aggregate at the percentage required by the approved rubberized asphalt concrete formula.
1. The temperature and viscosity of the asphalt rubber binder shall be within the range specified in the approved rubberized asphalt concrete formula.
 2. An armored thermometer of adequate range in temperature reading shall be in position in the asphalt rubber feed line at a suitable location near the mixing plant.

400.03.02 ASPHALT_-RUBBER BINDER MIXING AND REACTION PROCEDURE

- A. Asphalt Cement Temperature: The temperature of the asphalt cement shall be between 375° degrees F and 450° degrees F at the time of addition of the granulated rubber.
- B. Blending and Reacting:
1. The asphalt and ground rubber shall be combined and mixed together in a blender unit, pumped into the agitated storage tank, and then reacted for a minimum of ~~forty five (45)~~ minutes from the time the granulated rubber is added to the asphalt cement.
 2. Temperature of the asphalt_-rubber mixture shall be maintained at or above 350° degrees F during the reaction period, but shall not exceed 450° degrees F at any time.
 3. Exceeding 450° degrees F will be grounds for rejection of the affected material.
 4. The asphalt rubber binder may be allowed to cool to between 300° degrees F and 350° degrees F only after the reaction time is complete and the viscosity is within the specified range.
- C. Transfer: After the material has reacted for at least ~~forty five (45)~~ minutes, the asphalt_-rubber shall be metered into the mixing chamber of the asphalt concrete production plant at the percentage required by the approved job mix formula.
- D. Delays:

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1. When a delay occurs in binder use after its full reaction, the asphalt-rubber binder shall be allowed to cool.
2. The asphalt-rubber binder shall be reheated slowly just prior to use to a temperature between 300° degrees F and 335° degrees F, and shall also be thoroughly mixed before pumping and metering into the hot plant for combination with the aggregate.
3. The ~~entity~~-Engineer shall be notified of any material that is held over and allowed to cool.
4. A viscosity test shall be required to determine if the viscosity is out of the range specified. ~~t~~ The asphalt-rubber binder shall be adjusted by the addition of asphalt cement or ground rubber to produce a material with the appropriate viscosity.
5. The ~~entity~~-Engineer or ~~his~~ Engineer's representative shall be present at the time of testing.

400.03.03 ASPHALT-RUBBER BINDER-AGGREGATE MIXING EQUIPMENT

- A. The addition and mixing of the asphalt-rubber with the aggregate shall be accomplished with one of the following types of hot-mix asphalt plants:
 1. Batch Mixing:
 - a. Batch mix plant consisting of cold aggregate storage and feed, drier, gradation control unit, hot aggregate storage bins aggregate with-hopper, and twin-shaft pugmill mixing unit.
 - b. Also, the plant may be equipped with hot-mix surge or storage bins for short-term holding of the mixture until spreading.
 2. Drier-Drum Mixing: Drier-drum mix plant consisting of cold aggregate storage and feed, automatic weighing system, drier-drum mixer, and hot-mix surge or storage bins for short-term holding of the mixture until spreading.
- B. The asphalt-rubber binder/aggregate mixing equipment shall be capable of producing a paving mixture meeting all of the requirements contained in this specification. Specifically the plant shall provide proper aggregate gradation, asphalt-rubber content, and mixing temperature.
- C. The introduction of asphalt-rubber binder shall be controlled by an automated system fully integrated with the controls for mineral aggregate and mineral admixture. Failure to provide electronic integration of the feed controls at all times will be grounds for immediate suspension of production.

400.03.04 AGGREGATE PREPARATION/AGGREGATE MIXTURE PREPARATION

- A. The Contractor will not be allowed to feed the hot plant from stockpiles containing less than ~~two (2)~~ full days of production, unless only ~~two~~ 2 days' production remains to be done.
 1. Mineral aggregate shall be separated and stockpiled so that segregation is minimized.
 2. An approved divider of sufficient size to prevent intermingling of stockpiles shall be provided.
- B. If a batch plant is used, the mineral admixture shall be added and thoroughly mixed in the pugmill prior to adding the asphalt rubber binder.

- C. A positive signal system and a limit switch device shall be installed in the plant, at the point of introduction of the mineral admixture.
1. The positive signal system shall be placed between the metering device and the drum ~~dryer~~drier, and utilized during production, whereby the mixing shall automatically be stopped if the admixture is not being introduced into the asphalt rubber concrete mixture.
 2. Failure to provide electronic integration of the feed controls at all times will be grounds for immediate suspension of production.
- D. When mineral aggregate, mineral admixture, and asphalt rubber binder are proportioned by weight, all boxes, hoppers, buckets, or similar receptacles used for weighing materials, together with scales of any kind used in batching materials, shall be insulated against the vibration or movement of the plant.
1. The entire plant operating shall not exceed ~~two~~2 percent for any setting, nor ~~one and one-half~~1-1/2 percent for any batch.
 2. Bituminous material shall be weighed in an insulated bucket suspended from a spring-less dial scale system.
 3. All scales ~~must~~shall be certified.
- E. No fine material, ~~which~~that has been collected in the dust collection system, shall be returned to the mixture, unless the ~~entity~~ Engineer, on the basis of tests, determines that all or a portion of the collected fines can be utilized.
- F. If the ~~entity~~ Engineer so determines, ~~it~~the Engineer will authorize, in writing, the utilization of a specific proportion of the fines; however, authorization will not be granted unless the collected fines are uniformly metered into the mixture.
- G. When mineral aggregate, mineral admixture, and asphalt rubber binder are proportioned by volume, the correct portion of each mineral aggregate size introduced into the mixture shall be drawn from the storage bins by an approved type of continuous feeder.
- H. The continuous feeder will supply the correct amount of mineral aggregate in proportion to the bituminous material, and ~~shall be~~ arranged so that the proportion of each mineral aggregate size can be separately adjusted.
1. The continuous feeder for the mineral aggregate shall be electrically actuated.
 2. Failure to provide electronic integration of the feed controls at all times will be grounds for immediate suspension of production.
- I. The introduction of asphalt rubber binder shall be controlled by an automated system, fully integrated with the controls for mineral aggregate and mineral admixture. Failure to provide electronic integration of the feed controls at all times will be grounds for immediate suspension of production.
- J. A positive signal system shall be provided to indicate the low level of mineral aggregate in the bins.
1. The plant will not be permitted to operate unless this signal system is in good working condition.
 2. Each bin shall have an overflow chute or a divider to prevent material from spilling into adjacent bins.

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- K. The mixing operation shall be sufficient to achieve a satisfactory mixture with ~~one hundred~~ (100) percent coated particles as determined by AASHTO-T195 or ASTM-D-2489.
- L. The aggregate shall be dried and heated to provide a rubberized asphalt concrete mixture immediately after mixing, having a temperature of 290° degrees F to 335° degrees F, and having a moisture content not exceeding ~~one~~ (1) percent by weight of mixture.

400.03.05 ASPHALT RUBBER BINDER CONTROL

- A. The asphalt ~~-~~rubber binder shall be a minimum of 300° degrees F when pumped and metered into the mixing plant.
- B. The crumb rubber modifier content shall not fluctuate more than ~~one~~ (1) percent by weight of total rubberized asphalt concrete mixture.

400.03.06 ASPHALT RUBBER PAVEMENT CONTROL

- A. The asphalt rubber pavement mixture shall have a temperature not exceeding 335° degrees F and a moisture content not exceeding ~~one~~ (1) percent by weight of mixture immediately upon discharge from the mixer.
- B. If the asphalt rubber concrete is discharged from the mixer into a hopper, the hopper shall be constructed so that the segregation of the mix will be minimized.
- C. The moisture content of the asphalt rubber concrete immediately behind paver shall not exceed ~~one~~ 1 percent by total weight of the mix. Drying and heating shall be accomplished in such a manner as to preclude the mineral aggregate from becoming coated with fuel oil or carbon.

400.03.07 TRANSPORTING ASPHALT RUBBER PAVEMENT MIXTURE

- A. Trucks used for hauling the paving mixture shall be capable of discharging directly into the spreading equipment.
 - 1. Discharge onto the surface being paved shall not be permitted.
 - 2. The truck beds shall be clean of materials such as dirt, mud, and aggregates.
 - 3. Just prior to loading the mixture, the truck bed shall be sprayed with a light application of a soapy solution or a silicone emulsion (oiling with kerosene or diesel fuel will not be permitted) to reduce sticking of the mixture to the truck bed.
- B. If required by the ~~entity~~ Engineer or ~~his~~ Engineer's representative, the load shall be covered with a tarpaulin to prevent loss of heat.
- C. Mixtures ~~which~~ that have cooled in transport shall be rejected. The temperature of the mixture, in the mat behind the paver, shall be at least 275° degrees F but shall not exceed 325° degrees F.
- D. Hauling over freshly laid asphalt concrete pavement will not be permitted.

400.03.08 SPREADING ASPHALT RUBBER ~~PAVMENT~~ PAVEMENT MIXTURE

- A. Paving shall be accomplished with self-propelled mechanical spreading and finishing equipment.
 - 1. Equipment ~~should~~ shall have a tampering bar, ~~or~~ vibratory screed, or strike-off assembly capable of distributing the material to not less than the full width of a traffic

- lane and to the depth needed to achieve the minimum compacted thickness or finished grade as required.
2. The screen or strike-off assembly shall be equipped with a heating unit that maintains the temperature needed to prevent tearing of the pavement during spreading.
 3. The spreading temperatures shall be in accordance with the approved job mix formula.
- B. The mixture shall not be placed on any wet surface or when weather conditions will otherwise prevent its proper handling or finishing.
- C. Mixtures shall be placed only when the surface temperature is 60° degrees F and rising.
- D. A ski not less than ~~thirty (30)~~ feet ~~must~~ shall be used at all times on the through lane paving.
1. A longer ski is preferred, if available.
 2. Paving will be halted immediately if the auto screed controls fail and may not proceed without approval of the ~~entity~~-Engineer.
- E. Asphalt ~~R~~rubber ~~P~~pavement shall be placed in ~~two (2)~~ inch maximum lifts.

400.03.09 COMPACTING ~~ASPAHLT~~ ASPHALT RUBBER PAVEMENT MIXTURE

- A. A minimum of ~~two-2~~ self-propelled ~~two2-~~ axle steel-wheel rollers shall be furnished for each spreader and finisher. Rollers shall have a minimum roller weight of ~~eight (8)~~ tons and maximum roller weight of ~~twelve (12)~~ tons.
- B. All rollers shall be equipped with pads and a watering system to prevent sticking of the paving mixture to the ~~steel~~ steel-wheeled drums.
1. Vibratory rollers may not be used on ~~one (1)~~ inch or less ~~A.C.~~ asphalt rubber ~~P~~pavement thickness.
 2. Pneumatic tire rollers shall not be used due to the increased adhesiveness of the asphalt ~~-~~ rubber binder.
- C. Initial or break down compaction shall commence immediately after mixture spreading and shall consist of ~~three (3)~~ full coverage before the pavement temperature reaches 200° degrees F unless otherwise directed by the ~~entity~~-Engineer or ~~his~~ Engineer's representative.
1. A coverage shall be as many passes as are necessary to cover the entire width being paved with a pass being ~~one-1~~ movement of a roller in either direction.
 2. Each coverage shall be complete before subsequent coverage is started.
 3. Final rolling, consisting of not less than ~~one-1~~ complete coverage, shall be used to smooth the surface of the mat.
 4. All rolling shall be accomplished without excessive aggregate fracturing or mixture shoving.
- D. The asphalt shall be compacted to a minimum of ~~ninety five (95)~~ percent of the ~~seventy five (75)~~ blow design density, as specified in the approved job mix formula.

400.03.10 JOINTS

- A. Longitudinal joints of each course shall be staggered a minimum of ~~twelve (12)~~ inches with relation to the longitudinal joint of the immediate underlying course.

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- B. The Contractor shall schedule ~~his~~ paving operations to minimize exposed longitudinal edges.
1. Unless otherwise approved by the ~~entity~~ Engineer, the Contractor shall limit the placement of asphalt rubber concrete courses, in advance of adjacent courses, to ~~one~~ 1 shift of asphalt rubber concrete production.
 2. The Contractor shall schedule ~~his~~ paving operations in such a manner as to eliminate exposed longitudinal edges over weekends or holidays.
- C. Longitudinal joints shall be located within ~~twelve (12)~~ inches of the center of a lane, or within ~~twelve (12)~~ inches of the centerline between ~~two~~ 2 adjacent lanes.
- D. Before a surface course is placed in contact with a cold traverse construction joint, the cold existing asphalt concrete shall be trimmed to a vertical face by cutting the existing asphalt concrete back for its full depth and exposing a fresh face.
1. After placement and finishing of the new asphalt concrete, both sides of the joint shall be dense, and the joint shall be well sealed.
 2. The surface in the area of the joint shall conform to the requirements ~~hereinafter~~ specified below for surface tolerances when tested with the straightedge placed across the joint.
- E. No hot lap transverse jointing will be allowed in the paving of the through lanes. When stopping the paving for the shift or for any reason, the resulting transverse joint shall be formed on a skew of approximately ~~fifteen (15)~~ degrees from a line perpendicular to the centerline of the road.

400.03.11 PRODUCTION START-UP PROCEDURE

- A. On the first day of construction, the Contractor shall produce ~~five hundred (500)~~ tons of asphalt rubber pavement mix and then stop production for the day.
1. The ~~five hundred (500)~~ tons of asphalt rubber pavement mix shall be placed within the project limits as a test strip.
 2. The ~~entity~~ Engineer or ~~his~~ Engineer's representative will evaluate the test strip, which will also be used to establish a rolling pattern for compaction, calibration of nuclear density gauges for core densities, and to verify the mix design.
- B. Mix production and construction will not proceed until the test strip has been accepted by the ~~entity~~ Engineer.

400.03.12 WEATHER LIMITATIONS

- A. The asphalt rubber pavement shall be placed when temperature of the existing pavement surface is 60° degrees F and rising before placement.

400.03.13 TACK COAT

- A. An SS-1h tack coat shall be applied, as directed by the ~~entity~~ Engineer, at a rate of 0.05 to 0.10 ~~gallons~~ per square yard.
- B. Immediately before applying the bituminous material, the area to be surfaced shall be cleaned of dirt and other objectionable material.
1. In urban areas, the surface shall be cleaned with a self-propelled pick-up sweeper.
 2. In rural areas, power brooms may be used.

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C. When necessary, cleaning shall be supplemented by hand brooms.

400.03.14 MILLING

- A. The milling process shall not proceed more than ~~seven (7)~~ days ahead of the paving operation. The Engineer shall have the final decision in determining the time period between milling operations and paving operations.
- B. The Contractor shall be required to protect all milled surfaces from deterioration and repair subsequent damage prior to seal coating.
- C. Utility companies are not required to lower their appurtenances to facilitate edge milling or cul-de-sac milling.
- D. The Contractor through the ~~Inspector~~ Engineer shall notify the entity Traffic Department prior to milling at signalized intersections or any location where signal loop detectors may be damaged by the milling operation.

400.03.15 PREPARATION OF SURFACES

- A. The pavement shall not be used for vehicular traffic of any kind until the pavement has cooled to 180° degrees F, or less, after final rolling.
- B. Traffic shall be prohibited from using the new pavement by utilization of flagging or ribbons placed between barricades.
1. The Contractor, at ~~his own expense~~ no additional cost to the Contracting Agency, shall be responsible for repairing the new asphalt if damaged by vehicular traffic prior to cooling and curing.
 2. If traffic is permitted on the surface prior to cooling and curing of the asphalt ~~-~~rubber mix, a mixture of water and hydrated lime (1 ~~-~~bag/5,000 ~~-~~gallon) shall be applied followed by a water rinse to remove hydrated lime residue.
 3. The ~~entity~~ Engineer or ~~his~~ Engineer's representative will determine when the pavement can be opened to vehicular traffic and if a hydrated lime solution shall be applied.

400.03.16 CONTRACTOR SUBMITTALS DURING CONSTRUCTION

- A. The Contractor shall provide certification that the ground rubber meets or exceeds the requirements as set forth in Subsection 400.02.05, ~~“Crumb Rubber Modifier.”~~
- B. The Contractor shall furnish daily documentation to the ~~entity~~ Engineer that the required amount of mineral admixture has been incorporated into the asphalt rubber concrete.
- C. The asphalt rubber supplier shall maintain records indicating the following for each batch of asphalt rubber binder produced:
1. ~~;~~ The quantity of asphalt cement in gallons and tons.
 2. ~~;~~ The temperature of the asphalt cement.
 3. The amount of anti-stripping agent or other additives, if used, in gallons and/or tons.
 4. ~~;~~ and The quantity of crumb rubber modifier in pounds.
- D. The Contractor, ~~and~~ shall provide the supplier's records to the ~~entity~~ Engineer on a daily basis.

ASPHALT RUBBER PAVEMENT SURFACE

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- E. When producing asphalt rubber pavement, a recording pyrometer or other approved recording thermometric instrument, sensitive to a rate of temperature change not less than 10° degrees F per minute, shall be placed at the discharge chute of the dryer in order to automatically record the temperature of the asphalt rubber concrete or mineral aggregate. A copy of the recording shall be given to the entity-Engineer at the end of each shift.
- F. The entity-Engineer shall be provided with all other materials certifications, samples, test reports, and unrestricted access to all plant production records. Any corrective work, due to deviations from the requirements of these specifications, shall be done at no additional cost to the entityContracting Agency.

METHOD OF MEASUREMENT

400.04.01 MEASUREMENT

- A. The quantity of Asphalt Rrubber Ppavement will be paidmeasured for payment byper square yard, complete and in place.
- B. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

BASIS OF PAYMENT

400.05.01 PAYMENT

- A. The accepted quantity of asphalt rubber pavement will be paid for at the contract unit price bid per square yard, which price shall be considered full compensation for furnishing all the materials including tack coating, hydrated lime, Portland cCement, aggregate, asphalt rubber binder, asphalt cement, crumb rubber modifier, and admixtures, and shall also include full compensation for mixing, loading, hauling, placing, compacting, and incidentals necessary for doing all the work involved in constructing rubberized asphalt concrete pavement as shown on the plans or established by the Engineer.
- B. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- C. Payment will be made under:

Pay Item	Pay Unit
Two (2) (Thickness) -Inch Asphalt Rubber Pavement (Overlay).....	Square Yard

SECTION 401

PLANTMIX BITUMINOUS PAVEMENTS – GENERAL

DESCRIPTION

401.01.01 GENERAL

- A. These specifications include general requirements that are applicable to all types of bituminous pavements of the plantmix type irrespective of gradation of aggregate, kind, and amount of bituminous material, or pavement use. Deviations from these general requirements will be indicated in the specific requirements for each type.
- B. This work shall consist of one or more courses of bituminous mixture constructed on the prepared foundation in accordance with these specifications and the specific requirements of the type under contract, and in conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer.

401.01.02 PAVEMENT STRUCTURAL DESIGN

- A. All public pavement sections shall be designed in accordance with the 1993 AASHTO® Guide for Design of Pavement Structures. The following parameters, based upon the AASHTO® Guide and the 1996 Nevada Department of Transportation Pavement Structural Design and Policy Manual, shall be used in the design calculations. Parameters which are specific to a road classification are identified by the right-of-way dimension. The design ~~must~~shall be stamped and signed by a ~~P~~Professional ~~E~~Engineer registered in the ~~S~~State of Nevada.
1. The reliability factor will be a minimum of ~~eighty (80)~~ percent with a standard normal deviate (ZR) of -0.841 for ~~fifty-one (51)~~-foot, ~~sixty (60)~~-foot, and ~~eighty (80)~~-foot rights-of-way, and a minimum ~~ninety (90)~~ percent with a standard normal deviate (ZR) of -1.282 for ~~one-hundred (100)~~-foot rights-of-way.
 2. The standard deviation will be 0.45 for all classifications.
 3. The initial service index will be 4.2 and the final service index 2.5 for all classifications.
 4. Drainage coefficients shall not exceed 1.0.
 5. The structural coefficient for asphalt will be 0.35.
 6. For materials meeting ~~the Uniform Standard Specification Subsection 704.03.04,~~ "Type II Aggregate Base," the elastic modulus ~~will~~shall be 25,000 psi (~~172 MPa~~) and the structural coefficient shall be 0.12.
 7. For materials meeting ~~the Uniform Standard Specification Subsection 704.03.03,~~ "Type I Aggregate Base," the elastic modulus ~~will~~shall be 15,000 psi (~~103 MPa~~) and the structural coefficient shall be 0.11.
 8. Prior to design, soil testing will be performed in accordance with ASTM D-2844, or AASHTO T190, to determine a representative Resistance (R) value for the prepared subgrade. The subgrade shall be prepared in accordance with the Geotechnical Soils Investigation Report, and soil sampling performed subsequent to rough grading to confirm the original results. An average of the R-values ~~can~~may be used if the soil classification results are consistent, or if the values do not differ by more than 10. The minimum testing requirements are ~~one (1)~~ right-of-way R-value test and post grading soil classifications every ~~one-thousand (1,000)~~ linear feet (~~305 meters~~) of roadway, with a minimum of ~~two (2)~~ classifications per project.

9. The subgrade R-value (psi) shall be converted to a Resilient Modulus (MR, psi) using the following correlation: $MR=145*(10^{(0.0147*R)+1.23})$.
 10. The minimum AC sections are ~~two (2.0)~~-inches (~~51 millimeters~~) for a residential street, ~~three (3.0)~~-inches (~~76 millimeters~~) for a minor collector, ~~four (4.0)~~-inches (~~102 millimeters~~) for a major collector, and ~~four (4.0)~~-inches (~~102 millimeters~~) for an arterial street.
 11. All designs require a minimum of ~~four (4)~~-inches (~~102 millimeters~~) Type II aggregate base material.
 12. The subgrade ~~must~~shall be scarified and recompact to a minimum of ~~ninety-five (95)~~ percent, to minimum depth of ~~eight (8)~~-inches (~~204 millimeters~~).
 13. Expansive soils may require additional design compensation. If native soils classify as either an AASHTO A-6 or A-7 (more than ~~thirty-six (36)~~ percent passing the #200 sieve and a PI equal to or greater than 11), the design may include stabilization, over-excavation, or utilization of a geomembrane, as recommended by the geotechnical engineer.
 14. Hydro-collapsible soils, or the presence of soluble materials, may require additional design compensation, as recommended by the geotechnical engineer.
- B. The minimum design equivalent axial loads (EAL) based on a 20_-year design are 7.2E+3 for a residential street, 3.3E+4 for a minor collector, 3.7E+5 for a major collector, and 1.0E+6 for an arterial street. Locations with heavier than normal traffic ~~must~~shall be designed accordingly. A traffic study may be required for roads with a projected TI greater than 9.5. If required by the Contracting a Agency, actual vehicle count data and assigned axle factors shall be used in the design of the pavement section. Definition of the roadway classifications, for design purposes, are listed below:
1. Residential roadways are those that provide access for residential areas only: Most ~~fifty-one (51)~~-foot right-of-way roads are residential. The normal design TI is 5.0. A Residential road is considered to have heavy traffic, and a TI of 5.5, if minor amounts of thru-traffic use the road or bus traffic is encountered due to an adjacent school. Category II mix designs shall be used on residential streets.
 2. Minor Collector roadways are those that collect residential traffic or service limited commercial facilities: Most ~~sixty (60)~~-foot, and some ~~fifty-one (51)~~-foot, right-of-way roads fit this classification. The normal design TI is 6.0. A Minor Collector is assumed to have heavy traffic, and a TI of 6.5, if there is substantial commercial truck traffic, or bus traffic due to an adjacent school.
 3. Major Collector roadways are those that serve as destination roadways or service normal commercial or light industrial facilities: Most ~~eighty (80)~~-foot, and some ~~sixty (60)~~-foot, right-of-way roads fit this classification. The normal design TI is 8.0. A Major Collector is assumed to have heavy traffic, and a TI of 8.5, if there is substantial commercial or industrial truck traffic.
 4. Arterial roadways are those that provide primary traffic routes or service heavy industrial facilities: All ~~one-hundred (100)~~-foot, and some ~~eighty (80)~~-foot and ~~sixty (60)~~-foot, right-of-way roads fit ~~this~~ classification. The normal design TI is 9.5. An arterial may have light traffic, if there is a disruption or decrease in the road capacity, in which case the design TI is 9.0. An Arterial is assumed to have heavy traffic if it is at full capacity with substantial truck ~~traffic,~~ ~~or~~ ~~if~~ there is heavy industrial traffic. A traffic study is ~~recommended~~ in those situations.

MATERIALS

401.02.01 COMPOSITION OF MIXTURES

- A. The bituminous plantmix shall be composed of a mixture of aggregate, mineral filler if required, and bituminous material. The several aggregate fractions shall be sized, uniformly graded, and combined in such proportions that the resulting mixture meets the grading requirements of the job-mix formula.
- B. Before starting work, the Contractor shall submit a proposed job-mix formula in writing, for use by the Engineer in setting the job-mix formula to be used.
1. The proposed job-mix formula shall be determined by a testing laboratory under the direction and control of a registered professional engineer, based on tests performed in accordance with the "Marshall Method of Mix Design" as described in the Asphalt Institute Manual Series No. 2 (MS-2), ~~latest~~ latest ~~E~~Edition.
 2. The number of compaction blows to be applied to the specimens will be based on the appropriate traffic category.
 3. Traffic Category I will use a 75-blow design and will apply to all arterial streets and wherever "heavy" traffic is expected.
 4. Traffic Category II will use a 50-blow design and will apply to collector and local streets.
 5. Unless otherwise specified, ~~v~~voids determinations and effective asphalt contents will be determined and reported in accordance with procedures described ~~in this publication unless otherwise amended in the Special Provisions~~ herein.
- C. The job-mix formula shall be selected in accordance with the following procedures:
1. ~~(a)~~ Determine asphalt content required for 4 percent air voids, and
 2. ~~(b)~~ Determine the average asphalt content for:
 - a. ~~(1)~~ Maximum density.
 - b. ~~(2)~~ Maximum stability.
 - c. ~~and (3)~~ 4 percent air voids ~~and~~
 3. ~~(e)~~ The lower of the asphalt contents obtained for ~~(a)~~ or ~~(b)~~ above will be used as the design asphalt content for the job-mix formula.
- D. The job-mix formula asphalt content shall satisfy all Marshall design criteria as shown in the following table:

MARSHALL DESIGN CRITERIA

TRAFFIC CATEGORY*	I TRAFFIC INDEX (TI) ≥ 7.0		II TRAFFIC INDEX (TI) < 7.0	
	Min.	Max.	Min.	Max.
Compaction Blows Each <u>End</u> o <u>f</u> Specimen	75		50	
Test Property	Min.	Max.	Min.	Max.
Stability, Lb.	1800	--	1500	--
Flow, 0.01 In.	8	14	8	16
Percent Total Air Voids	3	5	3	5

MARSHALL DESIGN CRITERIA

TRAFFIC CATEGORY*	I TRAFFIC INDEX (TI) ≥ 7.0		II TRAFFIC INDEX (TI) < 7.0	
	Compaction Blows Each End of Specimen	75		50
Test Property	Min.	Max.	Min.	Max.
Percent Voids Filled With Asphalt	65	75	65	78
Minimum Voids In Mineral Aggregate - Percent	See Table In Asphalt Institute MS-2 Manual			
* Traffic Category I - Applies to arterials and major collectors. See roadway classification in Subsection 401.01.02. Traffic Category II - Applies to minor collectors and residential streets. See roadway classification in Subsection 401.01.02. The applicable Traffic Category will be designated in the Special Provisions for each project.				

- E. In addition to the Marshall Design Criteria set forth herein, the job-mix formula shall also meet the following tensile strength requirements for all traffic categories:

TEST PROPERTY	TEST METHOD	REQUIREMENTS
Indirect Tensile Strength (Unconditioned)	AASHTO T283	65 p.s.i. psi minimum (50 p.s.i. psi minimum with AC-10 asphalt)
Indirect Tensile Strength (Retained Strength)	AASHTO T283	70 percent minimum

- F. Should the job-mix formula fail to meet the tensile strength requirements, the Contractor shall add hydrated lime (hereinafter referred to as mineral filler) to the plantmix bituminous aggregates as specified in Subsection 401.03.08, "[Preparation of Aggregates.](#)" If the addition of mineral filler fails to achieve the minimum tensile strengths, the Contractor will be required to change sources of material, and submit a new job-mix formula that will satisfy all design criteria.
- G. The test report shall show the curves and data tabulations used to determine the following characteristics:
1. Unit weight per cubic foot.
 2. Percentage of air voids.
 3. Percent voids filled with asphalt.
 4. Marshall stability.
 5. Percent voids in mineral aggregate (VMA).
 6. Marshall flow.
 7. Indirect tensile strength (Unconditioned and Retained strength).
- H. Data tabulations shall include indications of the water absorption, aggregate bulk specific gravities for both coarse (retained on No. 8 sieve) and fine (passing No. 8 sieve) aggregate, theoretical specific gravity of bituminous mixture, absorbed asphalt, and effective asphalt content as determined in accordance with referenced Asphalt Institute procedures. ~~ASTM Test Method D-2041~~ will be used for determination of theoretical maximum specific gravity of bituminous paving mixtures.
- I. The test report shall give the recommended asphalt content and the values for:
1. Unit weight per cubic foot (bulk density).

2. Stability.
 3. Flow.
 4. Air voids.
 5. Voids filled with asphalt.
 6. Voids in mineral aggregate (VMA).
 7. Indirect tensile strength (Unconditioned and Retained strength).
- J. The formula submitted shall propose definite single values for:
1. ~~(A)~~—The percentage of aggregate passing each specified sieve.
 2. ~~(B)~~—The percentage of bitumen to be added (to 0.1 percent) based on weight of total mix.
 3. ~~(C)~~—The percentage of mineral filler to be added to the aggregate.
 4. ~~(D)~~—The temperature of the mixture leaving the mixer.
 5. ~~(E)~~—The temperature of the mixture in the hopper of the paving machine.
- K. The job-mix formula aggregate with the allowable tolerances herein shall conform to ~~the requirements of~~ Section 705, "Aggregates for Bituminous Courses," for plantmix bituminous base aggregates, plantmix bituminous surface aggregate, or plantmix bituminous open-graded aggregate, as ~~the case may be~~ applicable.
- L. The Engineer will determine a job-mix formula with single values for [Subsection 401.02.01, "Composition of Mixtures," paragraph J, subparagraphs 1 through 5\(a\), \(b\), \(c\), \(d\) and \(e\)](#) above, and so notify the Contractor in writing. This job-mix formula shall not be modified except with the written approval of the Engineer. The mix furnished shall conform to this job-mix formula, within the following range of tolerances:
1. Aggregate passing the No. 4 and larger sieves: ± 7 percent
 2. Aggregate passing the No. 8 to No. 100 sieves: ± 4 percent
 3. Aggregate passing the No. 200 sieve: ± 2 percent, but not to exceed upper limit of specification. Mineral filler is not considered as part of the aggregate.
 4. Bitumen content: ± 0.3 percent
 5. Temperature leaving the mixer: ± 20 degrees F. ~~(11 degrees C.)~~
 6. Temperature in hopper of paving machine: ± 20 degrees F. ~~(11 degrees C.)~~
- ~~*Mineral filler is not considered as part of the aggregate.~~
- M. Should there be a change in sources of materials, a new job-mix formula shall be established before the new material is used.
1. Check tests of properties of the plantmix bituminous materials shall be made on the first day of production and as requested by the Engineer during period of construction to confirm that all properties are in compliance with Marshall Design Criteria and tensile strength requirements.
 2. Adjustments in gradation, mineral filler content, and asphalt content shall be made as necessary ~~in order~~ to meet design criteria.
- N. The temperature of the bituminous material just prior to mixing and of the completed mixture in the hauling vehicle just prior to leaving the plant shall conform to the following table:

PLANTMIX BITUMINOUS MIXTURE WITH ASPHALT CEMENT

Grade of Asphalt Cement	Bituminous Material		Plantmix Bituminous Base of Surface Mixtures		Plantmix Bituminous Open-Graded Mixtures	
	Min.	Max.	Min.	Max.	Min.	Max.
AC-40	275°F 135°C	350°F 177°C	255°F 124°C	350°F 177°C	245°F 118°C	275°F 135°C
AC-20, AC-30	265°F 129°C	330°F 166°C	245°F 118°C	325°F 163°C	245°F 118°C	275°F 135°C
AC-10	255°F 124°C	325°F 163°C	235°F 112°C	325°F 163°C	=	=
AC-20P	280°F 138°C	350°F 177°C	300°F 149°C	350°F 177°C	300°F 149°C	350°F 177°C

401.02.02 AGGREGATES

- A. Aggregates shall ~~meet the applicable requirements of~~ comply with Section ~~_~~705, "Aggregates for Bituminous Courses."

401.02.03 COMMERCIAL MINERAL FILLER

- A. Commercial mineral filler shall ~~meet the requirements of~~ comply with Subsection ~~_~~705.03.04, "Commercial Mineral Filler."

401.02.04 BITUMINOUS MATERIALS

- A. The bituminous material shall ~~meet the applicable requirements of~~ comply with Section ~~_~~703, "Bituminous Materials." Bituminous material may be conditionally accepted at the source.
- B. Unless otherwise specified in the Special Provisions for Category ~~_I~~ pavements, the grade of bituminous material for dense-graded mixes shall be AC-30 asphalt cement. An AC-30, or AC-20P asphalt cement shall be used for open-graded mixes as specified in Subsection ~~_~~403.02.02, "Composition of Mixture." The grade may be changed one step by the Engineer.
- C. Unless otherwise specified in the Special Provisions, for Category ~~_II~~ pavements the grade of bituminous material for dense-~~_~~graded mixes shall be AC-20 asphalt cement. The grade may be changed one step by the Engineer.
- D. Certificates of Compliance for the asphalt, showing test values necessary for specification compliance, shall be made available upon request by the Engineer.

401.02.05 FIELD COMPACTION AND MIX DESIGN CORRELATION

- A. Type 2 coarse mix design annual submittals only.
- B. In an effort to establish the "point of refusal," ~~a maximum density of the field compaction must be obtained. i~~ if it has been determined that the in-place air voids are less than ~~six (6)~~ percent or more than ~~eight (8)~~ percent, the mix design bitumen content ~~will~~ shall be adjusted. This procedure will be required as a part of all new mix designs, and any field adjustment ~~so~~ shall be noted.
- C. The field compaction shall be as required in Section 401.03.11, "Rolling and Compaction."
- The in-place air voids, as based on the Maximum Theoretical Specific Gravity and ~~ten (10)~~ correlated nuclear tests or ~~five (5)~~ cores, shall then be calculated.

2. If the mean percent air voids is outside the limits noted above, the bitumen content shall be mathematically increased or reduced and noted on the mix design submittal. If adjustment is made, then a new control strip is required.
 3. Once the control strip meets the above requirements, it becomes the control strip for subsequent mix placements.
- D. Subsequent compaction testing lots shall be tested in accordance ~~to~~with Section 401.03.12, "[Acceptance Sampling and Testing of Bituminous Mixture.](#)" If the compaction cannot be maintained between the above limits, a new control strip shall be implemented to re-establish the mean density for testing.

CONSTRUCTION

401.03.01 BITUMINOUS MIXING PLANT

- A. Sufficient storage space shall be provided for the aggregate, or for each size aggregate when required. The storage yard shall be maintained neat and orderly and the stockpile, or separate stockpiles when required, shall be readily accessible for sampling. ~~Plants used for the preparation of bituminous mixtures shall conform to all requirements under (A). In addition, batch mixing plants shall conform to the requirements under (B) and drum drier plants shall conform to the requirements under (C).~~
- B. ~~(A)~~—Mixing plants shall be of sufficient capacity and coordinated to adequately handle the proposed bituminous construction.
- C. Mixing Plants. Plants used for the preparation of bituminous mixtures shall conform to the following requirements:
1. ~~(1)~~Equipment for Preparation of Bituminous Material:
 - a. Tanks for the storage of bituminous material shall be equipped to heat and hold the material at the required temperatures.
 - b. The heating shall be accomplished by steam coils, electricity, or other approved means so that no flame shall be in contact with the tank or contents.
 - c. The circulating system for the bituminous material shall be designed to asensure proper and continuous circulation during the operating period.
 - d. Provisions shall be made for measuring and sampling storage tanks.
 2. ~~(2)~~Drier: The plant shall include a drier or driers which continuously agitate the aggregate during the heating and drying process.
 3. ~~(3)~~Thermometric Equipment:
 - a. An armored thermometer of adequate range in temperature reading shall be fixed in the bituminous feed line at a suitable location near the charging valve at the mixer unit.
 - b. The plant shall ~~also~~be equipped with either an approved dial-scale, mercury-actuated thermometer, an electric pyrometer, or other approved thermometric instrument so placed at the discharge chute of the drier as to register automatically or indicate the temperature of the heated aggregate.
 - c. The Engineer may require replacement of any thermometer by an approved temperature-recording apparatus for better regulation of the temperature of aggregates.

4. ~~(4)~~ Smoke and Dust Control: The Contractor will be required to install satisfactory precipitation devices, or use other methods which will meet local conditions, city and county regulations as set forth by the Clark County Air Pollution Control Officer, and state laws pertinent to air pollution.
5. ~~(5)~~ Truck Scales:
 - a. Except as allowed in Subsection 401.04.01, "Measurements," bituminous mixture shall be weighed on approved scales furnished by the Contractor or on public scales at ~~the Contractor's expense~~ no cost to the Contracting Agency.
 - b. Such scales shall be platform scales and conform to the provisions of Subsection 109.01, "Measurement of Quantities."
6. ~~(6)~~ Safety Requirements:
 - a. Adequate and safe stairways to the mixer platform and sampling points shall be provided and guarded ladders to other plant units shall be placed at all points where accessibility to plant operations is required.
 - b. Accessibility to the top of truck bodies shall be provided by a platform or other suitable device to enable the Engineer to obtain sampling and mixture temperature data.
 - c. A hoist or pulley system shall be provided to raise scale calibration equipment, sampling equipment, and other similar equipment from the ground to the mixer platform and return.
 - d. All gates, pulleys, chains, sprockets, and other dangerous moving parts shall be thoroughly guarded and protected.
 - e. Ample and unobstructed passage shall be maintained at all times in and around the truck loading area.
 - f. This area shall be kept from drippings from the mixing platform.
- D. ~~(B) Requirements for Batching Plants.~~ Batch mixing plants shall conform to the following requirements:
 1. ~~(1)~~ Plant Scales:
 - a. Scales shall be accurate to 0.5 percent of the minimum load that may be required. Poises shall be designed to be locked in any position to prevent unauthorized change of position.
 - b. Scales shall be as described in Subsection 109.01, "Measurement of Quantities." In lieu of truck scales, the Contractor may provide an approved automatic printer system which will print the weights of the material delivered, provided the system is used in conjunction with an approved automatic batching control system. Such weights shall be evidenced by a weight ticket for each load.
 - c. The amount of filler material shall be determined by weighing on springless dial scales separate from the plant weigh hopper or by some method that uniformly feeds the mixer within ~~ten (10)~~ percent of the required amount.
 2. ~~(2)~~ Feeder for Drier: The plant shall be provided with accurate mechanical means for uniformly feeding the aggregate into the drier so that uniform production and uniform temperature will be obtained.

3. ~~(3)~~ Screens: Plant screens capable of screening the aggregate to the specified sizes will be required.
4. ~~(4)~~ Bins:
 - a. The plant shall include storage bins of sufficient capacity to supply the mixer when it is operating at full capacity.
 - b. Bins shall be arranged to ~~as~~ ensure separate and adequate storage of appropriate fractions of the mineral aggregates.
 - c. Separate dry storage shall be provided for mineral filler when used and the plant shall be equipped to feed such material into the mixer.
 - d. Each bin shall be provided with overflow pipes, of such size and at such locations as to prevent backing up of material into other compartments or bins.
 - 1) Each compartment shall be provided with its individual outlet gate constructed so that when closed there shall be no leakage.
 - 2) The gates shall cut off quickly and completely.
 - 3) Bins shall be so constructed that samples representative of the entire material in the bin can be readily obtained.
5. ~~(5)~~ Weigh Box or Hopper:
 - a. All materials shall be proportioned by weight.
 - b. ~~Aggregate scales shall be either~~ one of the following:
 - 1) ~~(1) a m~~ Multiple beam scale.
 - 2) ~~;(2) a s~~ Springless dial type scale.
 - 3) ~~;- or (3) a f~~ Fully automatic solid-state digital strain gauge transducer measuring device.
 - c. Aggregate scales shall have ~~ing~~ a capacity exceeding 1-1¹/₄ times the total amount of materials to be weighed in one operation. Each scale gradation shall be approximately 1/1000 of the total capacity of the scale.
 - d. All scales used for proportioning materials shall be accurate to within ~~one (1)~~ percent ~~;~~.
 - 1) The ~~y~~ scales shall be sealed and certified by the State Sealer of Weights and Measures ~~;~~.
 - 2) ~~These c~~ Certifications shall be dated within the past ~~twelve (12)~~ months and shall be renewed whenever required by the Engineer ~~;~~.
 - 3) ~~If n the event~~ the plant is moved, a new certificate will be required.
 - e. All scales shall be of such size and so arranged that they may be read easily from the operator's platform.
 - 1) The ~~y~~ scales shall indicate the true net weight without the application of any factor.
 - 2) ~~The~~ dials of scales shall not be less than ~~twelve (12)~~ inches ~~(300 millimeters)~~ in diameter ~~;~~.
 - 3) ~~and t~~ The figures ~~thereon~~ the scale dials ~~;~~ shall be clearly legible.

- f. Weighing equipment shall be so insulated against the vibration or movement of other operating equipment in the plant; that the error in weighing with the entire plant running will not exceed ~~one and one-half (1-1/2)~~ percent for any batch.
6. ~~(6)~~ Bituminous Control Unit: Satisfactory means, either by weighing or metering, shall be provided to obtain the proper amount of bituminous material in the mix within the tolerance specified. Means shall be provided for checking the quantity or rate of flow of bituminous material into the mixer.
7. ~~(7)~~ Bituminous Control:
- a. The equipment used to measure the bituminous material shall be accurate to plus or minus 0.~~5~~5 percent.
- 1) The bituminous material bucket shall be a non-tilting type with a loose sheet metal cover.
 - 2) The length of the discharge opening or spray bar shall be not less than three-fourths the length of the mixer and it shall discharge directly into the mixer.
 - 3) The bituminous material bucket, its discharge valve or valves, and spray bar shall be adequately heated.
 - 4) Steam jackets, if used, shall be efficiently drained and all connections shall be so constructed that they will not interfere with the efficient operation of the bituminous scales.
 - 5) The capacity of the bituminous material bucket shall be at least ~~fifteen (15)~~ percent in excess of the weight of bituminous material required in any batch.
 - 6) The plant shall have an adequately heated quick-acting, non-drip, charging valve located directly over the bituminous material bucket.
- b. Bituminous material shall be measured by means of springless dial scales or metering devices. Springless dial scales shall have a capacity of not more than ~~one thousand (1,000)~~ pounds (~~450 kilograms~~) in ~~two (2)~~ pound (~~1 kilogram~~) gradations.
- 1) The indicator dial shall have a capacity of at least ~~fifteen (15)~~ percent in excess of the quantity of bituminous material used in a batch.
 - 2) The controls shall be constructed so that they may be locked at any dial setting and will automatically reset to that reading after the addition of bituminous material to each batch.
 - 3) The dial shall be in full view of the mixer operator.
- c. The flow of bituminous material shall be automatically controlled so that it will begin when the dry mixing period is over.
- 1) All of the bituminous material required for one batch shall be discharged in not more than ~~fifteen (15)~~ seconds after the flow has started.
 - 2) The size and spacing of the spray bar openings shall provide a uniform application of bituminous material the full length of the mixer.

- 3) The section of the bituminous line between the charging valve and the spray bar shall be provided with a valve and outlet for checking the accuracy of the meter when a metering device is substituted for a bituminous material bucket.
8. ~~(8)~~Mixer:
- a. The batch mixer shall be of a twin pugmill type, steam jacketed, or heated by other approved means and capable of producing uniform mixtures within the specified tolerances.
 - b. It shall be equipped with a sufficient number of paddles or blades set in proper order and operated at such speed as to produce a properly and uniformly mixed batch.
 - c. At the beginning of the mixing operation, the clearance between paddle tips and liner shall not exceed half the maximum aggregate diameter for the specified job -mix.
 - d. The clearance of the paddles or blades from all fixed and moving parts shall not exceed ~~one (1)~~ inch ~~(25 millimeters)~~.
 - e. Badly worn or defective paddles or blades shall not be used in mixing operations.
9. ~~(9)~~Control of Mixing Time:
- a. The mixer shall be equipped with an accurate time lock to control the operations of a complete mixing cycle.
 - 1) It shall lock the weigh box gate after the charging of the mixer until the closing of the mixer gate at the completion of the cycle.
 - 2) It shall lock the mixer gates throughout the dry and wet mixing periods.
 - 3) The dry mixing period is defined as the interval of time between the opening of the weigh box gate and the start of introduction of bituminous material.
 - 4) The wet mixing period is the interval of time between the start of introduction of bituminous material and the opening of the mixer gate.
 - b. The mixer shall be equipped with a timing device which will indicate by a definite audible or visual signal the expiration of the mixing period.
 - 1) The device shall measure the time of mixing within an accuracy of ~~two (2)~~ seconds.
 - 2) A suitable automatic device for counting the number of completely mixed batches shall be provided and maintained in proper working condition.
 - c. When the aggregate and the bituminous material have been combined, the entire mass shall be mixed in a approved mixer.
 - 1) The mixing shall continue until homogeneity and a uniform coating are achieved.
 - 2) The output rate shall not exceed the manufacturer's capacity rating.

- E. ~~(C) Requirements for Dryer Drum Mixing Plants.~~ Drier drum mixing plants shall conform to the following requirements:
1. ~~(1) Aggregate Stockpiles: Comply with The first paragraph of~~ Subsection 401.03.08, "Preparation of Aggregates," paragraphs A through C shall apply.
 2. ~~(2) Aggregate Proportioning:~~
 - a. The plant shall include a means for accurately proportioning each bin size of aggregate prior to the drying operation.
 - b. The plant shall have a mechanical feeder mounted under each compartment bin.
 - 1) Each compartment bin shall have an accurately controlled individual gate for volumetrically measuring the material drawn from each compartment.
 - 2) The feeding orifice shall be rectangular with one dimension adjustable by positive means.
 - 3) Indicators shall be provided for each gate to show the respective gate opening in inches ~~(millimeters).~~
 - c. A meter for determining the rate of each feeder, or a revolution counter, shall be provided. Commercial filler material introduced into the mixer shall be drawn from storage bins by a continuous mechanical feeder which will uniformly feed the mixer within ~~ten (10)~~ percent of the required amount.
 3. ~~(3) Weight Calibration of Aggregate:~~ The plant shall include a means for calibration for each aggregate feeder by weighing test samples.
 4. ~~(4) Bituminous Metering Device:~~ The bituminous material shall be introduced into the mixer through a gallonage meter by a positive displacement metering device. ~~This metering device shall be~~ equipped with a ready means of varying the bituminous material delivery rate.
 5. ~~(5) Synchronization of Aggregate Feed and Bituminous Material Feed:~~
 - a. Satisfactory means shall be provided to afford a positive interlocking control between the flow of aggregate from each feeder and the flow of bituminous material.
 - b. The interlocking control shall indicate a visible or audible signal when the level of material in any one feeder approaches the strike off capacity of the feed gate, or shut the plant down.
 6. ~~(6) Mixer:~~
 - a. The plant shall include a mixing device which will obtain homogeneity and a uniform coating.
 - b. The mixing output shall not exceed the manufacturer's capacity rating.
 - c. The moisture content of the bituminous mixture shall not exceed ~~3%~~ percent at the discharge end of the dryer.
 7. ~~(7) Surge Bins:~~ The plant will be equipped with an approved surge bin at the discharge. This surge bin will be in excess of ~~twenty (20)~~ tons ~~(18 metric tons)~~, and shall be equipped with an approved surge batcher or other approved method

satisfactory to the Engineer that will prevent segregation of the bituminous mixture as it is being discharged into the hauling vehicle.

401.03.02 HAULING EQUIPMENT

- A. Trucks used for hauling bituminous mixtures shall have tight, clean, smooth beds which have been thinly coated with a minimum amount of paraffin oil, lime solution, or other approved material to prevent the mixture from adhering to the beds.

401.03.03 PAVERS

- A. Bituminous pavers shall be self-contained, self-propelled units, provided with an activated screed or strike-off assembly, heated if necessary, and capable of spreading the finishing courses of bituminous plantmix material in lane widths applicable to the specified typical section and thicknesses shown on the plans.
- B. Pavers used for shoulders and similar construction shall be capable of spreading and finishing courses of bituminous plantmix material in widths shown on the plans.
- C. The asphalt paver shall operate independently of the vehicle being unloaded and shall be capable of propelling the vehicle being unloaded in a satisfactory manner.
1. If necessary, the load of the haul vehicle shall be limited to that which will ensure satisfactory spreading.
 2. While being unloaded, the haul vehicle shall be in contact with the machine at all times, and the brakes on the haul vehicle shall not be depended upon to maintain contact between the vehicle and the machine.
- D. Pavers shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed.
- E. The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.
- F. Pavers shall be capable of placing the bituminous mixture to meet the surface tolerances specified under the respective sections of bituminous pavement.

401.03.04 ROLLERS

- A. Rollers shall be vibratory, steel-wheeled or pneumatic-tired type, ~~They shall be~~ in good condition.
1. Rollers shall be capable of reversing without backlash, and operating at slow speeds to avoid displacement of the bituminous mixture.
 2. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density without detrimentally affecting the completed material as determined by the Engineer.
 3. ~~Attention is directed to~~ Comply with Subsection 401.03.11, "Rolling and Compaction."
- B. Rollers for the test strip shall meet the following requirements:
1. ~~a) Breakdown rollers shall be either a three (3)-wheeled steel roller or a two (2)-axle tandem or a three (3)-axle tandem weighing not less than ten (10)-tons.~~

2. ~~b)~~ Except as hereinafter permitted, pneumatic-tired rollers shall comply with the following:
 - a. Rollers shall consist of not less than ~~nine (9)~~ wheels equipped with pneumatic tires of equal size and diameter.
 - b. Tires shall be mounted on ~~two (2)~~ axles attached to a rigid frame, equipped with a loading platform or body suitable for ballast loading, so that the total weight of the roller can be varied to produce an operating weight per tire of between ~~one thousand (1,000)~~ and ~~two thousand (2,000)~~ pounds ~~(450 and 900 kilograms)~~.
 - c. The tires shall have treads satisfactory to the Engineer.
 - d. ~~The tires on the rear axle shall be so spaced that the entire gap between adjacent tires on the front axle will be covered by one (1) tread of the following tires.~~
 - e. ~~The tires shall be uniformly inflated so that the air pressure in the several tires will not vary more than five (5) pounds per square inch (34 kPa). Inflation pressure in pounds per square inch shall be the tire manufacturer's recommendation.~~
 - f. Minimum tire size shall be 7.50 inches ~~by~~ 15 inches, ~~four (4)~~ ply.
3. ~~The use of pneumatic-tired rollers with lesser number of fewer wheels and a greater maximum operating weight per tire than that specified herein will be permitted subject to the following requirements:~~
 - a. ~~1.—~~The minimum width between the outer edge of the outside tires on a given axle shall be ~~sixty (60)~~ inches ~~(1.5 meters)~~.
 - b. ~~2.—~~The weight of the roller and the tire pressure can be varied to produce a ground contact pressure between ~~fifty (50)~~ and ~~seventy (70)~~ p.s.i. psi ~~(345 and 483 kPa)~~.
4. ~~e)~~ The finish roller shall be a ~~two (2)~~ axle tandem weighing not less than ~~eight (8)~~ tons ~~(7.3 metric tons)~~.

401.03.05 WEATHER LIMITATIONS

- A. The bituminous mixture shall not be placed upon any wet surface or when the surface temperatures of the underlying course is less than specified in Table ~~1~~. The temperature requirements may be modified, but only when so directed by the Engineer.

TABLE ~~1~~ - BASE TEMPERATURES LIMITATIONS

Mat Thickness	Base Temperature (Minimum °F) <u>°F</u> °C
3 Inches or Greater	40 4
Greater t han 1 Inch b ut -l ess -t han 3 Inches	45 7
1 Inch or Less	50 10

- B. The open-graded plantmix surface shall be placed only when the pavement surface temperature is above ~~sixty (60)~~ degrees F. ~~(15.5 degrees C)~~.

401.03.06 PREPARATION OF EXISTING SURFACE

- A. When the surface of the existing pavement or old base is irregular, it shall be brought to a uniform grade and cross section as shown on the plans.
- B. The subgrade to receive asphalt concrete, or asphalt concrete base immediately prior to applying prime coat, shall conform to the compaction and elevation tolerance specified for the material involved and shall be free of loose or extraneous material.
- C. If the plantmix bituminous surface is being constructed directly upon an existing hard-surfaced pavement, a tack coat of grade CSS-1h or SS-1h emulsified asphalt, diluted 50/50 at an approximate rate of 0.05 to 0.10 gallons per square yard ~~(0.23 to 0.45 liters per square meter)~~, shall be uniformly applied upon the existing pavement preceding the placement of the asphalt concrete.
 - 1. The surface shall be free of water, foreign material, or dust when the tack coat is applied.
 - 2. To minimize public inconvenience, no greater area shall be treated in any one day than is planned to be covered by plantmix during the same day, unless otherwise authorized by the Engineer.
- D. A similar tack coat shall be applied to the surface of any previous course placed longer than 24 hours, or if ~~the surface is such that~~ a satisfactory bond cannot be obtained between ~~it~~ the surface and a succeeding course, as determined by the Engineer.
- E. The contact surfaces of all cold pavement joints, curbs, gutters, manholes, and ~~the like~~ similar structures, shall be painted with grade CSS-1h or SS-1h emulsified asphalt immediately before the new asphalt concrete is placed. Comply with ~~Reference is made to~~ Section 405, "Tack Coat."
- F. When specified in the contract, longitudinal and transverse joints and cracks shall be sealed by the application of an approved joint sealing compound before spreading the mixture upon a Portland cement concrete surface. Excess bituminous material shall be removed from joints and cracks prior to spreading the mixture.

401.03.07 PREPARATION OF BITUMINOUS MATERIALS

- A. The bituminous material shall be heated to the specified temperature in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature at all times.

401.03.08 PREPARATION OF AGGREGATES

- A. Aggregates proportioned prior to the heating and drying process, shall be separated into at least two general sizes:
 - 1. ~~(1) that~~ that portion of the material having a minimum of 80 percent passing No. 4 sieve.
 - 2. ~~and (2) that~~ that portion of the material having a minimum of 80 percent retained on a No. 4 sieve.
- B. The material shall be maintained within ~~these~~ limits above with a uniformity of plus or minus 5 percent. Each portion of the material shall be stored separately.
- C. When moving the aggregate from storage to compartment bins, any method may be used which will not cause segregation, degradation, or combinations of aggregate which fail to

- meet the specified gradation requirement. Plantmix operations shall not commence until sufficient aggregate material is stockpiled to ~~ie~~ensure one day's run.
- D. Aggregate proportioned immediately after the heating and drying process shall be screened into a minimum of ~~two-2~~ two-2 fractions ~~in-the-case-when~~ minus 1/2-inch~~1/2"~~ aggregate is used, and into a minimum of ~~three-3~~ three-3 fractions when larger sized aggregate is used. The screened material shall be conveyed to separate compartments ready for proportioning and mixing with bituminous material.
- E. If the Contractor elects to introduce baghouse fines into the mix, the material shall be drawn from a storage facility in which the material is kept in a uniform free flowing condition.
1. The baghouse fines for delivery to the plant shall be from a vane type metering device which is interlocked; (electrical driven feeders shall be activated from the same circuit) to the flow of each aggregate feeder.
 2. The drive shaft on the baghouse fines vane feeder shall be equipped with a revolution counter accurate to ~~one-tenth-(1/10)~~ of a revolution, and a means for varying the rate.
 3. In a continuous mix and/or dryer drum plant, the baghouse fines shall be added at the asphalt feed line to ~~e~~insure a uniform mix.
 4. In batch plants, the baghouse fines shall be added by the use of a separate bin.
 5. The baghouse fines shall be introduced at a point as approved by the Engineer at a percentage determined ~~_~~by the Engineer, not to exceed ~~two-(2)~~ two-(2) percent by dry weight of the aggregate.
 6. Baghouse fines shall be considered as part of the aggregate, and not as a mineral filler.
- F. If mineral filler is required to meet the tensile strength requirements of the job-mix formula, it shall be added by one of the following methods:
1. ~~(a)~~ Cold Feed Method:
 - a. Hydrated lime (hereinafter referred to as mineral filler) shall be added to all plantmix bituminous aggregates at the rate of not less than ~~one-(1)~~ percent nor more than ~~two-and-one-half-(2-1/2)~~ percent of the weight of the dry aggregate. The exact rate of application shall be as determined by the job mix formula.
 - b. Mineral filler shall be drawn from a storage facility in which the mineral filler is agitated by air or other means to keep it in a uniform free flowing condition.
 - 1) The mineral filler for delivery to the mixer shall be from a vane type metering device which is interlocked, (electrical driven feeders shall be actuated from the same circuit) to the flow of each aggregate feeder.
 - 2) The drive shaft on the mineral filler vane feeder shall be equipped with a revolution counter reading to ~~one-tenth-(1/10)~~ of a revolution, and a means for varying the rate.
 - c. In continuous mix and/or drum dryer plants, the mineral filler shall be added to the aggregate after the aggregate is proportioned.
 - d. In batch plants, the mineral filler shall be added to the aggregate prior to drying.

- e. Regardless of which type of plant is used, the following methods shall be utilized:
- 1) Prior to the introduction of the mineral filler, sufficient moisture shall be added ~~by way of~~ using spray bars at the aggregate bins to bring the aggregate to a moisture content where enough free surface moisture is available to thoroughly wet the aggregate and wet the lime.
 - a) This content shall be a minimum of ~~four (4)~~ percent.
 - b) The actual amount of moisture required will be determined by the ~~ENGINEER~~ Engineer.
 - c) After the addition of water and mineral filler, the aggregate shall be mixed using a horizontal twin-shaft pugmill.
 - d) The mixing paddles shall be adjustable for angular position on the shaft to permit altering of the mixing pattern or retarding the flow to ~~as~~ ensure that the aggregate is thoroughly coated with mineral filler.
 - e) The volume of material in the pugmill shall not extend above the vertical position of the blade tips.
 - f) The completed mixture shall be directly introduced into the hot plant.
 - g) Stockpiling of the completed mixture is strictly prohibited.
 - 2) The moisture control valve shall be interlocked with the hot plant control room so the moisture control valve is automatically turned off when the cold feed belts are shut off. The control valve shall also turn on automatically when the cold feed belts are activated.

2. ~~(b)~~ Marination Method:-

- a. Hydrated lime (hereinafter referred to as mineral filler) shall be added to all fractions of the plantmix bituminous aggregates.
 - 1) The coarse aggregates ~~are to~~ shall be wet cured with mineral filler at a rate of ~~one (1)~~ percent of the weight of dry aggregate.
 - 2) The fine aggregates ~~are to~~ shall be wet cured with mineral filler at a minimum rate of ~~two (2)~~ percent of the weight of the dry aggregate.
- b. The aggregates ~~are to~~ shall be marinated (wet cured) in the stockpiles for a minimum of ~~forty-eight (48)~~ hours.
- c. The wet cured aggregate in the stockpile shall be used within ~~forty-five (45)~~ calendar days. Material marinated in stockpile in excess of ~~forty-five (45)~~ calendar days shall not be used for the production of plantmix bituminous aggregates unless otherwise approved by the Engineer.
- d. Prior to the introduction of the mineral filler, sufficient moisture shall be added ~~to by way of~~ using spray bars at the aggregate bins to bring the aggregates to a moisture content where enough free surface moisture is available to thoroughly wet the aggregate and activate the lime.
 - 1) This content is recommended to be a minimum of ~~three (3)~~ percent for coarse aggregates and ~~six (6)~~ percent for the fine aggregates.

- 2) The actual amount of moisture required will be determined by the ~~ENGINEER~~ Engineer.
 - 3) After the addition of water and mineral filler, the aggregate shall be mixed using a horizontal twin-shaft pugmill.
 - 4) The mixing paddles shall be adjustable for angular position on the shaft to permit altering of the mixing pattern or retarding the flow to ~~as~~ ensure that the aggregate is thoroughly coated with mineral filler.
 - 5) The volume of material in the pugmill shall not extend above the vertical position of the blade tips.
- e. Mineral filler shall be drawn from a storage facility in which the mineral filler is agitated by air or other means to keep it in a uniform free flowing condition.
- 1) The mineral filler for delivery to the mixer shall be from a vane type metering device which is interlocked, (electrical driven feeders shall be actuated from the same circuit) to the flow of each aggregate feeder.
 - 2) The drive shaft on the mineral filler vane feeder shall be equipped with a revolution counter reading to ~~one-tenth (1/10)~~ of a revolution, and a means for varying the rate.
3. ~~(e)~~ Slurry Method:
- a. Hydrated lime or slaked quicklime (hereinafter referred to as mineral filler) shall be added to all plantmix bituminous aggregates in slurry form.
 - 1) Add at a rate of not less than ~~one (1)~~ percent nor more than ~~two and one-half (2-1/2)~~ percent of dry mineral filler based on the weight of the dry aggregate.
 - 2) The exact rate of application shall be as determined by the job-mix formula.
 - b. A slurry containing ~~one (1)~~ part mineral filler and ~~two (2)~~ parts water by weight is recommended.
 - 1) The actual amount of water required in the production of the slurry will be determined by the Engineer after a visual inspection to ~~as~~ ensure that the aggregate is thoroughly and uniformly coated with the mineral filler.
 - 2) The addition of moisture to the aggregate prior to mixing of the mineral filler and aggregate will not normally be required.
 - c. The slurry shall be prepared in a central mixing tank provided with agitation for keeping the mineral filler in suspension until applied to the aggregate.
 - 1) The slurry mixing tanks ~~must~~ shall be capable of producing sufficient slurry for the hot mix asphalt manufacturing facility production rate, and shall produce a uniform slurry consistency.
 - 2) The plant shall be equipped with suitable pumps and meters for introducing the required amount of slurry to the aggregate. A suitable device shall be provided to the Engineer for determining the weight of mineral filler per gallon of slurry.
 - d. If quicklime is used as the mineral filler, it shall be converted to hydrated lime by using one or more slaking tanks. The slaking unit ~~must~~ shall be capable of:

- 1) ~~e~~Complete slaking or hydration of the quicklime.
 - 2) ~~, and shall be capable of p~~Providing agitation for mixing and keeping the mineral filler in suspension until use.
- e. After the addition of the mineral filler slurry, the aggregate shall be mixed using a horizontal twin-shaft pugmill.
- 1) The mixing paddles shall be adjustable for angular position of the shaft to permit altering of the mixing pattern or retarding the flow to ~~as~~ensure that the aggregate is thoroughly coated with mineral filler.
 - 2) The volume of material in the pugmill shall not extend above the vertical position of the blade tips.
 - 3) The completed mixture shall be directly introduced into the hot plant.
 - 4) Stockpiling of the completed mixture is strictly prohibited.

401.03.09 MIXING

- A. The permissible moisture content of the bituminous mixture just behind the paver shall not exceed ~~one and one-half (1-1/2)~~ percent as determined by test method ASTM D-1461 or equivalent.
1. Should the aggregate contain excessive moisture when heated within the temperature limits, the Contractor will be required to take satisfactory corrective action before resuming plantmix operations.
 2. When an approved dryer drum mixing process is used, the moisture content of the bituminous mixture at discharge from the mixer shall not exceed ~~three (3)~~ percent, and the resulting product at the discharge end of the drier shall be a homogenous mixture of uniformly distributed and properly coated aggregates of unchanging appearance.
- B. The drier aggregate shall be combined in the mixer in the amount of each fraction of aggregates required to meet the job-mix formula. The bituminous material shall be measured or gauged and introduced into the mixer in the amount specified by the job-mix formula.
- C. Commercial filler material, when required, shall be added to the mixer separately and shall be thoroughly dry. If the materials are mixed in a batching plant, the filler material shall be fed directly into the mixer as near the center as possible.
- D. The time of mixing a batch shall begin on the charging stroke of the weight hopper dumping mechanism and shall end when discharge is started.
1. Mixing shall continue until a homogenous mixture of uniformly distributed and properly coated aggregates of unchanging appearance is produced.
 2. In general, the time of mixing shall not be less than ~~thirty (30)~~ seconds, except that the time may be reduced when, in the opinion of the Engineer, the sizes of aggregates are uniformly distributed and all particles are thoroughly and uniformly coated with asphalt binder.
 3. The output rate shall not exceed the manufacturer's capacity rating.
- E. Should the mixture, at the plant or in place, show an excess or deficiency of bitumen, show injury or damage due to burning or overheating, or show an improper combination of

aggregates, due to the Contractor's failure to conform to the specified requirements, it shall be rejected and, if still in the truck, shall be disposed of as required.

1. If an unsatisfactory mix, as referred to above, has been placed, it shall be disposed of and replaced as directed.
2. No compensation will be allowed for rejected material.

401.03.10 SPREADING AND FINISHING

- A. The mixture shall be laid upon an approved surface, and shall be spread and struck off to the grade and elevation established. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable.
- B. The forward rate of travel of the paving machine(s) shall be regulated to a speed dependent upon the capacity of the mixing plant to furnish the mixture and the rate at which the rollers can obtain the required compaction. The machine shall be operated so that material does not accumulate and remain along the sides of the receiving hopper.
- C. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be spread, raked, and compacted by hand tools. For such areas, the mixture shall be dumped, spread, and screeded to give the required compacted thickness, correct grade, and cross section.
- D. The Contractor may windrow plantmixed bituminous base or surface material in front of the spreading and finishing machine, provided that the following conditions and requirements are strictly adhered to:
 1. ~~(a)~~ The windrow is properly sized, thereby ensuring the delivery of the correct amount of material to the spreading and finishing machine at all times.
 2. ~~(b)~~ The bituminous mixture shall be transferred from the windrow to the spreading and finishing machine in such a manner that the materials in the spreading machine will be a uniform mixture. The base upon which the windrow was formed shall not be disturbed, and there shall be no paving material remaining on this base between the pickup device and the spreading and finishing machine.
 3. ~~(c)~~ The temperature requirements for the material in the hopper of the spreading and finishing machine are complied with. Plantmix bituminous mixture that does not meet the minimum temperatures specified shall not be incorporated in the work, but shall be wasted in a manner satisfactory to the Engineer.
- E. Should any course of bituminous mixture placed by utilizing a windrow be inferior, as determined by the Engineer, to that placed by transferring the bituminous mixture directly from the hauling vehicle to the spreading machine, the use of a windrow shall be discontinued.
- F. The bituminous mixture spread through the paving machine during one day's operation shall come from a single plant manufacturer. Intermixing from more than one source shall not be allowed.

401.03.11 ROLLING AND COMPACTION

- A. The initial or breakdown rolling shall consist of one complete coverage of the bituminous mixture with a steel-wheeled roller.
 1. Initial rolling shall commence at the lower edge and shall progress toward the highest portion of the roadbed.
 2. Under no circumstances shall the center be rolled first.

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- B. The initial or breakdown rolling shall be followed by rolling such that uniform density is obtained throughout the depth of the layer of the material being compacted.
1. At least ~~two~~2 rollers, ~~one~~1 steel-wheeled, the other pneumatic-tired, shall be used.
 2. ~~and~~The total number of rollers used shall be sufficient to obtain the required compaction while the mixture is in a workable condition.
- C. The final rolling of the bituminous mixture shall be performed with the same type of roller used for breakdown rolling.
- D. Rolling shall be performed in such a manner that cracking, shoving, or displacement will be avoided.
1. All rollers shall be in good condition, and the reversing mechanism ~~so~~ maintained so that the roller is capable of changing directions smoothly.
 2. The roller shall be kept in continuous motion while rolling so that all parts of the pavement ~~shall~~ receive equal compression.
 3. The motion of the roller shall be slow enough at all times to avoid displacement of the pavement.
 4. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected immediately by the use of rakes and fresh mixture when required.
- E. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly maintained.
1. The use of diesel oil on pneumatic-tired rollers shall be kept to a minimum as determined by the Engineer.
 2. Preferably, a water soluble oil or an asphalt release agent shall be used. ~~The compaction for Type 2-C control strips shall proceed until the rate of change of in-place densities of subsequent compaction tests is less than two-tenths (0.2) percent.~~

401.03.12 ACCEPTANCE SAMPLING AND TESTING OF BITUMINOUS MIXTURE

- A. At no additional cost to the Contracting Agency~~the Contractor's expense~~, field thickness and density determinations of the bituminous mixture shall be made in lots, each lot representing one day's placement.
1. A lot shall be divided into ~~five~~(5) equal sublots, and ~~one~~(1) test shall be made for each subplot.
 2. The location of the field tests may be chosen on a random basis using ASTM D3665, Section 4.3, except that any random location given shall be set back ~~two~~(2) feet ~~(0.6 meter)~~ from a curb or ~~three~~(3) feet ~~(0.9 meter)~~ from an edge, joint, or seam.
 3. A summary of the random number chart used and the lot description shall be completed and approved by the Engineer prior to sampling and shall be included in the finished test results.
- B. Determination of the field thickness of the compacted bituminous mixture, as required by the Engineer, shall be accomplished by ASTM ~~D-3549~~, "Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.".

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- C. Determination of the field density of the compacted bituminous mixture shall be accomplished by either of the methods listed below. In case of dispute, ~~the~~ ASTM D 1188, as modified shall govern.
1. ~~(1)~~ ASTM D-2950, "Density of Bituminous Concrete in Place by Nuclear Method." When this method is used, the nuclear device shall first be correlated with the density of core samples.
 2. ~~(2)~~ ASTM D-1188, "Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens."
 - a. When this method is used, the procedure shall be modified to require the use of "Coated Specimens" (Parafilm or Paraffin) only.
 - b. The use of Bulk Specific Gravity determinations by SSD (surface saturated dry) method are prohibited.
- D. The use of ASTM D-2950, shall include correlation of test results to drilled cores.
1. A minimum of ~~one~~ 1 lot (1 full day's production), and not less than ~~five~~ (5) sub-lots, shall be used for this correlation.
 2. Should any nuclear test density in the first lot, differ from its corresponding drilled core density by more than ~~three~~ (3.00) percent relative compaction, a second lot shall be correlated and the average of all sub-lots in the first and second lots, but not less than ~~ten~~ (10) sub-lots, shall be used for the correlation. The ~~four~~ (4) inch ~~(100 millimeter)~~ cores ~~are to~~ shall be transferred to the Engineer along with the random number generator listing station/offset locations.
- E. The theoretical maximum density of the bituminous mixture shall be determined by taking random samples of the mixture delivered to the job site and testing in accordance with ASTM D-2041, "Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures."
1. At least ~~two~~ 2 theoretical maximum density determinations shall be made for each day's production of bituminous mixture used in the work.
 2. ~~, unless~~ If the day's production is less than 500 tons ~~(454 metric tons)~~, then only ~~one~~ 1 theoretical maximum density determination is required.
- F. As a quality control measure, the Contractor shall, at ~~his expense~~ no additional cost to the Contracting Agency, make periodic checks of the field density of the compacted bituminous mixture at any time during paving operations. The testing performed by the Contractor may be used by the Engineer in part or in whole as the basis of acceptance in addition to the Quality Assurance testing to be done by the Engineer.
- G. The pavement thickness acceptance criteria are as listed below ~~(unit costs to be updated January 2002)~~:
1. ~~(1)~~ If the average of all measurements meets or exceeds the design thickness, with no core more than ~~ten~~ (10) percent less than the design thickness, the placement is acceptable.
 2. ~~(2)~~ If there is only an isolated thin area, the limits of the area should be identified to determine if a construction resolution is necessary.
 3. ~~(3)~~ If the core results indicate a consistently thin section, with no core more than ~~fifteen~~ (15) percent less than the design thickness and with the approval of the Engineer, the ~~e~~ Contractor has the option of proposing a construction resolution or

contributing an amount equivalent to the reduction in the asset value. Calculation of the lost asset value is accomplished with the following steps:

- a. ~~(a)~~ Determine the annual numbers of 18-kip equivalent single axle loads (ESAL), based upon the design traffic index (TI), a 20-year design life and an assumed traffic growth rate.
 - b. ~~(b)~~ Calculate the composite structural number of the designed road section (i.e., the AC and aggregate base sections).
 - c. ~~(c)~~ Using the average AC thickness, calculate the structural number of the constructed road section.
 - d. ~~(d)~~ Determine the ESAL value that correlates with the reduced structural number.
 - e. ~~(e)~~ Based upon the annual ESAL counts, determine the corresponding design life of the reduced section.
 - f. ~~(f)~~ Using a ~~three (3)~~ percent inflation factor and the unit cost of the AC (on a \$/square yard basis) determine the equivalent uniform annual cost (EUAC) of each section.
 - g. ~~(g)~~ Multiply the reduction in design life by the EUAC to determine the reduced value of the pavement, on a unit cost basis.
 - h. ~~(h)~~ Multiply the unit cost by the pavement area.
 - i. ~~(i)~~ As an alternative, use the following unit cost values for the ~~four (4)~~ road classifications (dollars per square yard per inch deviation from design thickness): Residential = \$6.97, Minor Collector = \$7.10, Major Collector = \$6.14, and Arterial = \$7.20.
4. ~~(4)~~ If the core results yield an average thickness greater than the design thickness, but are alternately very high and very low (more than ~~ten (10)~~ percent out), the ~~e~~ Engineer may reject the placement.
- H. The pavement density acceptance criteria for production placements ~~are shall be~~ as listed below, or as otherwise specified in the project plans or contract documents ~~(unit costs to be updated January 2002)~~:
1. ~~(1)~~ The average density for Residential roadway pavement ~~must shall~~ be 92% percent ± 2.0% percent (90.0% percent - 94.0% percent), with no single density deviating more than ~~four (4)~~ percentage points (all measurements between 88% percent - 96% percent). If the average is between 2.0% percent - 4.0% percent out (88% percent - 90.0% percent or 94.0% percent - 96% percent), with no density more than 5.0% percent out (all measurements between 87% percent - 97% percent), the ~~e~~ Contractor has the option of contributing the lost asset value of \$1.22 per square yard per ~~percent~~ percentage point deviation from the acceptance range.
 2. ~~(2)~~ The average density for Minor Collector roadway pavement ~~must shall~~ be 93.0% percent ± 2.0% percent (91.0% percent - 95.0% percent), with no single density deviating more than ~~four (4)~~ percent percentage points (all measurements between 89% percent - 97% percent). If the average is between 2.0% percent - 4.0% percent out (89% percent - 91.0% percent or 95% percent - 97% percent), with no density more than 5.0% percent out (all measurements between 88% percent - 98% percent), the ~~e~~ Contractor has the option of contributing the lost

asset value of \$1.22 per square yard per ~~percentage~~ point deviation from the acceptance range.

3. ~~(3)~~The average density for Major Collector roadway pavement ~~must~~shall be 93.0% ~~percent~~ \pm 1.5% ~~percent~~ (91.5% ~~percent~~ - 94.5% ~~percent~~), with no single density deviating more than ~~four (4) percent~~ percentage points (all measurements between 89% ~~percent~~ - 97% ~~percent~~). If the average is between 1.5% ~~percent~~ - 4.0% ~~percent~~ out (89% ~~percent~~ - 91.5% ~~percent~~ or 94.5% ~~percent~~ - 97% ~~percent~~), with no density more than 5.0% ~~percent~~ out (all measurements between 88% ~~percent~~ - 98% ~~percent~~), the ~~e~~Contractor has the option of contributing the lost asset value of \$0.81 per square yard per ~~percentage~~ point deviation from the acceptance range.
4. ~~(4)~~The average density for Arterial roadway pavement ~~must~~shall be 93.0% ~~percent~~ \pm 1.5% ~~percent~~ (91.5% ~~percent~~ - 94.5% ~~percent~~), with no single density deviating more than ~~four (4) percent~~ percentage points (all measurements between 89% ~~percent~~ - 97% ~~percent~~). If the average is between 1.5% ~~percent~~ - 4.0% ~~percent~~ out (89% ~~percent~~ - 91.5% ~~percent~~ or 94.5% ~~percent~~ - 97% ~~percent~~), with no density more than 5.0 % ~~percent~~ out (all measurements between 88% ~~percent~~ - 98% ~~percent~~), the ~~e~~Contractor has the option of contributing the lost asset value of \$0.81 per square yard per ~~percentage~~ point deviation from the acceptance range.

~~5.(5) Or as may otherwise be specified in the project plans or contract documents.~~

401.03.13 MAINTAINING TRAFFIC

- A. Traffic shall not be allowed on newly placed pavement for at least 24 ~~hours~~ or until the bituminous paving mix in-place temperatures ~~s~~ has dropped below 104^o ~~degrees~~ F (~~60°C~~).
- B. Exceptions shall be made at the discretion of the Engineer. Artificial means to reduce the pavement temperature may be used as approved by the Engineer.

401.03.14 JOINTS

- A. Placing of the bituminous paving shall be as continuous as possible.
 1. Rollers shall not pass over the unprotected end of the freshly laid mixture unless authorized by the Engineer.
 2. Transverse joints shall be conformed by cutting back on the previous run to expose the full depth of the course.
 3. A brush coat of asphalt emulsion shall be used on contact surface of transverse joints just before additional mixture is placed against the previously rolled material.
- B. Longitudinal joints shall be spaced ~~in such a manner~~so that joints in succeeding courses will be at least ~~six (6) inches~~ (150 millimeters) horizontally from joints in any preceding course. Lanes will be evened up each day to eliminate cold longitudinal joints insofar as practicable.
- C. Transverse joints shall be spaced ~~in such a manner~~so that joints in succeeding courses will be a minimum of ~~five (5) feet~~ (1.5 meters) horizontally from joints in any adjacent course. Lanes shall be evened up each day to eliminate cold transverse joints insofar as practicable.
- D. ~~Attention is directed to~~Comply with Subsection 401.03.10, "Spreading and Finishing."

401.03.15 SURFACE TOLERANCES

- A. Surface tolerances will be specified under the respective sections of bituminous pavement.

401.03.16 SURFACING MISCELLANEOUS AREAS

- A. Surfacing of road approaches and connections, street intersection areas, frontage roads, island areas, sidewalks, dikes, curbs, gutters, gutter flares, ditches, downdrains, spillways, aprons at the ends of drainage structures, and other designated areas outside the travelled way shall conform to the provisions specified in these specifications.
- B. The combined aggregate grading for bituminous mixtures placed on miscellaneous areas shall conform to that specified for the bituminous mixture placed on the travelled way, except the aggregates used in the construction of island areas and dikes shall be constructed of aggregate conforming to the requirements of Plantmix Surface Aggregate, Type ~~3~~.
1. The amount of bituminous material used in the bituminous mixture placed in dikes, gutters, gutter flares, downdrains, spillways, aprons at the end of drainage structures, and other designated areas outside the travelled ways shall be increased not less than ~~one (1)~~ percent by weight of the aggregate over the amount of bituminous material used in the bituminous mixture placed on the travelled way.
 2. Submittal of a revised job-mix formula will not be necessary.
- C. The bituminous mixture placed in island areas, sidewalks, dikes, gutters, gutter flares, ditches, downdrains, spillways, aprons at the end of drainage structures, and other designated areas outside the travelled way may be spread in ~~one (1)~~ layer. The material shall be compacted to the required lines, grades, cross section, and density requirements for Category II pavements in accordance with Subsection 401.03.12, "Acceptance Sampling and Testing of Bituminous Material."
- D. Dikes shall be shaped and compacted with an extrusion machine or other equipment capable of shaping and compacting the material to the required correct grade and cross section.

METHOD OF MEASUREMENT**401.04.01 MEASUREMENT**

- A. The quantity of bituminous plantmix to be measured for payment shall be the number of tons used in the accepted work, and will be determined by weighing the completed mixture of aggregate, mineral filler if required, and bituminous material.
- B. The quantity of shoulder dikes constructed of bituminous plantmix to be measured for payment shall be the number of linear feet ~~(meters)~~ and will be determined from measurement taken along the top of the completed dikes to the nearest ~~one (1)~~ foot ~~(meter)~~ length.
- C. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantity ~~ies~~." Batch weights will not be permitted as a method of measurement unless the alternate provisions of Subsection 401.03.01 ~~(b)~~ D.1, "Plant Scales," are met, in which case the cumulative weight of all the acceptable batches will be used for payment.
- D. Due to possible variations in the specific gravity and voids of the payment, the tonnage used may vary from the proposal quantities and no adjustment in contract unit price will be made because of such variation.

BASIS OF PAYMENT

401.05.01 PAYMENT

- A. All accepted work and materials measured as prescribed above will be paid for as provided in the representative sections for each type specified.
- B. Full compensation for furnishing and applying bituminous material or asphaltic emulsion as provided for in Subsection 401.03.06, "Preparation of Existing Surface," including ~~"Tack Coat,"~~ and Subsection 401.03.14, "Joints," shall be considered as included in the contract price paid for the principal items involved and no further compensation will be allowed.
- C. When bituminous plantmix, ~~Type~~ Type III, is used in the construction of island areas, or dikes, and there is no separate payment for said mixture, this bituminous plantmix shall be included in the payment for plantmix bituminous surface of the major type shown in the list of bid items and the proposal.

SECTION 402

PLANTMIX BITUMINOUS SURFACE

DESCRIPTION

402.01.01 GENERAL

- A. This work shall consist of constructing ~~one~~ 1 or more courses of bituminous pavement on a prepared base in accordance with these specifications, and in conformity with the lines, grades, thickness, and typical cross sections shown on the plans or established by the Engineer.
1. The prepared base shall be prime coated or tack coated as specified in Section ~~405~~, "Tack Coat," and Section 406, "Prime Coat," prior to the placement of any plantmix bituminous surface.
 2. The cured prime coat shall have no raw asphalt exposed and shall be cleaned of all loose material.
- B. The requirements of Section ~~401~~, "Plantmix Bituminous Pavements – General" shall be applicable to this work, except as hereinafter specified.

MATERIAL

402.02.01 GENERAL

- A. The material shall conform to ~~the requirements as specified in~~ Subsections ~~401.02.01~~, "Composition of Mixtures," through Subsection 401.02.04, "Bituminous Materials," ~~inclusive, of Section 401, "Plantmix Bituminous Pavements – General."~~

CONSTRUCTION

402.03.01 GENERAL

- A. ~~The c~~onstruction ~~requirements~~ shall conform to ~~the requirements as specified in~~ Subsections ~~401.03.01~~, "Bituminous Mixing Plant," through Subsection 401.03.15 ~~16~~, "Surfacing Miscellaneous Areas," ~~inclusive, of Section 401, "Plantmix Bituminous Pavements – General,"~~ with the exceptions contained in the following two subsections below.

402.03.02 SPREADING AND FINISHING

- A. Unless otherwise specified, bituminous plantmix surface shall be placed in courses not exceeding ~~four (4)~~ inches (~~100 millimeters~~) in compacted thickness. When more than ~~one~~ 1 course is placed, the courses shall be of approximately equal thickness.
- B. Bituminous plantmix surface to be placed on shoulders and other areas of the travelled way having a width of ~~eight (8)~~ feet (~~2.4 meters~~) or more, shall be spread as specified in Subsection ~~401.03.10~~, "Spreading and Finishing."
1. When the areas are less than ~~eight (8)~~ feet (~~2.4 meters~~) in width, the material may be deposited and spread in ~~one~~ 1 or more layers by other mechanical means that will provide a uniform smoothness and texture.
 2. Stockpiling bituminous mixture on contiguous pavement that might be stained thereby will not be permitted.

402.03.03 SURFACE TOLERANCES

- A. The completed surfacing shall be smooth and free from ruts, humps, depressions, or irregularities.
1. Any ridges, indentations, or other objectionable marks left in the surface by rolling or other means shall be eliminated.
 2. The use of any equipment that leaves ridges, indentations, or other objectionable marks in the bituminous surface, or does not consistently produce a surface meeting the profile index requirements, shall be discontinued.
- B. After final rolling, the smoothness of the final dense-graded surface course shall be measured by the following methods:
- C. ~~402.03.03.01~~ — **Straightedge Measurement:**
1. The completed surfacing shall be thoroughly compacted, smooth, and free from ruts, humps, depressions, or irregularities. When a straightedge ~~ten (10_)~~ feet (~~3_ meters~~) long is laid on the finished surface and parallel with the centerline of the highway, the surface shall not vary more than 1/4 one-quarter inch (~~6_ millimeters~~) from the lower edge of the straightedge.
 2. The transverse slope of the finished surface shall be uniform to a degree such that no depressions greater than 1/4 one-quarter inch (~~6_ millimeters~~) are present when tested with a straightedge ~~ten (10_)~~ feet (~~3_ meters~~) long laid in a direction transverse to the ~~_~~ centerline and extending from edge to edge of a ~~twelve (12_)~~ foot (~~3.6_ meters~~) traffic lane. ~~Any ridges, indentations, or other objectionable marks left in the surface of the bituminous mixture by blading or other equipment shall be eliminated by rolling or other means. The use of equipment that leaves ridges, indentations, or other objectionable marks in the bituminous mixture shall be discontinued and other acceptable equipment shall be furnished by the Contractor.~~
- D. ~~402.03.03.02~~ — **Profilograph Measurement (When specified in the Contract Special Provisions):** ~~The completed surfacing shall be smooth and free from ruts, humps, depressions, or irregularities. Any ridges, indentations, or other objectionable marks left in the surface by rolling or other means shall be eliminated. The use of any equipment that leaves ridges, indentations, or other objectionable marks in the bituminous surface, or does not consistently produce a surface meeting the profile index requirements shall be discontinued. After final rolling, the smoothness of the final dense-graded surface course shall be measured by the following methods: Straightedge Measurement. The Contractor will perform this measurement. When a straightedge 12 feet (3.6 m) long is laid on the finished surface and parallel with the centerline of the roadway, the surface shall not vary more than 0.25 inches (6 mm) from the lower edge of the straightedge. When a straightedge 12 feet (3.6 m) long is laid on the finished surface and at right angles with the centerline and extending from edge to edge of traffic lane, the surface shall not vary more than 0.25 inches (6 mm) from the lower edge of the straightedge. Defective areas shall be corrected by approved methods.~~
1. ~~a) Profilograph Measurement.~~ The Contractor shall provide the profilograph and measurements under the direction of the Engineer.
 - a. The profiles shall be measured 3_ feet (~~1_ meter~~) from and parallel to either traffic lane line.
 - b. The profiles shall be measured for the entire length of each traffic lane within 48_ hours after each day's placement of plantmix bituminous mixture.

- c. Profile ~~M~~measurements will not be required on roadway segments less than 0.1 ~~_mile (0.16_kilometers)~~ in length, single lane utility construction less than 0.25 ~~_mile (0.40_kilometers)~~ in length, or in multiple lane utility construction 0.125 ~~_mile (0.20_kilometers)~~ in length.
2. Profile measurements on pavement along horizontal curves having a centerline radius less than 1,000 ~~_feet (300_meters)~~ will not be required.
 - a. Pavement within 30 ~~_feet (10_meters)~~ of a concrete bridge deck (including approach slabs) shall not be measured unless the bridge deck also is to be overlaid with plantmix bituminous surface.
 - b. At locations that tie into existing pavements, the profile shall begin 50 ~~_feet (15_meters)~~ before the starting joint and end 50 ~~_feet (15_meters)~~ after the ending joint.
 - c. Intersections where there is a grade break, valley gutters, and 50 ~~_feet (15_meters)~~ before and after swales will not be included in the measurements.
 3. Initial runs of the profilograph shall be completed before opening the new pavement to public traffic whenever practical.
 - a. The profilographs shall be submitted immediately thereafter for evaluation.
 - b. A profile index will be calculated for each 0.1 ~~_mile (0.1_kilometers)~~ of traffic lane measured according to Nev. Test Method No. T446.
 - c. All costs for traffic control required for running of the profilograph shall be included in the cost of traffic control.
 4. The pavement smoothness type (Type A, B, or C) and ~~will be in accordance with the following table unless otherwise specified in the Special Provisions.~~ ~~T~~the maximum allowable profile index for each mile ~~(kilometer)~~ section and 0.1 ~~_mile (0.1_kilometer)~~ section for the specified pavement type shall be ~~as follows~~ in accordance with the following table:

Profile Index

Pavement Smoothness Type		Max. per lane mile (per km)	Max. per 0.1 lane mile (per 0.1 km)
Type A *	<u>New Arterial and Major Collector</u>	5 inches (80 mm)	0.5 inches (8 mm)
Type B **	<u>Removal and Replacement in 80-foot and greater (arterial and collector) with new curb construction</u>	7 inches (110 mm)	0.7 inches (11 mm)
Type C ***	<u>Right-of-way less than 80-foot (collector) or on arterial and collector asphalt removal and replacement projects that contain existing curb</u>	10 inches (160 mm)	1.0 inches (16 mm)

* ~~New Arterial and Major Collector~~

** ~~Removal and Replacement in 80 ft. and greater (arterial and collector) with new curb construction~~

*** ~~Right-of-way less than 80 ft. (collector) or on arterial and collector asphalt removal and replacement projects that contain existing curb~~

5. Pavement on horizontal curves having a centerline radius of 1,000 ~~_feet (300_meters)~~ or more, but less than 2,000 ~~_feet (600_meters)~~, and within the

- superelevation transition of such curves will be evaluated as pavement smoothness Type C.
6. Areas ~~which~~that exceed the profile index requirements and areas representing high points on the profiles having deviations in excess of 0.3_-inches ~~(7.5_ millimeters)~~ as measured according to Test Method No. Nev._-T446 -shall be ground to conform to requirements. Ground areas shall be remeasured for conformance with the profile index ~~and for to confirm~~ no high points in excess of 0.3_-inches ~~exist~~exist ~~(7.5_ millimeters)~~.
 7. Additional grinding shall be performed as necessary to extend the ground area laterally to the nearest lane line or edge of pavement and longitudinally to lines normal to the pavement centerline.
 8. Deviations in excess of 0.3_-inches ~~(7.5_ millimeters)~~ that cannot be brought into specified surface tolerances shall be corrected by abrasive grinding, by either removal ~~and or~~ replacement, or by placing an overlay of hot mix asphalt. The Contractor shall obtain approval ~~efor~~ the exact method of correction from the Engineer.
 9. Seal coat shall be applied to the ground areas after the surface tolerance specifications have been met. The seal coat shall be Emulsified Asphalt, Type SS-1h (Diluted), applied as directed.
 10. The grinding machine for correcting pavement exceeding the profile requirements shall meet the following criteria:
 - a. ~~be p~~Power driven, self-propelled, and specifically designed to remove, profile, smooth, and texture hot mix asphalt. ~~The grinding machine shall~~
 - b. ~~Have a w~~Wheel base of not less than 12_-feet. ~~(3.6_ meters)~~ and
 - c. ~~be e~~Equipped with a rotating powered mandrel drum studded with diamond blades with a cutting head not less than 3_-feet ~~(0.9_ meters)~~ wide.
 - d. ~~The grinding machine shall be e~~Equipped with an effective means for controlling dust and other particulate matter.
 - e. The grinding machine shall not cause strain or damage to the underlying surface of the pavement.
 - f. Grinding and texturing equipment that causes ravels, aggregate fractures, spalls, or disturbance of joints shall not be used.
 11. Grinding shall be performed in a longitudinal direction.
 - a. Grinding shall result in a uniform textured surface over the designated surface areas.
 - b. The surface of the ground pavement shall have parallel corduroy-type texture consisting of grooves between 0.1_-inch ~~(2.3_ millimeters)~~ and 0.13_-inch ~~(3.3_ millimeters)~~ wide.
 - c. The peaks of the ridges shall be approximately 0.06_-inch ~~(1.5_ millimeters)~~ higher than the bottom of the grooves with approximately 52 to 57 ~~evenly~~ evenly-spaced grooves per foot ~~(170 to 190_ grooves per meter)~~.
 12. The ground material, including water used for the grinding operation, shall be picked up and disposed of outside the right-~~of-~~way according to Subsection_-107.14, "Disposal of Material Outside Project Right-of-Way."

402.03.04 PROFILOGRAPH EQUIPMENT

- A. The Contractor shall furnish and operate a California-type profilograph for checking riding tolerances at the time and date ordered.
- B. The profilograph shall be equipped with a 25-foot ~~(7.6-meter)~~ wheel base and the following features:
1. ~~a)~~ 3-Unit Frame Assembly:
 - a. ~~1)~~ All welded construction of light-weight aluminum square tubing.
 - b. ~~2)~~ Index frame connections by 4 steel locating pins and secured by 4 quick-acting clamps.
 2. ~~b)~~ Multiple Wheel Assemblies:
 - a. ~~1)~~ Wheel supports of square steel tubing and all-welded construction.
 - b. ~~2)~~ Secure connections by quick-acting clamps.
 - c. ~~3)~~ Wheels with cast aluminum hubs, ball bearings, and cushion rubber tires.
 - d. ~~4)~~ Bearing support caster wheel assemblies.
 - e. ~~5)~~ Steerable front wheels from the center of the machine.
 - f. ~~6)~~ Rear wheels with a quick-setting manual adjustment for turning in a short radius, moving sideways, and to prevent rear-end crabbing on superelevations.
 3. ~~c)~~ Recording Wheel Assembly:
 - a. ~~1)~~ Frame of all-welded construction of light-weight rectangular aluminum tubing.
 - b. ~~2)~~ Light-weight 24-inch ~~(600-millimeter)~~ minimum diameter recording wheel with heavy duty spokes for maximum rigidity, with a pneumatic tire maintained at 25 psi ~~(170-kPa)~~ air pressure unless otherwise specified by the manufacturer.
 4. ~~d)~~ Recorders (if computerized):
 - a. ~~1)~~ A high-resolution printer capable of printing the profile trace to the specified scale and automatic positioning and marking of the specified "blanking band" and "must grind" bumps. It shall also be capable of printing station numbers, distances, and comments entered by the operator via keypad while measuring the profiles.
 - b. ~~2)~~ It shall also calculate the profile index in inches per mile per each 0.1 mile ~~(millimeter per kilometer per each 0.1 kilometer)~~ section without hand calculations or data reduction.
 - c. ~~3)~~ A display screen for instant visual observation of the road profile and "must grind" areas while measurements are being taken.
 - d. ~~4)~~ The horizontal chart scale shall be 1 inch equals 25 feet ~~(25-millimeters equals 7.5-meters)~~ and the vertical scale shall be 1 inch equals 1 inch ~~(25-millimeters equals 25-millimeters)~~.
 - 1) The recorder shall have an adjustment feature to calibrate the scales to these parameters.

- 2) Calibrate the profilograph before usage to be accurate within 0.1 foot in 100 feet (~~0.1 meter in 100 meters~~) longitudinally.
 - e. ~~5)~~ Battery backed-up memory shall retain control parameters when the system is powered down.
 - f. ~~6)~~ Capable of accurate operation in ambient temperatures from 45° ~~degrees F (7 °C)~~ to 120° ~~degrees F (49°C)~~.
5. ~~e)~~ Recorders (if not computerized):-
- a. ~~1)~~ Use sealed ball bearings throughout.
 - b. ~~2)~~ A low inertia recording pen assembly shall run on hardened and ground guide rods for both sensitive and smooth trace response.
 - c. ~~3)~~ The recording pen travel shall be 7_ inches (~~175_ millimeters~~) in ~~one~~ 1 setting.
 - d. ~~4)~~ The recorder reversing mechanism shall be fully automatic and the paper shall reverse direction without manual adjustment of drag clutches.
 - e. ~~5)~~ The drag clutches shall be pre-set, sealed from dust, and self-compensating for wear.
 - f. ~~6)~~ Integral aluminum case with formed ~~plexiglass~~ plexiglas viewing windows.
 - g. ~~7)~~ The horizontal chart scale shall be 1_ inch -equals 25_ feet (~~25_ millimeters equals 7.5 meters~~) and the vertical scale shall be 1_ inch -equals 1_ inch (~~25_ millimeters equals 25_ millimeters~~).
 - h. ~~8)~~ A variable roller disc integrator shall be incorporated into the drive system to permit accurate calibration of horizontal chart speed.
 - i. ~~9)~~ The profilograph shall be calibrated before usage to be accurate within 0.1_ feet in 100_ feet (~~0.1_ meter in 100_ meters~~) horizontally.

METHOD OF MEASUREMENT

402.04.01 MEASUREMENT

- A. Plantmix bituminous surface will be measured as specified in Subsection ~~401.04.01~~, "Measurement."

BASIS OF PAYMENT

402.05.01 PAYMENT

- A. The accepted quantity of plantmix bituminous surface will be paid for at the contract unit price bid per ton (~~metric ton~~) of plantmix bituminous surface, which price shall ~~include all asphalt cement. The above prices shall~~ be full compensation for furnishing all the material, mixing, loading, hauling, placing, compacting, and incidentals necessary for doing all the work involved in constructing plantmix bituminous surface as shown on the plans or established by the Engineer.
- B. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- C. Partial payments for plantmix bituminous surface may be made as set forth under Subsection 109.06, "Partial Payments."

PLANTMIX BITUMINOUS SURFACE

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D. Payment will be made under:

PAY ITEM	PAY UNIT
Plantmix Bituminous Surface.....	Ton (Metric Ton)
Plantmix Bituminous Shoulder Dikes.....	Linear Foot (Linear Meter)

SECTION 403**PLANTMIX BITUMINOUS OPEN-GRADED SURFACE**

DESCRIPTION

403.01.01 GENERAL

- A. This work shall consist of placing plantmix bituminous open-graded surface in one course in accordance with these specifications and in conformity with the lines, grades, thickness, and the typical cross sections shown on the plans or established by the Engineer.
- B. ~~This Work~~ shall not be started until the Contractor has completed all motor patrol and power loader equipment work or any other work that could scar or mar the finished open-graded surface.
- C. The requirements of Section 401, "Plantmix Bituminous Pavements – General," shall be applicable to this work, except as hereinafter specified.

MATERIALS

403.02.01 GENERAL

- A. ~~The m~~Materials shall conform to ~~the requirements as specified in~~ Subsections ~~401.02.02,~~ "Aggregates," and Subsection 401.02.04, "~~Plantmix~~ Bituminous ~~Pavements~~ General Materials."

403.02.02 COMPOSITION OF MIXTURE

- A. The plantmix open-graded mixture shall be composed of aggregates and bituminous material as described in these specifications.
- B. Before starting work, the Contractor shall submit a proposed job-mix formula in writing for use by the Engineer in setting the job-mix formula to be used.
 - 1. The proposed job-mix formula shall be determined by a testing laboratory, under the direction and control of a ~~R~~registered ~~P~~professional ~~E~~engineer, based on tests required to determine the gradation and surface capacity for coarse aggregate.
 - 2. The initial design asphalt content for open-graded mixes shall be determined in accordance with the following:
 - a. ~~a~~Applicable sections of California Testing Method ~~303~~, latest edition (State of California, Department of Transportation, Manual of Test Volume ~~2~~).
 - b. ~~, except that~~ However, the formula shall be: Asphalt content, percent by weight of total mix = $2.0(Kc)+4$.
- C. Modifications in the asphalt content will be made by the Engineer as necessary based on field observations made during construction.
- D. Test reports for determination of the job-mix formula shall include the following information:
 - 1. ~~(A)~~ Aggregate Gradation.
 - 2. ~~(B)~~ Surface Capacity, Kc.

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PLANTMIX BITUMINOUS OPEN-GRADED SURFACE

- E. The grade of asphalt to be used for all mixes shall be AC-30 or AC-20P as specified in Subsection ~~703.03.02~~, "[Asphalt Cements](#)," unless otherwise stipulated in the Special Provisions.
- F. The formula submitted shall propose definite single values for:
1. ~~(A)~~—The percentage of aggregate passing each specified sieve.
 2. ~~(B)~~—The percentage of bitumen to be added (to 0.1 percent)
 3. ~~(C)~~—The temperature of the mixture leaving the mixer.
- G. The temperature of the open-graded mixture at the hopper of the paver shall conform to the following table, except the temperature shall not be more than 20° ~~degrees~~ F (~~11°C~~) lower than the temperature of the completed mixture leaving the plant.

TEMPERATURES OF PLANTMIX BITUMINOUS OPEN-GRADED MIXTURES AT THE PAVER		
Grade of Asphalt Cement	Minimum	Maximum
AC-30	225°F 107°C	275°F 135°C
AC-20P	280°F 138°C	350°F 177°C

- H. The mixture furnished shall conform to the job-mix formula within the following range of tolerances:
1. Aggregate passing the No. 4 and larger sieves: ±7 percent%.
 2. Aggregate passing the No. 8 sieve: ±4 percent%.
 3. Aggregate passing the No. 200 sieve, not to exceed: 3 percent%.
 4. Bitumen Content: ±0.3 percent% of volume or batch weight of aggregate.
- I. Should there be a change in sources of materials, a new job-mix formula shall be established before the new mix is used.
- J. The temperature of the bituminous material just prior to mixing shall conform to the requirements of Subsection ~~401.02.01~~, "[Composition of Mixtures](#)."

CONSTRUCTION

403.03.01 GENERAL

- A. The construction ~~requirements~~ shall conform to ~~the requirements as specified in~~ Subsections ~~401.03.01~~, "[Bituminous Mixing Plant](#)," through [Subsection 401.03.156](#), "[Surfacing Miscellaneous Areas](#)," ~~inclusive of Section 401, "Plantmix Bituminous Pavements - General,"~~ with the exceptions ~~contained in the following three Subsections~~ [below](#).

403.03.02 ROLLERS

- A. There shall be operating with each paver, ~~two (2)~~ tandem rollers weighing not less than ~~eight (8)~~ nor more than ~~ten (10)~~ tons (~~not less than 7.25 nor more than 9 metric tons~~).
- B. When ~~two (2)~~ pavers are paving in echelon, within ~~four hundred (400)~~ feet (~~122 meters~~) of each other, no additional rollers will be required, and generally not over ~~two (2)~~ passes will be required.

403.03.03 JOINTS

- A. Longitudinal joints shall be constructed only on the shoulders, or at the edge of travel lanes.

403.03.04 SURFACE TOLERANCESA. **Straightedge Measurement:**

1. The completed surfacing shall be thoroughly compacted, smooth, and free from ruts, humps, depressions, or irregularities.
2. When a straightedge ~~ten (10)-feet (3-meters)~~ long is laid on the finished surface and parallel with the centerline of the highway, the surface shall not vary more than ~~one-quarter 1/4 inch (6-millimeters)~~ from the lower edge of the straightedge.
3. The transverse slope of the finished surface shall be uniform to a degree such that no depressions greater than ~~one-quarter 1/4 inch (6-millimeters)~~ are present when tested with a straightedge ~~ten-twelve (12)-feet (3.7-meters)~~ long laid in a direction transverse to the centerline and extending from edge to edge of a ~~twelve (12)-foot (3.7-meters)~~ traffic lane.
4. Any ridges, indentations, or other objectionable marks left in the surface of the bituminous mixture by blading or other equipment shall be eliminated by rolling or other means.
5. The use of any equipment that leaves ridges, indentations, or other objectionable marks in the bituminous mixture shall be discontinued and other acceptable equipment shall be furnished by the Contractor.

B. **Profilograph Measurement (When specified in the Contract Special Provisions):**

1. The Contractor shall produce completed surfacing which meets the requirements of Subsections ~~s-402.03.03-02.D-~~, "Profilograph Measurement," with the following additions and exceptions to the profilograph measurement.
2. The Contractor shall furnish and operate a profilograph, as specified in ~~s~~Subsection ~~402.03.04,~~ "Profilograph Equipment," at the time and date ordered.
3. The Contractor shall repair, or remove and replace, all areas exceeding the profile index requirements and areas representing high points on the profiles having deviations in excess of 0.4-inches ~~(10-mm)~~ as measured according to Nev. Test Method No. Nev.-T446.
4. The Contractor shall remeasure repaired or replaced areas for conformance with the profile index and for no high points in excess of 0.4-inches ~~(10-mm).~~
5. High points in excess of 0.4-inches ~~(10-mm)~~ may be allowed to remain in place, if requested and approved.
 - a. Liquidated damages of \$500.00 will be assessed for each such high point that is allowed to remain in place.
 - b. Grinding may be utilized for repair to the open-graded surface when approved.
 - c. Limit grind areas to 25-feet ~~(7.5-m)~~ in length.
 - d. The grinder and grinding operations shall confiorm to Subsection ~~402.03.03,~~ "Surface Tolerances."

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PLANTMIX BITUMINOUS OPEN-GRADED SURFACE

METHOD OF MEASUREMENT

403.04.01 MEASUREMENT

- A. Plantmix bituminous open-graded surface will be measured as -specified in Subsection 401.04.01, "Measurement," or if the contract documents specify payment by area, the quantity of Plantmix Bituminous Surface to be measured for payment shall be the number of square yards ~~(square meters)~~, including the asphalt cement, used in the accepted work.

BASIS OF PAYMENT

403.05.01 PAYMENT

- A. The accepted quantity of plantmix bituminous open-graded surface will be paid for at the contract price bid per square yard ~~(square meter)~~ of plantmix bituminous open-graded surface thickness, which ~~price~~ shall include the bituminous material (asphalt cement) or it will be paid for at the contract unit price bid per ton ~~(metric ton)~~ which ~~price will~~ shall include the cost of all bituminous material (asphalt cement). The above prices shall be full compensation for furnishing all the materials, mixing, loading, hauling, placing, compacting, and incidentals necessary for doing all the work involved in constructing plantmix bituminous open-graded surface as shown on the plans or established by the Engineer.
- B. All payments will be made in accordance with Subsection^o ~~109.0402~~, "Scope of Payment."
- C. Partial payments for plantmix bituminous open-graded surface may be made as set forth under Subsection 109.06, "Partial Payments."
- D. Payment will be made under:

PAY ITEM

PAY UNIT

Plantmix Bituminous Open-Graded Surface (<u>Thickness</u>).....	Square Yard	(Square Meter)
Plantmix Bituminous Open-Graded Surface.....	Ton	(Metric Ton)

SECTION 404**HOT PLANTMIX RECYCLED BITUMINOUS PAVEMENT**

DESCRIPTION

404.01.01 GENERAL

- A. This work shall consist of recycling a bituminous pavement in a central plant and re-laying the reprocessed bituminous mixture on a prepared surface in accordance with the line, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer.
- B. Recycled hot plantmix bituminous pavement, conforming to the requirements specified herein, may be substituted at the Contractor's option for conventional base course or surface course mixtures (Section ~~303~~, "[Plantmix Bituminous Base](#)," and [Section 402](#), "[Plantmix Bituminous Surface](#)"). The requirements of Section 401, "Plantmix Bituminous Pavements - General" shall be applicable to this work, except as herein specified.

MATERIALS

404.02.01 COMPOSITION OF MIXTURES

- A. The recycled bituminous plantmix shall be composed of a mixture of reclaimed bituminous pavements, additional virgin aggregate, mineral filler, if required, recycling agent, and/or additional bituminous material.
1. The several aggregate fractions shall be sized, uniformly graded, and combined in such proportions that the resulting mixture meets the grading requirements of the job-mix formula.
 2. Unless otherwise specified in the Special Provisions, the proportion of reclaimed bituminous pavement used in the mix shall not exceed ~~15~~ [15](#) percent.
 3. A greater percentage (more than ~~15%~~ [15 percent](#)) of the reclaimed bituminous pavement material may be used in the recycling process if the Engineer determines that the resultant mixture satisfies the requirements specified for the mix design.
 4. A new job-mix formula shall be established should there be a change in source of materials or a change in the percentage of reclaimed material used in the mix.
- B. Before starting work, the Contractor shall submit a proposed job-mix formula in writing, for use by the Engineer in setting the job-mix formula to be used. The proposed job-mix formula shall be determined by a testing laboratory under the direction and control of a registered professional engineer, in accordance with ~~the requirements of~~ Subsection ~~401.02.01~~, "Composition of Mixtures."
- C. The formula submitted for the combined mix shall also indicate the recommended grade and amount of recycling agent and/or additional bituminous material to be used in the mix.
1. This shall be determined by recovering the asphalt cement from representative samples of the pavement to be recycled and testing the properties of the asphalt cement after adding various amounts of the recycling agent and/or additional bituminous material.

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HOT PLANTMIX RECYCLED BITUMINOUS PAVEMENT

2. The test report shall show the curves for the following properties of the recycled asphalt cement after adding various amounts of recycling agent and/or bituminous material:
 - a. Penetration ~~@at 77° degrees F (25°C)~~ (before ~~&and~~ after RTFC test).
 - b. Absolute Viscosity ~~@at 140° degrees F (60°C)~~ (before ~~&and~~ after RTFC test).
- D. The grade and amount of recycling agent and/or additional bituminous material to be used will be that which will produce a paving grade asphalt cement conforming to ~~the requirements specified in~~ Section ~~_~~703, "Bituminous Materials."
 1. For Traffic Category ~~_~~I pavements, the combined bituminous materials shall meet all of the requirements of an AC ~~_~~30 or AC ~~_~~20 grade.
 2. ~~, and f~~For Traffic Category ~~_~~II pavements, the combined bituminous material shall meet all the requirements of an AC ~~_~~20 or AC ~~_~~10 grade.
 3. All properties specified for a paving grade asphalt cement shall be tested on the combined bituminous material, and the results shall be submitted with the proposed job-mix formula.

404.02.02 AGGREGATES

- A. **Reclaimed Bituminous Pavement Aggregate.** The aggregate shall be the product of crushed, milled, or planed bituminous pavement.
- B. **Virgin Aggregates.** Virgin aggregates shall meet the requirements of Section ~~_~~705, "Aggregates for Bituminous Courses."

404.02.03 BITUMINOUS MATERIAL

- A. The bituminous material shall be an asphalt cement and shall ~~conform to the requirements of~~ comply with Section ~~_~~703, "Bituminous Materials."
- B. The grade shall be determined by the job-mix formula.

404.02.04 RECYCLING AGENT

- A. The recycling agent shall conform to the requirements in the following table.
- B. The grade shall be determined by the job-mix formula.

SPECIFICATIONS FOR HOT-MIX RECYCLING AGENT¹

TEST	ASTM Test Method	RA-5		RA-25		RA-75		RA-250		RA-500	
		min	max	min	max	min	max	min	max	min	max
Viscosity @ 60°C (140°F), cSt	D2170	200	800	1,000	4,000	5,000	10,000	15,000	35,000	40,000	60,000
Flash Point COC, °C (°F)	D92	204 (400)	--	284 (425)	--	232 (450)	--	232 (450)	--	232 (450)	--
Saturates, wt. %	D2007	--	30	--	30	--	30	--	30	--	30
Residue for RTFC Oven Test @ 325°F	D2872²	--	--	--	--	--	--	--	--	--	--
Viscosity Ratio ³	--	--	3	--	3	--	3	--	3	--	3
RTFC Oven Weight Change ±%	D2872 ²	--	4	--	3	--	2	--	2	--	2

SPECIFICATIONS FOR HOT-MIX RECYCLING AGENT¹

TEST	ASTM Test Method	RA-5		RA-25		RA-75		RA-250		RA-500	
		min	max	min	max	min	max	min	max	min	max
Specific Gravity	D70 or D1298	Report		Report		Report		Report		Report	

¹ The final acceptance of recycling agents meeting this specification is subject to the compliance of the reconstituted asphalt blends with current asphalt specifications.

² The use of ASTM_D1754 has not been studied in the context of this specification; however, it may be applicable. In cases of dispute, the reference method shall be ASTM_D2872.

³ Viscosity Ratio = $\frac{\text{RTFC Viscosity at } 60^{\circ}\text{C (140}^{\circ}\text{F) cSt}}{\text{Original Viscosity at } 60^{\circ}\text{C (140}^{\circ}\text{F) cSt}}$

CONSTRUCTION**404.03.01 GENERAL**

- A. ~~The construction requirements~~ shall conform to the ~~requirements as specified in Subsections 401.03.01, "Bituminous Mixing Plant," through Subsection 401.03.15, "Surface Tolerances," inclusive, of Section 401, "Plantmix Bituminous Pavements - General,"~~ with the exceptions ~~contained in the following two subsections~~ below.

404.03.02 BITUMINOUS MIXING PLANT

- A. The plant shall ~~meet all of the requirements of~~ comply with Subsection ~~401.03.01, "Bituminous Mixing Plant."~~ In addition, the control and handling of the recycling agent shall be in a manner similar to that specified for the bituminous material.
- B. If a batch plant is used, the plant shall be modified so that:
- ~~the virgin~~ aggregate can be superheated to a temperature required to produce a resultant mix temperature as specified in Subsection ~~401.02.01, "Composition of Mixtures,"~~ after adding the ambient temperature reclaimed bituminous pavement aggregate.
 - ~~The plant shall also be modified to feed the r~~ Reclaimed aggregate shall be fed to the aggregate weigh hopper in a manner to ensure uniform proportioning.
- C. If a ~~dryer~~ drum plant is used, the plant shall be modified so that:
- ~~e~~ Either the virgin aggregate can be superheated to a temperature required to produce the required resultant mix temperature, or the combination of reclaimed bituminous pavement aggregate and virgin aggregate can be heated to a temperature needed for a resultant mix temperature as specified in Subsection ~~401.02.01, "Composition of Mixtures."~~
 - The reclaimed aggregate shall be introduced into the plant in such a manner to ensure uniform proportioning and to protect the material from direct contact with the burner flame.
- D. Regardless of the type of bituminous mixing plant used, the air pollution requirements as set forth by the Clark County Air Pollution Control Division and state law shall apply to the manufacture of recycled bituminous pavement.

404.03.03 PREPARATION OF AGGREGATES

- A. Virgin aggregates shall be prepared as specified in Subsection ~~401.03.08~~, "[Preparation of Aggregates.](#)"
- B. Reclaimed bituminous pavement aggregates shall be prepared so that 100% percent will pass a ~~one and one-half inch (38 millimeters)~~ 1-1/2-inch sieve. The moisture content of the reclaimed bituminous pavement aggregate at the time of introduction into the mixer shall not exceed 3% as determined by Test Method ASTM ~~D-2216~~.
- C. The stockpiling area for the reclaimed bituminous pavement aggregate shall be graded and compacted so a firm level base can be maintained at all times.
 - 1. Layer placing or alternate approved methods shall be used to prevent coning or segregation of component sizes.
 - 2. The stockpile will be limited to ~~10-10 feet (3 meters)~~ in height and no equipment of any type will be allowed on top of the stockpile.
 - 3. The stockpile shall be maintained in a loose and uncompacted state.
 - 4. To prevent premature consolidation, reclaimed bituminous pavement aggregate shall not be stored in confined metal bins or hoppers unless slated for immediate processing.
- D. Immediately prior to feeding the reclaimed bituminous pavement aggregate into the mixing plant, the material shall first pass through a grizzly with bars spaced ~~two 2 inches (50 millimeters)~~ apart.

METHOD OF MEASUREMENT

404.04.01 MEASUREMENT

- A. Hot plantmix recycled bituminous pavement shall be measured as specified in Subsection ~~401.04.01~~, "Measurement."

BASIS OF PAYMENT

404.05.01 PAYMENT

- A. The accepted quantity of hot plantmix recycled bituminous pavement will be paid for at the contract unit price bid per ton, ~~(metric ton)~~ which ~~price~~ shall include all asphalt cement and recycling agent.
- B. The above ~~prices~~ shall be full compensation for furnishing all the material, mixing, loading, hauling, placing, compacting, and incidentals necessary for doing the work involved in constructing hot plantmix recycled bituminous pavement as shown on the plans or established by the Engineer.
- C. All payments will be made in accordance with Subsection ~~109.02~~, "Scope of Payment."
- D. Partial payments for hot plantmix recycled bituminous pavement may be made as set forth under Subsection ~~109.06~~, "Partial Payments."
- E. Payment will be made under:

PAY ITEM

PAY UNIT

Hot Plantmix Recycled Bituminous Pavement	Ton (Metric-Ton)
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SECTION 405**TACK COAT**

DESCRIPTION

405.01.01 GENERAL

- A. This work shall consist of preparing and treating an existing bituminous or concrete surface with asphaltic emulsion in accordance with these specifications and in conformity with the lines shown on the plans or established by the Engineer.

MATERIAL

405.02.01 BITUMINOUS MATERIAL

- A. The type and grade of bituminous material shall be SS-1h or CSS-1h asphalt emulsion unless otherwise specified in the Special Provisions.
1. The grade may be changed by the Engineer during construction.
 2. The bituminous material shall ~~meet the applicable requirements of~~ comply with Section ~~703~~, "Bituminous Materials."
 3. The bituminous material may be conditionally accepted at the source.
- B. Asphaltic emulsion used as a tack coat between the courses of plantmix surface or over an existing surface shall be of the type and grade specified and prepared for application as follows:
1. The emulsion shall be cut back by warm water.
 2. Water shall be added to the emulsion in the quantity of ~~fifty (50)~~ percent of the emulsion by weight.

CONSTRUCTION

405.03.01 EQUIPMENT

- A. The Contractor shall provide equipment for heating and applying the bituminous material.
- B. The distributor shall be so designed, equipped, maintained, and operated that bituminous material at even heat may be applied:
1. ~~u~~Uniformly on variable widths of surface up to ~~fourteen (14)~~ feet (4.3 meters).
 2. ~~a~~At readily determined and controlled rates from 0.05 to 2.0 gallons per square yard ~~(0.23 liters to 9.05 liters per square meter)~~ with uniform pressure and
 3. ~~w~~With an allowable variation from any specified rate not to exceed 0.02 gallon per square yard ~~(.09 liter per square meter)~~.
- C. Distributor equipment shall include a tachometer, pressure gauges, accurate volume measurement devices or a calibrated tank, and thermometer for measuring temperatures of tank contents.
- D. Distributors shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically.

405.03.02 WEATHER LIMITATIONS

- A. Application of bituminous material will not be permitted:
1. ~~w~~When the surface to be treated is damp or wet, ~~or~~
 2. ~~w~~When weather conditions are unsuitable, ~~or~~
 3. ~~w~~When the surface temperature is below ~~fifty (50)~~ degrees ~~F.~~ ~~(10.0 degrees C.)~~.

405.03.03 PREPARATION OF SURFACE

- A. The existing surface shall be patched and cleaned and be free of irregularities to provide a smooth and uniform surface to receive the treatment.
- B. The edges of existing pavements, ~~which are to that will~~ be adjacent to new pavement, shall be cleaned to permit the adhesion of bituminous materials.
- C. Where the Contractor is applying tack upon a previously constructed course under the contract, patching, cleaning, repairing, ~~etc. and so forth~~, will be at ~~the Contractor's expense~~ no additional cost to the Contracting Agency, unless otherwise provided. ~~Attention is directed to~~ Comply with Subsection ~~104.04~~, "Maintenance of Traffic," and Subsection ~~105.14~~, "Maintenance During Construction."
- D. Where the Contractor is applying tack upon a previously constructed course not a part of the contract, and when there are no items or provisions to pay for preparing the existing surface, the Contractor shall be paid for such preparation under the provisions of Subsection 104.03, "Extra Work."

405.03.04 APPLICATION OF ASPHALTIC EMULSION

- A. The asphaltic emulsion shall be uniformly applied at the rate called for on the plans or ordered by the Engineer.
- B. The temperature of the material to be spread at the time of application shall conform to ~~the applicable requirements in~~ Table ~~1~~ of Subsection 406.03.04, "Application of Bituminous Material."
- C. The tack coat shall be applied ~~in such manners~~ so as to offer the least inconvenience to traffic and to permit one-way traffic without pickup or tracking of the bituminous material.
1. Tack coat shall be applied only so far in advance that it will be covered during the following ~~thirty-six (36)~~ hours.
 2. The tack coat shall be completely "broke" prior to being covered.

METHOD OF MEASUREMENT**405.04.01 MEASUREMENT**

- A. The quantity of bituminous material to be measured for payment will be the number of tons ~~(metric tons)~~ conforming to all the requirements in the completed work.
- B. Bituminous material diluted as prescribed shall be measured in square yard ~~(square meter)~~, or tons ~~(metric tons)~~ of the diluted mixture acceptably applied to the surface.
- C. All measurements will be made in accordance with Subsection ~~109.01~~, "Measurement of Quantities."

BASIS OF PAYMENT

405.05.01 PAYMENT

- A. The accepted quantity of bituminous material measured as provided in Subsection 405.04.01, "Measurement," will be paid for at the contract unit price bid per square yard ~~(square meter)~~, or ton ~~(metric ton)~~.
- B. The unit bid prices shall be full compensation for furnishing the material, mixing, loading, hauling, placing, and incidentals necessary for doing all the work involved in placing tack coat, as shown on the plans or established by the Engineer, all in accordance with Subsection 109.02, "Scope of Payment."
- C. The Contracting Agency reserves the right to increase or to omit all or any part of the estimated amount of bituminous material to be used and no adjustment in unit price shall be allowed by reason of such increase or decrease.
- D. When an item for "Tack Coat" does not appear in the proposal, tack coat will be considered as incidental to the subsequent paving and compensation shall be included in the contract prices for other items of work.
- E. Payment will be made under:

PAY ITEM

PAY UNIT

Emulsified Asphalt "Tack Coat" (Type) (diluted) Ton ~~(Metric Ton)~~, Square Yard ~~(Sq. Meter)~~

SECTION 406**PRIME COAT**

DESCRIPTION

406.01.01 GENERAL

- A. This work shall consist of preparing and treating an existing aggregate base with bituminous material, and blotter material, if required, in accordance with these specifications and in conformity with the lines shown on the plans or established by the Engineer.

MATERIAL

406.02.01 BITUMINOUS MATERIAL

- A. The type and grade of bituminous material shall be MC-70 liquid asphalt unless otherwise specified in the Special Provisions. The grade may be changed ~~one~~ 1 step by the Engineer during construction.
- B. The bituminous material shall meet the applicable requirements of Section ~~703~~, "Bituminous Material." The bituminous material may be conditionally accepted at the source.

406.02.02 SAND BLOTTER

- A. Sand blotter shall meet the requirements of Subsection ~~705.03.06~~, "Sand Blotter." The material may be accepted in the stockpile at the source.

CONSTRUCTION

406.03.01 EQUIPMENT

- A. The Contractor shall provide equipment for heating and applying the bituminous material and for applying blotter material.
- B. The equipment shall meet the requirements of Subsection ~~405.03.01~~, "Equipment."

406.03.02 WEATHER LIMITATIONS

- A. Bituminous material shall not be applied:
1. ~~On~~ On a wet surface that has free ~~standing~~ standing water ~~or~~.
 2. ~~When~~ When the atmospheric temperature is below ~~fifty (50)~~ 50 degrees F. ~~(10 degrees C.)~~ °F.
 3. ~~When~~ When weather conditions, in the opinion of the Engineer, would prevent the proper construction of the prime coat.

406.03.03 PREPARATION OF SURFACE

- A. The surface upon which the bituminous prime coat is to be placed shall conform to the established lines and grades, shall be smooth and uniform, and shall be compacted to the required density.

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PRIME COAT

- B. If the required density deteriorates between the time the gravel course was compacted originally and the time the prime coat is placed, for any reason whatsoever, then the surface shall be recompacted to the required density at ~~the expense of the Contractor~~ no additional cost to the Contracting Agency.
- C. When required by the Engineer, an application of water shall be applied immediately before bituminous application.

406.03.04 APPLICATION OF BITUMINOUS MATERIAL

- A. Bituminous material shall be applied to the width of the section to be primed by means of a pressure distributor in a uniform, continuous spread.
1. When traffic is maintained, not more than ~~one-half (1/2)~~ of the width of the section shall be treated in one application.
 2. Care shall be taken that the application of bituminous material at the junctions of spreads is not in excess of the specified amount.
 3. Excess bituminous material shall be squeegeed from the surface.
 4. Skipped areas or deficiencies shall be corrected.
- B. When traffic is maintained, ~~one~~ 1-way traffic shall be permitted on the untreated portion of the roadbed.
- C. As soon as the bituminous material has been absorbed by the surface and will not pick up, traffic shall be transferred to the treated portion and the remaining width of the section shall be primed.
- D. Application rate shall be between 0.10 and 0.25 ~~gallon per square yard (0.45 liter to 1.1 liter per square meter)~~.
- E. The temperature requirements pertaining to the application of liquid asphalts and asphaltic emulsions shall conform to the requirements of the following Table ~~1~~:

**TABLE 1
SPRAYING TEMPERATURES OF LIQUID ASPHALTS
AND ASPHALTIC EMULSIONS**

Grade & Type RC, MC, & SC	Distributor Spraying Temperatures	
	Minimum °F(°C)	Maximum °F(°C)
70	120(49)	180(82)
255	165(74)	220(104)
800	200(93)	255(124)
3000	235(113)	290(143)
Grade of Asphalt Emulsion		
RS-1, CRS -1	75(24)	130(54)
RS-2, CRS-2	110(43)	160(71)
SS-1, CSS-1	75(24)	130(54)
SS-1h, CSS-1h	75(24)	130(54)
CMS-2S	100(38)	160(71)

406.03.05 APPLICATION OF BLOTTER MATERIAL

- A. If, after the application of the prime coat, the bituminous material fails to penetrate within ~~twenty-four (24)~~ hours, blotter material may be spread in the amounts required to absorb any excess bituminous material.
- B. Excess ~~blotter~~ sand blotter shall be removed prior to the placement of the subsequent courses.

406.03.06 MAINTENANCE

- A. All loose sand shall be completely removed from the treated areas before placing any pavement or surfacing material thereon.
- B. Immediately in advance of placing asphalt concrete or asphalt concrete base, additional prime coat shall be applied as directed by the Engineer to areas where the prime coat has been damaged, and loose or extraneous material shall be removed, and no additional compensation will be allowed therefore.

METHOD OF MEASUREMENT

406.04.01 MEASUREMENT

- A. The quantity of bituminous material to be measured for payment will be the number of square yards (~~square meters~~) or the number of tons (~~metric tons~~) conforming to all the requirements in the completed work.
- B. The quantity of ~~blotter~~ sand blotter measured for payment will be the number of tons (~~metric tons~~) conforming to all the requirements in the completed work.
- C. All measurements will be made in accordance with Subsection ~~109.01~~, "Measurement of Quantities."

BASIS OF PAYMENT

406.05.01 PAYMENT

- A. The accepted quantity of materials measured as provided in Subsection ~~406.04.01~~, "Measurement," will be paid for at the contract unit price bid per ton (~~metric ton~~) or square yard (~~square meter~~) for bituminous material and per ton (~~metric ton~~) for ~~blotter~~ sand blotter.
- B. When sand blotter is not included in the proposal and it is needed to protect the work or public traffic, "~~Blotter S~~ and blotter" shall be considered subsidiary to other items of work and no additional compensation will be allowed.
- C. The above prices shall be full compensation for furnishing the material, mixing, loading, hauling, placing, and incidentals necessary for doing all of the work involved in placing prime coat and sand blotter as shown on the plans or established by the Engineer.
- D. The Contracting Agency reserves the right to increase or to omit all or any part of the estimated amount of blotter material or bituminous material to be used and no adjustment in unit price will be allowed by reason of such increase or decrease.
- E. When an item for "~~P~~prime ~~G~~coat" does not appear in the proposals, but is shown on the plans or Standard Drawings, ~~P~~prime ~~G~~coat will be considered as incidental to the subsequent paving and compensation shall be included in the contract prices for other items of work.

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PRIME COAT

- F. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- G. Payment will be made under:

PAY ITEM	PAY UNIT
Liquid Asphalt " Prime Coat " (Type)	Ton (Metric Ton), Sq- <u>uare</u> Yard (Sq. Meter)
Blotter Sand <u>Blotter</u>	Ton (Metric Ton)

SECTION 407**SEAL COAT**

DESCRIPTION

407.01.01 GENERAL

- A. This work shall consist of an application of bituminous material on a compacted and bonded bituminous surface, and blotter sand, if required, in accordance with these specifications and in conformity with the lines shown on the plans or established by the Engineer.

MATERIAL

407.02.01 BITUMINOUS MATERIAL

- A. Unless otherwise specified in the Special Provisions, the type and grade of bituminous material shall be SS-1h or ~~CSS~~SS-1h asphalt emulsion. The grade may be changed by the Engineer during construction.
- B. The bituminous material shall meet the applicable requirements of Section ~~703~~, "Bituminous Materials." The bituminous material may be conditionally accepted at the source.
- C. The emulsion shall be cut back by warm water. Water shall be added to the emulsion in the quantity of ~~fifty (50)~~ percent of the emulsion by weight.

407.02.02 SAND BLOTTER

Sand blotter shall meet the requirements of Subsection 705.03.06, "Sand Blotter." The material may be accepted in stockpile at the source.

CONSTRUCTION

407.03.01 EQUIPMENT

- A. The Contractor shall provide equipment for heating and applying the bituminous material and for applying blotter material. ~~The equipment shall meet the requirements of Subsection 405.03.01, "Equipment."~~

407.03.02 WEATHER LIMITATIONS

- A. Bituminous material shall not be applied:
1. ~~On~~ When on a wet surface, ~~or~~
 2. ~~When~~ When the surface temperature is below ~~fifty (50)~~ degrees F. ~~(10 degrees C)~~, ~~or~~
 3. ~~When~~ When weather conditions, in the opinion of the Engineer, would prevent the proper construction of the seal coat.

407.03.03 PREPARATION OF SURFACE

- A. Immediately before applying the bituminous material, the surface to be sealed shall be thoroughly cleaned of all dirt and loose material by sweeping with power brooms supplemented by hand brooms if necessary.

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SEAL COAT

- B. The process of cleaning shall continue until dirt and loose material are removed from the entire width of the surfacing.

407.03.04 APPLICATION OF BITUMINOUS MATERIAL

- A. Bituminous material shall not be spread later in the day than will permit the stopping of traffic control prior to darkness.
- B. Bituminous material shall be applied to only one designated traffic lane at a time and the entire width of the lane shall be covered in one operation.
- C. The bituminous material shall be uniformly applied at the rate called for on the plans or ordered by the Engineer.
- D. The temperature of the bituminous material shall conform to the applicable requirements of Subsection ~~_406.03.04, of Section 406, "Prime Coat"~~ [Application of Bituminous Material.](#)
- E. The seal coat shall be applied in ~~such a~~ manner ~~as~~ to offer the least inconvenience to traffic and to permit ~~one~~¹-way traffic without pickup or tracking of the bituminous material.
- F. When seal and screenings are to be applied to the central portion of the pavement, the shoulder seal coat shall be applied at least ~~four (4)~~ days in advance of the application of the adjacent surface treatment requiring screenings, and the seal coats shall be applied ~~in such a manner~~^{so} that the joints between the ~~two~~² types will present a neat and uniform appearance true to the line shown on the typical cross section and as established by the Engineer.

407.03.05 APPLICATION OF BLOTTER MATERIAL

- A. The applicable requirements of Section ~~_406, "Prime Coat,"~~ shall apply to this Section 407, "Seal Coat," when sand blotter is required.

METHOD OF MEASUREMENT

407.04.01 MEASUREMENT

- A. The quantity of bituminous material to be measured for payment will be the number of tons ~~(metric tons)~~, or square yards ~~(square meters)~~ conforming to all the requirements in the completed work.
- B. All measurements will be made in accordance with Subsection ~~_109.01, "Measurement of Quantities."~~

BASIS OF PAYMENT

407.05.01 PAYMENT

- A. The accepted quantity of material measured as provided in Subsection ~~_407.04.01, "Measurement,"~~ will be paid for at the contract unit price bid per ton ~~(metric ton)~~, or square yards ~~(square meters)~~ for bituminous material.
- B. The above prices ~~s~~ shall be full compensation for furnishing the material, loading, hauling, placing, and incidentals necessary for doing all the work involved in placing seal coat as shown on the plans or established by the Engineer.

SEAL COAT

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- C. The Contracting Agency reserves the right to increase or to omit all or any part of the estimated amount of bituminous material to be used and no adjustment in unit price shall be allowed by reason of such increase or decrease.
- D. Sand blotter will be paid for in accordance with Section-406, "Prime Coat."
- A. When an item for "~~S~~seal ~~C~~coat" does not appear in the proposal, but it is shown on the plans or Standard Drawings, ~~S~~seal ~~C~~coat will be considered as incidental to the subsequent paving and compensation be included in the contract prices for other items of work.
- B. All payments will be made in accordance with Subsection-109.02, "Scope of Payment."
- C. Payment will be made under:

PAY ITEM

PAY UNIT

Emulsified Asphalt "~~S~~Seal Coat" (Type) Ton-~~(Metric Ton)~~, Square Yards-~~(Square Meters)~~

SECTION 408**PAVEMENT SURFACE TREATMENTS - CHIP SEAL**~~**408-1 CHIP SEAL**~~

DESCRIPTION

408.01.01 GENERAL

- A. This work shall consist of an application of bituminous material and cover of screenings applied on a previously compacted and bonded bituminous surface, in accordance with these specifications and in conformity with the lines shown on the plans or established by the Engineer.

MATERIAL

408.02.01 BITUMINOUS MATERIAL

- A. The type and grade of bituminous material will be specified in the contract. The grade may be changed by the Engineer during construction.
- B. The bituminous material shall ~~meet the applicable requirements of~~ comply with Section 703, "Bituminous Materials." The bituminous material may be conditionally accepted at the source.

408.02.02 SCREENINGS

- A. Screenings shall ~~meet~~ comply with ~~the requirements of~~ Subsection ~~705.03.05~~, "Screenings" for the size specified. ~~Attention is directed to~~ Comply with Subsection 106.04, "Samples and Tests."

CONSTRUCTION

408.03.01 DISTRIBUTORS

- A. The distributor shall ~~meet the requirements of~~ comply with Subsection ~~405.03.01~~, "Equipment."

408.03.02 AGGREGATE SPREADER

- A. The aggregate spreader shall be self-propelled and supported by at least ~~four (4)~~ two (2) wheels equipped with pneumatic tires on ~~two (2)~~ two (2) axles.
- B. The aggregate spreader shall be equipped with positive control so that the required amount of material will be deposited uniformly over the full width of the bituminous material.

408.03.03 ROLLING AND COMPACTION

- A. There shall be operating with each aggregate spreader at least ~~one (1)~~ one (1) pneumatic-tired roller.
- B. Rollers shall meet the following requirements:

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1. The ~~y~~ rollers shall be pneumatic-tired rollers and shall consist of not less than ~~nine (9)~~ wheels equipped with pneumatic tires of equal size and diameter mounted on ~~two~~ 2 ~~axles~~.
 2. Axles shall be attached to a rigid frame equipped with a loading platform or body suitable for ballast loading, so that the total weight of the roller can be varied to produce an operating weight per tire of between ~~one thousand (1,000)~~ and ~~two thousand (2,000)~~ pounds (450 and 900 kilograms).
 3. The tire treads, rear tire spacing, tire inflation, and tire size shall be ~~presented to and~~ approved by the Engineer.
- C. Rolling with a pneumatic-tired roller shall begin immediately after the distribution of the screenings, and continue until the aggregate is properly sealed in the binder.
1. As soon as the asphalt has achieved a definite set, rolling shall ~~be~~ discontinued unless otherwise directed by the Engineer.
 2. Rollers shall begin at the outer edge of the treatment and proceed in a longitudinal direction, working toward the center of the road.
 3. Each pass shall overlap the previous pass by about ~~one-half~~ 1/2 the width of the front wheels.
 4. All rollers shall be in good condition and the reversing mechanism so maintained that the roller is capable of changing directions smoothly.

408.03.04 WEATHER LIMITATIONS

- A. Bituminous material shall not be spread when:
1. ~~w~~ Weather conditions are unsuitable.
 2. ~~, or when t~~he atmospheric temperature is below ~~sixty-five (65)~~ degrees F. (18 degrees C.).
 3. ~~or t~~he pavement temperature is below ~~eighty (80)~~ degrees F. (27 degrees C.).

408.03.05 MAINTAINING TRAFFIC

- A. Where public traffic is being routed over a surface upon which a surface treatment is to be applied, the surface treatment shall not be applied to more than ~~one-half~~ 1/2 the width of the traveled way at a time, and the remaining half-width shall be kept free of obstructions and open for use by public traffic at all times until the surface treatment first applied is ready for use by traffic.
- B. Traffic will not be allowed on the newly placed bituminous material and screenings until, in the opinion of the Engineer, the screenings and bituminous material have sufficiently set and bonded to prevent displacement by such traffic.
- C. When the newly completed surface treatment is open to traffic, the traffic shall be controlled by use of flagmen and a pilot car for a period of ~~six (6)~~ hours or for such time as deemed necessary by the Engineer as follows:
1. A flagman shall be stationed at the beginning of each newly completed section open to traffic, to stop oncoming traffic preparatory to piloting operations, and shall be kept on duty during the entire control period.
 2. Traffic control as described above shall be moved ahead progressively as the newly completed surface is open to traffic.

408.03.06 PREPARATION OF SURFACE

- A. Immediately before applying the bituminous material, the surface to be treated shall be thoroughly cleaned of all dirt and loose material by sweeping with power brooms, supplemented by hand brooms if necessary.
- B. The process of cleaning shall continue until the surfacing is exposed and all dirt and loose material is removed from the entire width of surfacing.

408.03.07 APPLICATION OF BITUMINOUS MATERIAL

- A. Bituminous material shall be applied by means of a pressure distributor in a uniform, continuous spread over the section to be treated.
 - 1. The temperature of the bituminous material shall conform to ~~the applicable requirements of~~ Subsection 406.03.04, "[Application of Bituminous Material of Section 406, "Prime Coat."](#)"
 - 2. The quantity of bituminous material to be used per square yard shall be as directed.
 - 3. If the texture of the surface is such that bituminous material penetrates too rapidly, a preliminary application of from 0.05 to 0.10 gallon per square yard (~~0.25 to 0.50 liter per square meter~~) of surface may be required.
 - 4. A strip of building paper at least ~~three (3)~~ feet (~~1 meter~~) in width and with a length equal to that of the spray bar of the distributor plus ~~one (1)~~ foot (~~300 millimeters~~) shall be used at the beginning of each spread.
 - 5. If the cutoff is not positive, the use of paper may be required at the end of each spread.
 - 6. The paper shall be removed and disposed of in a satisfactory manner.
- B. The distributor shall be moving forward at proper application speed at the time the spray bar is opened.
 - 1. Any skipped areas or deficiencies shall be corrected.
 - 2. Junctions of spread shall be carefully made to ~~as~~ ensure a smooth riding surface.
- C. The length of spread of bituminous material shall not be in excess of that which trucks loaded with screenings can immediately cover.
- D. The spread of bituminous material shall not be more than ~~six (6)~~ inches (~~150 millimeters~~) wider than the width covered by the screenings from the spreading device. Under no circumstances shall operations proceed in such manner that bituminous material will be allowed to chill, set up, dry, or otherwise impair retention of the screenings.
- E. The distributor, when not spreading, shall be parked so that the spray bar or mechanism will not drip bituminous materials on the surface of the traveled way.

408.03.08 APPLICATION OF SCREENINGS

- A. Immediately following the application of the bituminous material, screenings shall be spread at the required rate per square yard (~~square meter~~).
- B. ~~In order to~~ To avoid building a longitudinal joint, when spreading screenings on the first width of bituminous material, no screenings shall be applied within ~~six (6)~~ inches (~~150 millimeters~~) of the edge adjacent to the next application of bituminous material.

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- C. ~~In order to~~ To eliminate dust film, screenings shall be moistened with water before applied. In spreading the screenings, the equipment used shall be so operated that the fresh bituminous material will be covered before equipment wheels come upon it.
- D. Asphaltic emulsion applied to the road surface shall be covered with screenings before setting or breaking occurs.
 - 1. After the screenings have been spread upon the bituminous material, any piles, ridges, or uneven distribution shall be carefully removed with flat bottom shovels, or other approved methods, to ensure against permanent ridges or bumps in the completed surface.
 - 2. Additional screenings shall be spread by hand in whatever quantities required to prevent picking up by the rollers or traffic.
- E. After the application of the screenings, the surface, where specified, shall be lightly broomed or otherwise maintained as directed for a period of ~~four (4)~~ days or as directed.
 - 1. Maintenance of the surface shall include the distribution of screenings over the surface to absorb any free bituminous material and cover any area deficient in screenings.
 - 2. The maintenance shall be conducted so as not to displace embedded material. Excess material shall be swept off and removed at the time determined by the Engineer.

METHOD OF MEASUREMENT

408.04.01 MEASUREMENT

- A. The quantity of bituminous material to be measured for payment will be the number of tons ~~(metric tons)~~ or the number of square yards ~~(square meters)~~ conforming to all the requirements in the completed work.
- B. The quantity of screenings measured for payment will be the number of tons ~~(metric tons)~~ or square yards ~~(square meters)~~ conforming to all the requirements in the completed work.
- C. All measurements will be made in accordance with Subsection ~~109.01~~, "Measurement of Quantities."

BASIS OF PAYMENT

408.05.01 PAYMENT

- A. The accepted quantity of materials measured as provided in Subsection ~~408-4.04.01~~, "Measurement," will be paid for at the contract unit price bid per ton ~~(metric ton)~~ or square yards ~~(square meters)~~ for bituminous material and per ton ~~(metric ton)~~, or square yards ~~(square meters)~~ for screenings.
- B. The above prices shall be full compensation for furnishing the material, mixing, loading, hauling, placing, rolling, sweeping, and incidentals necessary for doing all the work involved in placing bituminous material and screenings, as shown on the plans or established by the Engineer.
- C. The Contracting Agency reserves the right to increase or to omit all or any part of the estimated amount of screening or bituminous material to be used, and no adjustment in unit price shall be allowed ~~by reason of~~ such increase or decrease.

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- D. Flagmen and pilot cars will be paid for in accordance with Section ~~624~~, "Accommodations for Public Traffic."
- E. All payments will be made in accordance with Subsection ~~109.02~~, "Scope of Payment."
- F. Payment will be made under:

PAY ITEM	PAY UNIT
Emulsified Asphalt (Type).....	Ton, (Metric Ton) , Square Yard (Square Meter)
Screenings.....	Ton (Metric Ton) , Square Yard (Square Meter)

SECTION 409**PORTLAND CEMENT CONCRETE PAVEMENT**

DESCRIPTION

409.01.01 GENERAL

- A. This work shall consist of a pavement composed of Portland cement concrete, with or without reinforcement as specified, constructed on a prepared subgrade or base course in accordance with these specifications and in conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer.
- B. At the option of the Contractor, concrete pavement may be constructed with equipment utilizing stationary side forms or by the use of slip-form paving equipment.

MATERIALS

409.02.01 MATERIALS

- A. Materials shall conform to the requirements of the following sections and subsections:

Materials	Section/Subsection
Fine Aggregate	706.03.03
Coarse Aggregate	706.03.01
Portland Cement	701
Water	722
Air Entraining Admixtures	702.03.0302
Joint Filler	707.03.04032.043
Curing Materials	702.03.01
Subgrade Paper	702.03.02
Reinforcement	713

- B. An inadequate water supply shall be considered sufficient cause for delaying or stopping mixing operations. In case of a deficiency of water, the requirements for subgrade and curing concrete previously placed shall have priority over mixing.

409.02.02 GRADATION REQUIREMENTS

- A. Gradation ~~requirements~~ shall conform with ~~to the requirements as specified in Subsection 501.02.02, "Gradation Requirements."~~

409.02.03 CONCRETE PROPERTIES AND TESTS

- A. Portland cement concrete pavement shall be subject to the following requirements and test methods:

Test	Test Designation	Requirements
Flexural Strength of Concrete	ASTM C293	Minimum "Modulus of Rupture" 450 psi <u>PSI (3.10 MPa)</u>

CONSTRUCTION

409.03.01 CLASSIFICATION AND PROPORTIONS

- A. The Contractor shall notify the Engineer not less than ~~thirty-two (32)~~ calendar days in advance of use of the proposed sources of materials and shall make arrangements for the Engineer to obtain samples as required for testing purposes.
1. When requested by the Contractor and allowed in writing by the Engineer, samples will not be required from aggregate sources previously tested within the past ~~one (1)~~ year.
 2. Samples ~~will~~shall not exceed ~~five hundred (500)~~ pounds (~~227 kilograms~~) for each separate grading.
 3. The Contractor shall furnish a written statement giving the cement factor in sacks per cubic yard ~~(cubic meter)~~; the proportions of cement, water, and each size of aggregate in saturated surface dry (S-S-D) condition; and the percentage of air in the concrete proposed for use in the work.
 4. If the Contractor proposes to use an admixture other than an air-entraining agent, the Contractor shall state ~~its~~admixture's complete brand name and the quantity proposed to be used per sack of cement.
 5. The Engineer, after making such tests as the Engineer deems advisable, will either accept the proposed materials and proportions or suggest modifications needed for acceptance.
 6. After acceptance by the Engineer of batch proportions and materials, ~~they~~batch proportions and materials shall not be altered during the course of the work except as found necessary to maintain yield, cement factor, and unit weight within specification requirements.
- B. Portland cement concrete shall be proportioned using the aggregates tested such that the requirements in Table ~~4.1~~ of this subsection will be satisfied without falling below the minimum; or exceeding the maximum values given.
1. The cement factor of any individual batch placed in the work shall not be more than 0.15 sack per cubic yard (~~18.4 kilograms per cubic meter~~) less, nor more than 0.25 sack per cubic yard (~~30.7 kilograms per cubic meter~~) greater than the designated factor (sacks of cement per cubic yard).
 2. Aggregates shall be batched and reported to the Engineer.
 3. The weights used may be varied as necessary to comply with the above tolerances in cement factor and unit weight.
 4. Coarse and fine aggregate in each batch of concrete shall be combined in proportions that will produce a mixture within the grading limits for combined aggregates specified as follows:

GRADING LIMITS OF COMBINED AGGREGATES

Sieve Sizes	Percentage Passing
<u>2"-inch</u>	100
<u>1-1/2"-inch</u>	90-100
<u>1"-inch</u>	50-86
<u>3/4"-inch</u>	45-75

PORTLAND CEMENT CONCRETE PAVEMENT

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TABLE 1

Class of Concrete	Sacks of Cement Per Cubic Yard		Kg.-Cu. Meter		Coarse Aggregate	Maximum Water Gallons Per Sack	Slump Range		Air Range	Unit-Weight Variation		
	Min.	Max	Min.	Max			In.	Cm.			%	Lbs.
P.C.A	5.5	7	307	391	467	5.5	0.44	0-3**	0-7.6	4±1	±3	1-4
P.C.A.A.	6	7.5	334	419	467	5.5	0.44	0-3**	0-7.6	5±1	±3	1-4

*Based on aggregate in a saturated surface dry condition.

**The nominal slump in inches (centimeters) shall be three (3) inches (7.6 centimeters), the maximum slump shall be three and one-half (3½) inches (8.9) centimeters). When the slump of concrete is found to exceed the nominal slump, the mixture shall be adjusted as directed by the Engineer to reduce slump to a value within the specified range. Four slump tests will be considered sufficient to determine nominal slump. The difference in slump, determined by comparing slump tests on two samples of mixed concrete for each individual batch tested, shall not exceed one (1) inch (2.5 centimeters). When the difference in slump does exceed one (1) inch (2.5 centimeters) procedure and equipment used in producing the concrete shall be adjusted to reduce the difference in slump to not

3/8"-inch	38-55
No. 4	30-45
No. 8	23-38
No. 16	15-33
No. 30	8-22
No. 50	4-13
No. 100	1-5
No. 200	0-3

TABLE 1 - CONCRETE PROPORTIONS

<u>Class of Concrete</u>	<u>Sacks of Cement Per Cubic Yard</u>		<u>Coarse Aggregate Size No.</u>	<u>Maximum Water Gallons Per Sack Cement*</u>	<u>Slump Range Inches</u>	<u>Air Range %</u>	<u>Unit Weight Variation Pounds</u>
	<u>Min.</u>	<u>Max.</u>					
<u>P.C.A.</u>	<u>5.5</u>	<u>7</u>	<u>467</u>	<u>5.5</u>	<u>0-3**</u>	<u>4±1</u>	<u>±3</u>
<u>P.C.A.A.</u>	<u>6</u>	<u>7.5</u>	<u>467</u>	<u>5.5</u>	<u>0-3**</u>	<u>5±1</u>	<u>±3</u>

*Based on aggregate in a saturated surface dry condition (SSD).

**The nominal slump in inches shall be 3 inches, the maximum slump shall be 3-1/2 inches. When the slump of concrete is found to exceed the nominal slump, the mixture shall be adjusted as directed by the Engineer to reduce slump to a value within the specified range. Four slump tests will be considered sufficient to determine nominal slump. The difference in slump, determined by comparing slump tests on 2 samples of mixed concrete for each individual batch tested, shall not exceed 1 inch. When the difference in slump does exceed 1 inch, procedure and equipment used in producing the concrete shall be adjusted to reduce the difference in slump to not more than 1 inch.

409.03.02 EQUIPMENT

A. General:

1. Equipment and tools necessary for handling materials and performing all parts of the work ~~must~~shall meet the approval of the Engineer as to design, capacity, and mechanical condition.
 - a. This equipment shall be on the site ~~and~~ available for inspection, testing, and approval before paving operations are started.
 - b. All equipment, tools, and machinery shall be maintained in a satisfactory working condition.
2. The Contractor shall provide equipment of such capacity that the paver will operate continuously or at a constant rate of production insofar as feasible. In the event that any piece of equipment does not have sufficient capacity to keep pace with the other operations, the Engineer may limit the size of the batch or otherwise limit the rate of production to prevent poor workmanship, overloading of equipment, or frequent delays.
3. Any equipment operating entirely or partially on the pavement, regardless of the age of the pavement, shall be equipped so that only rubber-tired wheels will come in contact with the pavement.
4. Aggregates and cement shall be proportioned by weight, except that when the amount of concrete required for any ~~one-1~~ contract is ~~ten-(10)-~~cubic yards (~~7.6 cubic meters~~) or less, the materials may be measured by volume. Materials that are proportioned by volume shall be measured in containers of known capacity.
5. Proportioning shall consist of combining the aggregates, each stored in a separate bin in the various gradations prescribed in Subsection ~~706.03.01~~ 706.03.01 "Coarse Aggregate." with cement and water.
 - a. Weigh hoppers shall be charged from bins located directly over the ~~m~~ hoppers or from conveyor belts.
 - b. When conveyor belts are used, there shall be a separate belt for each size aggregate.
 - c. There shall be an approved moisture meter installed to indicate the moisture in the sand.

6. Bulk cement shall be weighed in an individual hopper and shall be kept separate from the aggregates until the ingredients are released for discharge. The cement hopper shall be attached to a separate scale for individual weighing.
7. The amount of water to be added to the mixture shall be measured and discharged rapidly into the mixing drum through a valve with a positive cut-off. When water is measured by weight, the water shall be weighed on a separate scale.
8. All weighing or metering devices, except moisture meters used for proportioning materials, shall be accurate to within ~~one~~ 1 percent.
 - a. The devices shall be sealed and certified by the Nevada State Department of Weights and Measures.
 - b. These certifications shall be dated within the past ~~twelve (12)~~ months and shall be renewed whenever required by the Engineer.
 - c. The moisture meter shall be accurate to within ~~one-half (1/2)~~ of one percent.
 - d. Whenever portable bunkers are set up at a new location, the scale assemblies shall be inspected and certified regardless of the date the scales were last tested.
9. Scales ~~utilized~~ used in proportioning shall be either springless dial or multiple beam type.
 - a. Scale gradations shall be no greater than the following:
 - 1) Aggregate Scales: 25 pounds ~~Lbs. (11.3 Kgs)~~
 - 2) Cement Scales: 5 pounds ~~Lbs. (2.3 Kgs)~~
 - 3) Water Scales: 5 pounds ~~Lbs. (2.3 Kgs)~~
 - b. All scales shall be of such size and so arranged that the scales may be read easily from the operator's platform.
 - c. If a multiple beam type scale is used, the scale shall be provided with an indicator operated by the main beam ~~which~~ that will give positive visible evidence of over or under weight.
 - d. The indicator shall be ~~so~~ designed ~~that it will~~ to operate during the addition of the last 400 pounds ~~(181 kilograms)~~ of any weighing.
 - e. The over travel of the indicator hand shall be at least ~~one-third (1/3)~~ of the loading travel.
 - f. Indicators shall be enclosed against moisture and dust.
10. Weighing equipment shall be insulated against vibration and movement of other operating equipment in the plant. When the entire plant is running, the scale reading at cut-off shall not vary from the weight designated by the Engineer by more than ~~one (1)~~ percent for cement, ~~one (1)~~ percent for water, ~~one and one-half (1-1/2)~~ percent for any size of aggregate, ~~nor one (1)~~ percent for the total aggregate in any batch.
11. Machine mixing will be required in all cases other than those in which the mixing would obviously prove to be impractical, in which event hand mixing will be permitted. Mixing shall be commenced as soon as possible after the cement is placed in contact with the aggregates, but in no event shall the intervening period exceed 30 minutes.
12. All concrete mixers shall be of such design and construction and so operated as to provide a thoroughly and properly mixed concrete in which the ingredients are uniformly distributed.

- a. Mixers shall be maintained in proper and serviceable working condition and any part or portion thereof that is out of order, or becomes worn to such extent as to detrimentally affect the quality of mixing, shall be promptly repaired or replaced.
- b. Mixers shall not have any aluminum parts which will have direct contact with concrete.

B. Concrete Consistency:

1. The amount of water added at the mixer shall be regulated to take into account the free water in the aggregates. Free water is defined as the total water minus the water absorbed by the aggregate in a saturated surface dry condition.
2. The amount of water used in the mixture shall not exceed the minimum amount necessary to permit practical placement and consolidation of the concrete, and unless otherwise authorized by the Engineer, shall be that required to produce concrete with a slump within the range shown as nominal in the following table:

Type of Work	Nominal Slump		Maximum Slump	
	Inches	Centimeters	Inches	Centimeters
Concrete Pavement	0-3	0-7.5	3.5	8.9

<u>Type of Work</u>	<u>Nominal Slump</u>	<u>Maximum Slump</u>
	<u>Inches</u>	<u>Inches</u>
<u>Concrete Pavement</u>	<u>0-3</u>	<u>3.5</u>

3. The concrete used in the work shall not have a slump greater than that shown as maximum above, nor a free water content greater than 312- pounds per cubic yard (~~185 kilograms per cubic meter~~) of concrete.
4. The consistency of concrete shall be determined in accordance with ASTM C-143.
5. If slump tests of individual samples taken at approximately the 1/4 and 3/4 points of the discharge differ by more than ~~two (2) inches (5 centimeters)~~, the mixer will not be acceptable for further use until the condition is corrected.

C. Paving and Stationary Mixers:

1. Paving and stationary mixers shall be equipped with an accurate automatic timing device so designed and constructed as to lock the discharge lever before aggregate and cement enter the drum, and release ~~such~~the lever only after the specified mixing time has elapsed. The regulation of the setting of ~~said~~the device shall be under the supervision of the Engineer. Water control equipment shall also be provided with each concrete mixer.
2. The proper proportions of aggregate, cement, and water for each batch of concrete shall be placed in the mixer, and shall be mixed for a period of not less than ~~one~~ 1 minute after all ~~such~~ materials are in the drum. The minimum mixing time, however, shall not be less than ~~one and one-half~~ 1-1/2 minutes.
3. The rotating speed at which the mixer shall be operated shall conform to that recommended by the manufacturer.

4. The total volume of materials mixed in any ~~one~~1 batch shall exceed neither the water level capacity of the mixer nor the manufacturer's guaranteed capacity of the mixer.

D. Transit Mixers:

1. The type, capacity, and manner of operation of the mixing and transporting equipment for ready-mix concrete shall conform to the current "Standards for Operation of Truck Mixers and Agitators of the National Ready-Mixed Concrete Association" and the "Truck Mixer and Agitator Standards of the Truck Mixer Manufacturers Bureau."
 - a. Transit mix concrete trucks shall be equipped with an automatic device for recording the number of revolutions of the drum during the mixing period.
 - b. Each mixer and agitator shall have attached thereto, in a prominent place, a metal plate or plates installed by the manufacturer on which is plainly marked the capacity of the drum in terms of the volume of mixed concrete and the speed of rotation for the agitating and mixing speeds of the mixing drum or blades.
2. Each mixer shall have an identification number painted in a location on the truck ~~in such a location~~ that it can be easily read from the batching platform.
3. The total volume of materials introduced into the mixer shall not exceed the manufacturer's guaranteed mixing capacity.
 - a. If the concrete so mixed does not meet the uniformity requirements of this subsection, the amount of materials charged into the mixer shall be reduced.
 - b. The drum of the mixer shall be completely emptied of ~~any~~ previously mixed load.
 - c. The proper proportions of aggregate, cement, and water for each load of concrete shall be placed in the mixer and shall be mixed therein for not less than 70 nor more than 100 ~~revolutions~~ of the drum or blades at the speed designated by the manufacturer of the equipment as mixing speed.
 - d. Additional revolutions of the drum shall be at the speed designated by the manufacturer of the equipment as agitating speed.
 - e. The revolving of the drum shall be continuous until the concrete is completely emptied from the drum.
4. When concrete is being placed for pavement structures, all wash water shall be emptied from the mixer before any portion of the succeeding load is placed therein. For all other work, the mixer shall be empty or may carry ~~(10)~~ gallons ~~(38 liters)~~ of water in the drum.
 - a. Adequate control of ready-mixed concrete will normally require that additional water be added and mixed into the batch at the point of discharge.
 - b. Water so added shall be mixed into the load for a minimum mixing time of ~~three~~3 minutes.
 - c. Water shall not be added to the load during transit.
 - d. The total elapsed time between the addition of water at the batch plant and discharging the completed mix shall not exceed 60 minutes. Under conditions contributing to quick setting, the total elapsed time permitted may be reduced by the Engineer.

5. The Engineer shall be provided with a legible certified weighmaster's certificate at the job site for each load which shall contain the following information:
 - a. Name of Vendor
 - b. Name of Contractor
 - c. Number of Cubic Yards in the Load
 - d. Actual Weights of Cement and of ~~e~~Each Size of Aggregate
 - e. Amount of Water ~~a~~Added at the Plant
 - f. Amount of Water in the Aggregate
 - g. Brand and Type of Cement
 - h. Brand and Amount of Admixture
 - i. Time and Date of Batching
6. When mix proportions have been designated for a project and are identified by number, the Engineer may waive the foregoing and accept a legible certified weighmaster's certificate which shall contain the following information:
 - a. Name of Vendor
 - b. Name of Contractor
 - c. Number of Cubic Yards in the Load
 - d. Mix Designation Number
 - e. Amount of Water ~~a~~Added at the Plant (including Water in Aggregate)
 - f. Time and Date of Batching
7. Space shall be provided on the certificate so that amount of water added on the job may be indicated.

E. Forms and Headers:

1. Forms and headers shall be either wood or metal, ~~and~~. ~~They~~ shall be:
 - a. ~~s~~Set plumb and true to line and grade, with the upper edge thereof set to the grade of the pavement to be constructed.
 - b. ~~and shall be r~~Rigidly installed on a true alignment and so maintained for a distance in advance of placing the pavement to provide for at least a ~~one~~ 1-day run of concrete.
2. Headers shall rest firmly on the subgrade or base. They shall be oiled immediately prior to the placing of the concrete and shall remain in place at least 12 hours after concrete has been placed.
3. Forms and headers ~~must~~shall be removed before the work will be accepted.

F. Wooden Forms:

1. Wooden forms shall be constructed of ~~three (3)~~ 3-inch ~~(8 centimeters)~~ nominal lumber in pieces not less than ~~sixteen (16)~~ 16-feet ~~(4.9 meters)~~ long except where changes in alignment or grade necessitate the use of material of smaller dimensions. The lumber used shall:

- a. ~~b~~Be free from warp and other imperfections ~~which~~that would impair the strength for the use intended.
 - b. ~~shall h~~Have square edges (which may be slightly beveled) and square ends.
 - c. ~~shall b~~Be surfaced on the upper edge.
 - d. ~~and shall n~~Not be more than ~~one-half (1/2)~~ inch (~~1.3 centimeters~~) less in depth than the specified thickness of the edge of the pavement.
2. ~~Such~~Wooden forms shall be secured by nailing to side stakes spaced not more than ~~four (4)~~ feet (~~1.2 meters~~) apart, driven into the subgrade vertically to a depth not less than ~~twelve (12)~~ inches (~~30 centimeters~~), and so that the tops will be below the upper edge of the header. The stakes shall be sufficient length and cross-sectional area to adequately resist lateral displacement of the headers during the paving operations.
 3. Wooden headers shall be spliced by nailing a board to the outside of the headers. The board shall be at least ~~four (4)~~ feet (~~1.2 meters~~) long, ~~one (1)~~ inch (~~2.5 centimeters~~) thick, and at least ~~six (6)~~ inches (~~15 centimeters~~) wide (or the depth of the header, whichever is ~~least~~less), and shall be centered on the joint.

G. Metal Forms:

1. Metal forms shall be free from warp, have sufficient rigidity to resist springing during the paving operations, and shall be not less in depth than the specified thickness of the edge of the pavement being constructed.
2. The ~~y~~ forms shall be secured ~~by means of~~with metal stakes spaced not more than ~~five (5)~~ feet (~~1.5 meters~~) apart and driven below the top of the forms.
3. The ~~y~~ stakes shall be designed so as to be driven through openings in the forms to lock the forms in position.

H. Slip Form Construction:

1. At the option of the Contractor, and with the approval of the Engineer, concrete pavement may be constructed by the use of slip form paving equipment.
2. Slip form paving equipment shall be provided with traveling side forms of sufficient dimensions, shape, and strength to support the concrete laterally for a sufficient length of time during placement to produce pavement of the required cross section, and ~~it~~ the equipment shall spread, consolidate, screed, and float-finish the freshly placed concrete ~~in such a manner as~~ to provide a dense and homogenous pavement.
3. The concrete shall be distributed uniformly into final position by the slip form paver and the horizontal deviation in alignment of the edges shall not exceed ~~one and one-fourth (1-1/4)~~ inches (~~3 centimeters~~) from the alignment established by the Engineer.
4. The concrete, for the full paving width, shall be effectively consolidated by internal vibration, with transverse vibrating units, or with a series of longitudinal vibrating units. Internal vibration shall mean vibration by means of vibrating units located within the specified thickness of pavement section and at a minimum distance ahead of the screed equal to the pavement thickness.
5. When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement shall be equipped with protective pads on crawler tracks or rubber-tired wheels, offset to run a sufficient

distance from the edge of the pavement to avoid breaking or cracking the pavement edge.

6. After the concrete has been given a preliminary finish by finishing devices incorporated in the slip form paving equipment, the surface of the fresh concrete shall be checked by the Contractor with a straightedge to the tolerance and finish required in Subsection ~~409.03.08~~, "[Spreading, Compacting, and Shaping](#)."
7. The subgrade shall be moist at the time of placing concrete.
 - a. The subgrade shall be thoroughly wet the night before or at least ~~six (6)~~ hours prior to placing the concrete, and again sprinkled immediately before the concrete is placed on it.
 - b. Sprinkling shall be such that mud and pools of water will not be formed.
 - c. At the time of placing the concrete, the grade shall not be muddy, soft, or frozen.

409.03.03 BLANK

409.03.04 BLANK

409.03.05 REINFORCEMENT

- A. Concrete pavement shall be reinforced at structure approaches and other locations as shown on the plans or directed by the Engineer, and as specified in this section.
- B. Bar reinforcement shall conform to the provisions in Section ~~505~~, "Reinforcing Steel."
- C. Bar reinforcement shall be held accurately and firmly in position during the placing and compacting of the concrete without sagging by means of supporting devices which shall be left in place.
- D. The supports shall be specially manufactured for the purpose and each support shall be capable of supporting a vertical load of ~~two hundred (200)~~ pounds (~~91 kilograms~~).

409.03.06 BLANK

409.03.07 PLACING CONCRETE

- A. The Contractor shall make adequate advance arrangements for preventing ~~delay~~ in delivery and placing of the concrete.
 1. An interval of more than ~~forty five (45)~~ minutes between placing of any ~~two~~ consecutive batches or loads shall constitute cause for stopping paving operations.
 2. ~~and t~~The Contractor shall make a contact joint, at ~~his expense~~ [no additional cost to the Contracting Agency](#), at the location and of the type directed by the Engineer, in the concrete already placed.
- B. Unless otherwise specified, concrete pavement shall be placed in ~~twelve (12)~~ foot (~~3.7 meter~~) traffic lane widths separated by contact joints as shown on the plans, or, at the option of the Contractor, the concrete pavement may be placed monolithically ~~two~~ or more lanes wide without a contact joint, but with a longitudinal weakened plane joint at each traffic lane line.
- C. All concrete shall be used while fresh. The use of water for retempering any concrete will not be permitted.

- D. Any concrete showing improper proportions of materials, including water, shall not be used in the pavement and any such unsatisfactory concrete shall be removed and disposed of by the Contractor at ~~his expense~~ no additional cost to the Contracting Agency.
- E. The Contractor shall protect freshly placed concrete from damage by any cause and any damage shall be repaired by the Contractor at ~~his expense~~ no additional cost to the Contracting Agency.
- F. Expansion joint material shall be protected while depositing fresh concrete adjacent thereto.
- G. Concrete work shall be adequately barricaded in all directions to protect the work.

409.03.08 SPREADING, COMPACTING, AND SHAPING

- A. The concrete shall be consolidated, and the surface finished true to grade and cross section.
 - 1. Upon completion, the surface shall be free of any unevenness greater than ~~one-eighth (1/8) inch (0.3 centimeters)~~ when checked with a ~~ten (10) foot (3 meters)~~ straightedge placed on the surface of the pavement.
 - 2. The ~~ten (10) foot (3 meters)~~ straightedge shall be furnished by the Contractor and shall be at the site of the work prior to ~~the commencing of the~~ concrete ~~placing of the concrete~~ ement.
- B. **Tamping:**
 - 1. The concrete shall be distributed uniformly between the side forms as soon as ~~it~~ the concrete is placed, after which the concrete shall be struck off and tamped ~~means~~ of with a mechanical tamper.
 - 2. The tamper shall be operated at right angles to the centerline of the pavement, and tamping continued until the concrete is thoroughly consolidated to the specified cross section and sufficient mortar for finishing purposes has been brought to the surface.
 - 3. Steel-shod hand tampers or vibrating bars may be substituted in those cases where the use of mechanical spreader and tamper would be obviously impracticable.
 - 4. Approved concrete vibrating equipment shall be used in conjunction with the mechanical tamper to consolidate the concrete adjacent to the forms or existing pavement.
- C. **Floating:**
 - 1. After tamping, the surface of the concrete shall be floated by either the finishing machine method or the transverse float method described below.
 - 2. Bridge decks may be floated by the longitudinal float method.
 - 3. **Finishing Machine Method:** The concrete shall be floated smooth and true to grade with an approved finishing machine.
 - 4. **Transverse Float Method:**
 - a. The concrete shall be floated at least twice with a long-handled float at least ~~five (5) feet wide (1.5 meters)~~, ~~following~~ after which the surface of the concrete shall be finished smooth and true to grade, with a wooden float ~~sixteen (16) feet (4.9 meters)~~ long, ~~two (2) inches (5 centimeters)~~ thick, and ~~six (6) inches (15 centimeters)~~ wide.

- b. ~~#~~The float shall be rigidly ribbed and with adjustable screws between the rib and float board to ensure a true and flat surface on the underside at all times.
 - c. The float shall be operated from the side of the pavement, and parallel with the centerline.
 - d. The edge of the float shall be used to cut down all high areas, and the material so removed shall be floated into the depressions until a true surface is obtained.
 - e. Each successive pass of the float shall halflap the previous pass.
 - f. The float shall be operated as far behind the tamping machine as the workability of the concrete will permit before its initial set.
5. **Longitudinal Float Method:**
- a. The concrete shall first be floated with a double-handled longitudinal float not less than ~~sixteen (16)~~ feet ~~(4.9 meters)~~ nor more than ~~twenty (20)~~ feet ~~(6 meters)~~ in length, having a trowelling surface not less than ~~eight (8)~~ inches ~~(20 centimeters)~~ nor more than ~~ten (10)~~ inches ~~(25 centimeters)~~ wide.
 - b. The float shall be operated from bridges over the pavement with its length parallel to the centerline of the improvement, and shall be worked back and forth transversely across the slab, planing off high spots and filling depressions.
 - c. ~~This operation~~Floating shall ~~be continued~~ until the surface is reasonably smooth, after which the bridges may be advanced not to exceed 2/3 the length of the surface so floated, and the operation continued.
- D. After being finished by one of the above methods, the outside edges of pavement shall be rounded to a ~~one-half (1/2)~~ inch ~~(1.3 centimeters)~~ radius; and transverse contact joints, expansion joints, and joints adjacent to an existing pavement shall be rounded to a ~~one-fourth (1/4)~~ inch ~~(.6 centimeters)~~ radius.
- E. A strip of wetted burlap shall be provided, of a length not less than the width of the pavement slab.
1. ~~#~~The burlap shall be attached by ~~one~~ edge to a rigid frame supported over the pavement so that the free edge of the burlap will rest or drag on the surface of the concrete.
 2. The burlap shall be dragged back and forth longitudinally along the pavement until the surface of the slab is of uniform texture appearance throughout its entire length.

409.03.09 JOINTS

- A. Joints in concrete pavement will be designated as longitudinal and transverse contact joints, transverse expansion joints, and longitudinal and transverse weakened plane joints. Unless otherwise specified:
1. ~~;~~Transverse joints shall be constructed perpendicular~~ly~~ to the centerline of the pavement.
 2. Longitudinal joints shall be constructed parallel to the centerline of the pavement.
 3. ~~and~~ the faces of all joints shall be perpendicular to the finished surface of the pavement.
- B. Joint filler, when required, will be as designated on the plans or in the Special Provisions.

C. Contact Joints:

1. Contact joints are those made by placing fresh concrete against hardened concrete at planned locations. ~~They~~ Contact joints shall be constructed at the locations and in the manner shown on the plans.
2. Longitudinal contact joints shall be constructed by one of the following methods: A plain face, the use of tie bars, or the construction of keyways. Tie bars or keyways will be as designated on the plans or in the Special Provisions.

D. Transverse Expansion Joints:

1. Transverse expansion joints shall be installed at locations shown on the plans.
2. Expansion joint filler material shall have a minimum thickness of ~~one-half (1/2)~~ inch ~~(1.3 centimeters)~~, a maximum thickness of ~~three-fourths (3/4)~~ inch ~~(1.9 centimeters)~~, and a depth equal to the thickness of the pavement, and shall be composed of materials as specified in the Special Provisions or approved by the Engineer.
3. After the concrete has been finished, an edger of ~~one-fourth (1/4)~~ inch ~~(0.6 centimeters)~~ radius shall be used on each side of the expansion joint filler. The expansion joint filler shall be cleaned of all concrete mortar.

E. Weakened Plane Joints:

1. Weakened plane joints shall be constructed at the locations shown on the plans and shall be formed by cutting a groove in the pavement with a power driven saw.
 - a. The groove for a transverse joint shall be cut to a minimum depth of ~~one and one-half (1-1/2)~~ inches ~~(3.8 centimeters)~~ or ~~one-sixth~~ 1/6 of the pavement thickness, whichever is greater; the groove for a longitudinal joint shall be cut to a depth of ~~one-fourth (1/4)~~ of the pavement thickness; and the width shall be a minimum width possible with the saw being used, but in no case shall the width exceed ~~one-fourth (1/4)~~ inch ~~(0.6 centimeters)~~.
 - b. Any portion of the sealing compound which has been disturbed by sawing operations shall be restored by spraying the areas with additional sealing compound.
 - c. In the initial lane of concrete, the first transverse weakened plane joint immediately following a transverse contact joint, and every fourth weakened plane joint thereafter, shall be sawed within 10 to 24 hours after the concrete has been placed.
 - d. The time lapse will be subject to the approval of the Engineer.
 - e. Every second transverse weakened plane joint shall be sawed within 24 hours after the concrete is placed, and the remaining weakened plane joints may be sawed at such time as the Contractor may elect; except that in any lane, all weakened plane joints shall be sawed before concrete is placed in succeeding adjacent lanes and before any traffic whatsoever is permitted to use the pavement.
2. In succeeding adjacent lanes of concrete pavement, transverse weakened plane joints opposite those which have been sawed in the initial lane shall be sawed within 10 to 24 hours after the concrete has been placed.
 - a. The time lapse will be subject to the approval of the Engineer.

- b. In all cases, no more than three consecutive transverse weakened plane joints shall be bypassed.
3. At the option of the Contractor, longitudinal weakened plane joints may be used at traffic lane lines in multi-lane monolithic concrete pavement in lieu of longitudinal contact joints. Dowel requirements will be as designated on the plans or in the Special Provisions.

409.03.10 CURING

A. General:

1. All Portland cement concrete pavement ~~must~~shall be cured for ~~seventy-two (72)~~ hours by the methods specified in this section, subject to the conditions set forth in Subsection ~~501.03.09.A.1(a)~~, "Curing—General."
2. In case of low temperatures, the curing period will be increased according to the provisions of Subsection ~~501.03.10.B(b)~~, "Cold Weather - General."

B. Curing Compound Method:

1. Curing by use of curing compound shall be as specified in Subsection ~~501.03.09.A.3(e)~~, "Curing Compound Method." The curing compound shall not be applied until all patching and surface finishing, except grinding, ~~has~~have been completed.
2. When deemed necessary by the Engineer during periods of hot weather, fogging of the concrete with water shall be continued after curing compound is applied or until the Engineer determines that a cooling effect is no longer required.

- C. **Waterproof Membrane Method:** Curing by use of waterproof membrane material shall be as specified in Subsection ~~501.03.09.A.4(d)~~, "Waterproof Membrane."

409.03.11 PROTECTION OF PAVEMENT

- A. Concrete shall not be placed on frozen ground nor shall ~~it~~concrete be mixed or placed while the atmospheric temperature is below ~~thirty-five (35)~~ degrees ~~Fahrenheit (1.7 degrees Celsius)~~—unless adequate means are employed to heat the aggregates and water, and provision satisfactory to the Engineer has been made for protecting the work.
- B. Placing the concrete shall be stopped before rainfall is sufficient to cause a flow or wash the surface.
- C. Upon written notice from the Engineer, all concrete which has been damaged shall be replaced by the Contractor at ~~his expense~~no additional cost to the Contracting Agency.
- D. All concrete in pavement shall be protected from freezing or frost for a period of ~~five (5)~~ days after placing. The temperature of the surface of the concrete shall not be allowed to drop below ~~forty (40)~~ degrees ~~Fahrenheit (4.4 degrees Celsius)~~ for this period of ~~five (5)~~ days.
- E. When ordered by the Engineer or shown in the contract documents, pavement crossings shall be constructed for the convenience of public traffic.
 1. The material and work necessary for the construction of ~~such~~these ramps, and ~~their~~ subsequent removal and disposal of the ramps, will be paid for at the contract unit prices for the items of work involved.

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2. ~~and, if~~ there are no contract items for the work involved, payment for pavement crossings will be made by force account work as provided in Subsection ~~104.03~~, "Extra Work."
 3. Where public traffic will be required to cross over the new pavement, Type ~~III~~ Portland cement shall be used in concrete.
 4. When Type ~~III~~ Portland cement is used in concrete, and if permitted in writing by the Engineer, the pavement may be opened to traffic as soon as the concrete has developed a modulus of rupture of ~~four hundred fifty (450) pounds per square inch psi (31.6 kilograms per square centimeter)~~.
- F. No traffic or Contractor's equipment, except for subgrading equipment, will be permitted on the pavement before a period of ~~ten~~ 10 calendar days has elapsed after the concrete has been placed, nor before the concrete has developed a modulus of rupture of at least ~~four hundred fifty (450) pounds per square inch psi (31.6 kilograms per square centimeter)~~, as determined by Test Method ASTM ~~C-293~~. Concrete that fails to attain a modulus of rupture of ~~four hundred fifty (450) pounds per square inch psi (31.6 kilograms per square centimeter)~~ within ~~ten~~ 10 days shall not be opened to traffic until directed by the Engineer.
- G. Equipment used to prepare subgrade may be permitted to ride upon one edge of the previously placed concrete at the end of ~~seventy-two (72)~~ hours, provided, however, that no damage is done to the pavement edge by reason of such operation. Any damage to the pavement resulting from such operations shall be repaired by the Contractor at ~~his expense~~ no additional cost to the Contracting Agency prior to placing the adjacent lane.

METHOD OF MEASUREMENT

409.04.01 MEASUREMENT

- A. The number of square yards ~~(square meters)~~ of concrete pavement to be measured for payment will be determined from horizontal measurements of the completed finished surface of the pavement.
- B. Prefomed joint sealer in weakened plane joints will be measured by the linear foot ~~(meter)~~ of the sealed joint. Prefomed joint filler in transverse expansion joints and prefomed polyethylene joint filler in ~~four (4) inch (10 centimeters)~~ joints will be measured by the linear foot ~~(meter)~~ of joint filler complete in place.
- C. Tie bars will not be measured for payment.
- D. The length of sawed joint for prefomed polyethylene joint sealer shall be the length in feet ~~(meters)~~ of the joint.
- E. The length of sawed transverse weakened plane joints shall be the length in feet ~~(meters)~~ of the transverse weakened plane joints actually sawed except as otherwise provided in Subsection ~~409.03.09 (eE)~~, "Weakened Plane Joints." Volunteer cracks will not be included in the length of transverse weakened plane joints measured for payment. No measurement or separate payment will be made for longitudinal joints.
- F. All measurements will be made in accordance with Subsection ~~109.01~~, "Measurement of Quantities."

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BASIS OF PAYMENT

409.05.01 PAYMENT

- A. The accepted quantities measured as provided in Subsection ~~409.04.01~~, "Measurement," will be paid for at the contract unit price bid per square yard ~~(square meter)~~ for Portland cement concrete pavement.
- B. The above prices shall be full compensation for furnishing all the material including Portland cement and water, mixing, hauling, placing, finishing, and incidentals necessary for doing all the work as shown on the plans or established by the Engineer.
- C. Payment for reconstructing or adjusting manholes to grade will be made as a separate item as provided in Subsection ~~609.05.01~~, "Payment." If no such item is provided, payment will be deemed included in the other items of work.
- D. All payments will be made in accordance with Subsection ~~109.02~~, "Scope of Payment."
- E. Partial payments for Portland cement concrete payment may be made as set forth under Subsection ~~109.06~~, "Partial Payments."
- F. Payment will be made under:

PAY ITEM	PAY UNIT
Portland Cement Concrete Pavement (Inches).....	Square Yard (Square Meter)
Saw Transverse Weakened Plane Joints.....	Linear Foot (Meter)
Joint Sealer.....	Linear Foot (Meter)
4-Inch Expansion Joint (Saw Cut).....	Linear Foot (Meter)
Joint Filler.....	Linear Foot (Meter)
Reinforcing Steel.....	Pound (Kilogram)

SECTION 412

PAVEMENT SURFACE TREATMENTS - SLURRY SEAL/MICRO-SURFACING

~~408-2 PAVEMENT SURFACE TREATMENTS -- SLURRY SEAL/MICRO-SURFACING~~

DESCRIPTION

412.01.01 GENERAL

- A. This work shall consist of ~~an~~the application of a mixture of mineral aggregate, emulsified asphalt, water, and additives ~~applied~~ on a previously compacted and bonded bituminous surface, in accordance with these specifications and in conformity with the lines shown on the plans or established by the Engineer.

~~02~~MATERIALS**412.02.01 ASPHALT EMULSION**

- A. The asphalt emulsion shall be LMCQS-1h.
- B. Each shipment of emulsified asphalt shall be accompanied with a certificate of analysis/ compliance from the manufacturer.
- C. When the daily high ambient temperature is below ~~eighty (80)~~ degrees F. ~~(27 degrees C.)~~, the Contractor shall chemically modify the emulsion to accelerate the break and set times.
- D. The emulsion modifier shall be adjusted at the emulsion manufacturer's facility.
- E. The asphalt emulsion shall ~~meet all applicable requirements of~~comply with Section ~~703,~~ "Bituminous Materials."

412.02.02 POLYMER MODIFIERS

- A. The polymer modifier shall be either a solid synthetic rubber or latex material.
- B. The polymer modifier shall be combined with the emulsion by co-milling with the manufacture of the asphalt emulsion at a minimum rate of ~~3%~~ percent polymer solids by weight of the base asphalt in the emulsion prior to loading at the emulsion plant.
- C. If the contract includes quantities for conventional slurry seal, the polymer modified emulsion shall be compatible with the mix design developed for the conventional slurry seal.

412.02.03 COMMERCIAL MINERAL FILLER

- A. The mineral filler shall be considered a part of the mineral aggregate and shall ~~conform to the requirements of~~comply with Section ~~705,~~ "Aggregates for Bituminous Courses."
- B. The quantity of filler shall be determined by the job mix design. ~~#~~Filler shall be used for one or more of the following reasons only:
1. ~~to~~ To improve the gradation of the aggregate.
 2. ~~to~~ To provide improved stability and workability of the slurry ~~or~~.
 3. ~~to~~ To increase the durability of the cured slurry.

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412.02.04 CARBON BLACK

- A. If specified, carbon black shall be added to the slurry seal mixture at a minimum 2% percent to maximum 3% percent based on the weight of the emulsion.
- B. The product shall be Mono-Chem perma-black 115A, 2847A, or equal as approved by the Engineer.

Specifications	Tolerances
Total Solids	40-44
Percent Black by Weight	35-37
Type Black	Medium furnace color

412.02.05 SET CONTROL ADDITIVE

- A. The set control additive shall be aluminum sulfate, or Portland Type I/II cement, or other approved additive previously included in the mix design.
- B. The quantity of set control additive shall be field adjusted to provide the specified mix properties.

412.02.06 WATER

- A. Water for the slurry mixture shall conform to Section ~~722~~, "Water," and be clear, potable, free from harmful soluble salts, and compatible with the slurry mixture.

412.02.07 MINERAL AGGREGATE

- A. The mineral aggregate shall conform to the specified contract gradations for ~~either~~ ISSA Type I, Type II, or Type III.
- B. ~~#~~Mineral aggregate shall be 100% percent manufactured crushed stone that is free from dirt, organic matter, clay balls, adherent films of clay, dust, or other objectionable matter.
- C. The parent rock used in the manufacturing shall have a normal size greater than ~~one-half (2) 1/2 inch (13 millimeters)~~ and shall ~~meet all applicable requirements of~~ comply with Section ~~705~~, "Aggregates for Bituminous Courses."
- D. Aggregate sources may be required to be evaluated for use based upon petrographic examination in accordance with ASTM C-295. Such tests shall be at ~~the expense of the Contractor~~ no additional cost to the Contracting Agency.

03 CONSTRUCTION**412.03.01 SLURRY SEAL/MICRO-SURFACING MIXTURES**

- A. Slurry Seal Mixtures:
- The slurry seal shall consist of a mixture of emulsified asphalt; mineral aggregate; mineral filler and carbon black, if required; set control additive; and water.
 - The mixture shall conforming to ISSA Type I, Type II, and Type III gradations.
 - The mix shall be per in accordance with this section, and in accordance with Section ~~703~~, "Bituminous Materials"; Section ~~705~~, "Aggregates for Bituminous Courses" and Section ~~722~~, "Water."
 - The mixture shall be proportioned, mixed, and spread evenly on a prepared surface in accordance with these specifications or as directed by the Engineer.

5. The completed slurry seal shall leave a homogeneous mat, adhere firmly to the prepared surface, and have a friction-resistant surface texture throughout its service life.
- B. ~~Micro-s~~urfacing Mixtures:
1. ~~m~~Mixtures shall be capable of being spread in varying cross sections (wedges, wheel path depressions, leveling courses, and surfaces) which, after curing and initial traffic consolidation, resist compaction throughout the entire design tolerance range of bitumen content and the various thicknesses encountered.
 2. The blended mixture shall have proper workability during lay-down and ~~wi~~shall permit traffic loading within ~~one~~1 hour after placement, without the occurrence of bleeding, raveling, separation, or other distresses.
- C. Prior to the start of work, the Contractor ~~wi~~shall ~~be required to~~ place ~~two~~2 test sections of at least ~~fifteen hundred (1,500)~~ square yards (~~1,250 square meters~~) each, for each mix to be used, in an area designated by the Engineer.
1. The test section ~~wi~~shall be placed using the same equipment, methods, and mixes as scheduled for use on the Contract.
 2. At these test sections, the Contractor ~~must~~shall also satisfactorily demonstrate the equipment and procedure intended for the removal of oil deposits from the pavement surface.
 3. The test sections will be evaluated for a minimum of ~~three (3)~~ days after placement under traffic and normal usage.
 4. If a test section proves to be unsatisfactory, the necessary adjustments to the mix design, equipment, and ~~or~~ placement methods shall be made.
 5. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications.
 6. The ~~two~~2 initial test sections, if acceptable, will be paid for at the contract unit price.
- D. When the test sections do not conform to the specification requirements, the slurry seal shall be removed at ~~the Contractor's expense~~no additional cost to the Contracting Agency.
1. No compensation will be made for reapplication or additional test sections required due to unsatisfactory work or material.
 2. Initiation of work on the project streets, shall not begin without the Engineer's approval of test sections.
- E. The equipment, tools, and machines needed in the performance of the work shall be provided by the Contractor, shall be subject to the approval of the Engineer, and shall be maintained in a satisfactory working condition at all times.
- F. ~~(a)~~ **Job Mix Design**:
1. No slurry or micro-surfacing mixture shall be placed until mix design(s) submitted by the Contractor have been approved by the Engineer.
 2. Sources of all materials shall be selected prior to the time when the mix design is prepared and the materials are required to be used in the work.

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3. The exact proportions used in the preparation of the slurry seal or micro-surfacing shall be determined by a testing laboratory, experienced in slurry seal and micro-surfacing mix design procedures, and approved by the Engineer.
 4. Mix design preparation shall conform to Section ~~703~~, "Bituminous Materials," and shall be at ~~the expense of the Contractor~~ no additional cost to the Contracting Agency.
 5. The approved mixture shall be homogenous, and sufficiently stable during the entire mixing and/spreading period so that:
 - a. ~~The~~ The emulsion does not break prematurely.
 - b. ~~There~~ There is no segregation of the fines from the ~~coarser~~ coarser aggregate, ~~and~~
 - c. ~~The~~ The liquid portion of the mix does not float to the surface.
 6. The amount and type of asphalt emulsion to be blended with aggregate shall be determined by the laboratory mix design.
 7. The set control additive shall be introduced into the slurry mix by an approved method that will ~~assure~~ ensure uniform distribution and proper control. The exact amount shall be determined by conditions in the field and indicated in the mix design.
 8. A minimum amount of water, added as specified by the Engineer, shall be used as necessary to obtain a workable and homogeneous mixture.
 9. The slurry mixture shall show no signs of uncoated aggregate or premature breaking of emulsion when applied to the pavement surface.
- G. ~~(b)~~ **Sampling and Testing:**
1. Suitably ~~e~~ e sized samples of aggregate, bituminous material, and mineral filler shall be submitted, when required by the Engineer, for approval not less than ~~ten~~ 10 days before the work starts. All samples of materials shall be supplied by the Contractor at ~~his expense~~ no additional cost to the Contracting Agency.
 2. All tests deemed necessary by the ~~Owner~~ Contracting Agency to determine conformance with requirements specified shall be performed without cost to the Contractor.
 3. Additional samples of materials shall be furnished as directed by the Engineer during progress of the work.
 4. The aggregate manufacturer shall produce and stockpile each specified gradation of aggregate in 500 ~~-ton~~ (450 metric ton) lots. The first lot of material shall be sampled and tested by the ~~Owner~~ Engineer.
 5. Certification of Lot ~~1~~ shall be based upon the averaged test values from ~~five~~ 5 samples.
 - a. The approved gradation of Lot ~~1~~ shall be the "job target gradation."
 - b. The stockpile tolerance identified in ~~sub~~ Section 705-03-07, "Aggregates for Bituminous Courses", shall be applied to this "job target gradation."
 6. Each successive lot of 500 tons ~~(450 metric tons)~~ shall be sampled and tested once.

- a. When the "job target ~~gradation~~" has been tested and accepted, the Contractor shall continuously manufacture the aggregate until the total estimated quantity is produced, tested, and accepted.
 - b. The ~~e~~C contractor shall not receive compensation for unused aggregate.
 - c. The approved lots of aggregate shall be stockpiled in a secured area, protected from contamination, and reserved for use on this contract.
7. If it is established that a satisfactory mixture meeting the requirements specified herein cannot be produced from the materials furnished, the materials shall be rejected and the Contractor shall submit new samples.

412.03.02 PREPARATION OF SURFACE

- A. At least two weeks prior to cleaning and slurry sealing the streets, an application of Pramitol 25E herbicide as distributed by Universal Cooperatives, Inc., Minneapolis, MN 55440, or an equal product as approved by the Engineer, shall be applied to all vegetation within the limits of curb flow line to curb flow line.
 1. At the direction of the Engineer, multiple applications of herbicide may be required to ensure complete kill of vegetation.
 2. No additional compensation will be made for multiple applications of herbicide.
 3. Extreme care shall be used when placing the herbicide to ~~insure~~ensure that it is not allowed to go beyond the intended limits.
 4. The Contractor shall be responsible for ~~any necessary~~licenses required ~~or~~and for damage to any plant or animal ~~which is~~caused by the Contractor's operations.
- B. Immediately prior to applying the slurry seal, the existing pavement surface shall be cleaned of all silt deposits, oil spots, vegetation, and all loose or objectionable material.
- C. At the direction of the Engineer, if the pavement cracks have not been previously sealed, the loose material in cracks shall be removed as follows:
 1. ~~by the use of c~~Compressed ~~a~~Air: ~~ninety (90) pounds per square inchpsi (620 kilopascals)~~ at the nozzle immediately before sweeping or vacuuming operations.
 2. ~~, or by use of p~~Pressurized ~~W~~water: ~~at n~~Not greater than ~~one thousand (1,000) pounds per square inchpsi (6.9 Megapascals)~~ at the nozzle prior to ~~the~~sweeping or vacuuming operations. ~~If pressurized water is used, t~~The cracks may be damp but shall not have freestanding water in the crack.
 3. All surface debris from the crack cleaning process shall be thoroughly cleaned prior to placement of slurry seal. Payment for crack cleaning shall be by force account.
 4. In urban areas, the surface shall be cleaned with a self-propelled pick-up sweeper. In rural areas, power brooms may be used.
 5. Water flushing will be permitted by approval of the Engineer when normal sweeping will not adequately remove debris from the surface. If water flushing is approved, the pavement ~~will~~shall be dry before the slurry seal is applied.
- D. Areas impregnated with grease, oil, or fuel shall be cleaned by grinding.
 1. Traffic paint not tightly bonded to the surface and any thermoplastic markings shall also be removed.
 2. The grinding machine used to remove the existing bituminous surface, paint, and pavement markings shall meet the following requirements:

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- a. ~~b~~Be a hydrostatically powered mandrel type device.
 - b. The mandrel shall be studded with a minimum of 72 ~~_~~ cutter bits to provide a pavement texture acceptable to the Engineer.
 - c. Bits shall have tungsten carbide tips in forged steel holders and be conical in shape.
 - d. The mandrel device shall have a minimum cutting width of ~~twenty-four (24)~~ _ inches ~~(600 millimeters)~~ and a variable cutting depth of zero ~~to four (0 to 4)~~ _ inches ~~(0-100 millimeters)~~.
3. Areas inaccessible to the grinder ~~wi~~shall be treated and prepared with an alternate method approved by the Engineer.
 4. The debris produced by the grinding machine or other method shall be immediately removed from the pavement surface and disposed of at an acceptable location.
 5. ~~It shall be the responsibility of t~~The Contractor t~~eshall~~ shall protect existing facilities (i.e., concrete, valve boxes, manholes, ~~etc.~~and so forth).
 6. Damaged facilities shall be replaced ~~at the Contractor's expense~~ at the direction of the Engineer and at no additional cost to the Contracting Agency.
- E. The Engineer shall give final approval that the surface has been properly prepared; prior to the application of the slurry. ~~;~~ ~~_~~t~~his~~ approval shall not relieve the Contractor from responsibility as outlined above.
- F. Prior to application of the slurry or ~~micro-surfacing~~, manholes, valve boxes, drop inlets, and other service entrances shall be protected by covering with paper, plastic, or other suitable material approved by the Engineer. The paper shall be held in place with spray glue or tape and removed within ~~twenty-four~~ 24 hours after slurry seal has cured.
- G. Raised pavement markers not scheduled for reinstallation shall be covered, washed off, or protected from the slurry by a method approved by the Engineer.

412.03.03 MIXING UNIT

- A. The slurry seal or micro-surfacing shall be mixed and applied with a machine designed and manufactured to lay the mixture.
- B. Self-loading mixing units shall not be used on roadway right-of-way widths of ~~sixty (60)~~ _ feet ~~(18 meters)~~ or less.
- C. The ~~mixing~~ machine shall meet the following requirements:
 1. ~~be a~~A continuous flow mixing unit, automatically sequenced, ~~and~~
 2. ~~e~~Capable of delivering accurately predetermined proportions of aggregate, water, and asphalt emulsion to a revolving ~~multi-blade, double-shafted, spiraled mixer tank,~~ ~~and~~
 3. Capable of discharging the thoroughly mixed product on a continuous basis.
 4. ~~The machine shall be e~~Equipped with a hydraulically controlled steel pugmill gate for positive discharge operations. Discharge from the pugmill shall be controlled by a chute or other suitable mechanical device.
 5. ~~The mixing unit shall be e~~Equipped with a metering system to accurately meter all liquids by volume by the use of flow meters reading gallons per minute ~~(liters per~~

- ~~second~~). The flow of the liquids shall be consistent and precise and feed into the pugmill in the proportions outlined in the mix design.
6. ~~The machine shall be e~~Equipped with a temperature-~~i~~ndicating device installed in the emulsion tank at the emulsion pump suction line level.
 7. ~~The mixing unit shall be c~~Capable of thoroughly blending all ingredients together without violent action.
 8. ~~The mixing machine shall be e~~Equipped with an approved fines feeder that provides an accurate metering device or method of introducing a predetermined proportion of mineral filler into the mixer as the aggregate is fed in. The fines feeder shall be used when mineral filler is part of the aggregate blend.
 9. ~~The mixing machine shall be e~~Equipped with a water pressure system and fog type spray-~~_~~bar.
 10. ~~The machine shall be c~~Capable of mixing materials at pre-~~s~~et proportions regardless of the speed of machine and without changing machine settings.
- D. Each mixing unit to be used in performance of the work shall be calibrated prior to construction.
1. Previous calibration documentation covering the exact materials to be used may be accepted provided they were made during the current calendar year.
 2. The documentation shall include an individual calibration ~~of for~~ each type of material ~~of various settings which can be related to the machine metering device(s) to be used on the project.~~
- E. The Contractor shall ensure that all equipment used to transport materials and mixing units on public roadways ~~are in conformance comply~~ with Nevada Revised Statutes Sections-~~_~~484.764 through 484.771. If special use permits are required, the Contractor shall provide the ~~Owner~~Engineer with copies.
- F. **Slurry Seal Spreader ~~b~~Box:**
1. The ~~S~~lurry ~~S~~seal shall be spread with a box specifically designed to place ~~S~~lurry ~~S~~seal.
 2. The mixture shall be spread uniformly by means of a conventional slurry seal surfacing spreader box attached to the mixer.
 3. Front, rear, ~~_~~ and side seals shall be provided to ~~insure~~ensure no loss of the mixture at the pavement contact point. The rear seal shall be provided to act as a final strike-off and shall be adjustable.
 4. The spreader box and rear strike-off shall be so designed and operated that a uniform consistency is achieved to produce a free flow of material to the rear strike-off.
 5. Augers within the box may ~~_~~be required due the consistency of the material and ~~/or~~ the pavement slope. The spreader box shall have suitable means provided to side shift the box to compensate for variations in the pavement geometry.
 6. A burlap drag or other approved material shall be attached to the rear of the spreader box to provide a uniform, highly textured mat. If used, the burlap drag shall be clean, flexible, and not leave drag or scour marks in the finished slurry seal surface.
 7. The spreader box shall be kept clean and build-~~u~~p of asphalt and aggregate on the box shall not be permitted.

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~~8. If a burlap drag is used, it shall be clean, flexible, and not leave drag or scour marks in the finished slurry seal surface.~~

G. **Micro-surfacing Spreader Box:**

1. The micro-surfacing shall be placed with a spreader box specifically designed to place micro-surfacing. Conventional slurry seal boxes will not be allowed to spread micro-surfacing.
2. Attached to the mixer machine shall be a mechanical spreader box capable of placing the micro-surfacing at a minimum width of ~~twelve (12)~~ feet (~~3.7 meters~~) and ~~shall prevent~~ the loss of micro-surfacing materials from the box.
3. The spreader box shall have baffles, reversible hydraulic motor driven augers, or paddles to ~~insure~~ ensure uniform application on super-elevated sections and shoulder slopes.
4. The mixture shall be agitated and spread uniformly within the spreader box by means of twin shafted paddles or spiral augers fixed within the spreader box.
5. Spreader box skids shall be a minimum of ~~six (6)~~ feet (~~1.8 meters~~) in length and maintained in such a manner as to prevent chatter (wash-boarding of the surface) in the finished mat.
6. The spreader box shall have suitable means provided to side shift the box to compensate for variations in the pavement geometry.
7. The spreader box shall have a series of strike-off devices at the rear of the box:
 - a. The leading strike-off device shall ~~be~~ meet the following requirements:
 - 1) ~~f~~ Fabricated of steel, stiff rubber, or other suitable material.
 - 2) ~~The first strike-off shall be d~~ Designed to maintain close contact with the pavement during spreading operations.
 - 3) ~~s~~ Shall obtain the uniform thickness required, ~~and~~
 - 4) ~~s~~ Shall be capable of being adjusted to the various pavement cross sections for the application of a uniform micro-surfacing finished surface.
 - b. The final strike-off device shall ~~be~~ meet the following requirements:
 - 1) ~~f~~ Fabricated of flexible material suitable for the intended use, ~~and~~
 - 2) ~~s~~ Shall be designed and operated to ensure that a uniform texture is achieved in the finished surface of the micro-surfacing.
 - 3) ~~The final strike-off s~~ Shall have the same type of adjustments as the spreader box.
8. The final strike-off shall be cleaned daily and changed if problems with longitudinal drag marks or scouring occur.
9. The spreader box shall be kept clean and build-up of asphalt and aggregate on the box shall not be ~~permitted~~.

H. **Rut Filling Box:**

1. When required in the specifications, before the final surface course is placed with the spreader box, preliminary micro-surfacing may be required to fill ruts, utility cuts, depressions in the existing surface, ~~etc~~ and so forth.

2. Ruts of ~~one-half (2)~~ 1/2 inch (~~13 millimeters~~) or greater in depth shall be filled independently with a ~~rut-rut~~-filling spreader box, either ~~five (5)~~ foot ~~feet~~ or ~~six (6)~~ foot ~~feet~~ (~~1.5 or 1.8 meters~~) in width.
3. For irregular or shallow rutting of less than ~~one-half (2)~~ 1/2 inch (~~13 millimeters~~) in depth, a full-width scratch-coat pass may be used as directed by the Engineer.
4. Ruts that are in excess of ~~one and one-half (12)~~ 1-1/2 inches (~~20 millimeters~~) in depth may require multiple placements with the rut-filling spreader box to restore the cross-section.
5. All rut-filling level-up material ~~should~~shall cure under traffic for at least a ~~twenty-four (24)~~ hour period before additional material is placed on top of the level-up course.
6. The spreader box shall be kept clean and build-up of asphalt and aggregate on the box shall not be permitted.

412.03.04 MIX PREPARATION

- A. The Contractor shall ensure that all oversized aggregate particles and other objectionable matter is removed from the mineral aggregate utilized in the slurry mix.
- B. At the direction of the Engineer, the aggregate shall be screened prior to loading into the mixing unit.
 1. Type I and II gradations shall be screened through a ~~three-eighths (3/8)~~ 1/2-inch (~~10 millimeter~~) screen.
 2. Type III gradation shall be screened through a ~~one-half (2)~~ 1/2-inch (~~13 millimeter~~) screen.
 3. With the approval of the Engineer, temporary use of screens attached to the distributor box will be permitted.
- C. The aggregate shall be moistened immediately prior to mixing with the emulsion.

412.03.05 WATER FOG

- A. Immediately prior to application of the slurry seal, the surface of the pavement and all crack faces shall be moistened with a fog spray of water, applied at the rate of 0.02 to 0.05 gallon per square yard (~~0.09 to 0.25 liter per square meter~~) from the spray bar on the slurry seal machine.
- B. No free water shall be on the surface of the pavement following the fog spray.
- C. Rate of application of the fog spray shall be adjusted during the day to suit pavement temperatures, surface texture, humidity, and dryness of pavement surface.

412.03.06 APPLICATION

- A. Sufficient quantities of the slurry seal or micro-surfacing mixture shall be fed into the spreader box ~~such~~ that uniform and complete coverage of the pavement is obtained.
- B. The mixing ~~machine~~ shall be operated at such a speed that the mixture in the spreader box shall not exceed a total mixing time of ~~four (4)~~ minutes and the volume shall remain essentially constant.
- C. The slurry seal shall be placed in accordance with the following: ~~at a rate of eight to twelve (8 to 12) pounds of aggregate per square yard (3.6 to 5.5 kilograms per square meter) of Type I aggregate, twelve to twenty (12 to 20) pounds of aggregate per square yard (5.5~~

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~~to 9 kilograms per square meter) for Type II aggregate, and eighteen to thirty (18 to 30) pounds of aggregate per square yard (8.2 to 14 kilograms per square meter) for Type III aggregate.~~

<u>Aggregate</u>	<u>Application Rate</u> (pounds per square yard)
<u>Type I</u>	<u>8-12</u>
<u>Type II</u>	<u>12-20</u>
<u>Type III</u>	<u>18-30</u>

- D. The application rate shall be adjusted for the surface texture of the pavement to ensure effective embedment of the aggregate and the durability of the surface treatment.
- E. The Contractor shall submit ~~at the following~~ signed, written reports to the Engineer each working day:
1. A report indicating the amount of aggregate and emulsion delivered, aggregate and emulsion used on the project, and the amount of area in square yards completed.
 2. ~~A In order to comply with and verify the mixture of materials to the mix design and the specified aggregate application rate, the Contractor shall submit a signed written report to the Engineer each working day~~ report indicating the percentage of emulsion used to aggregate used, and the application rate in pounds of aggregate applied per square yard (~~kilograms per square meter~~) of area covered. This report will verify compliance with the mixture of materials to the mix design and the specified aggregate application rate.
- F. The ~~C~~ contractor shall submit to the Engineer from the aggregate and emulsion suppliers an original copy of the ~~B~~ bill of ~~L~~ lading daily for each delivery of material to be used on the project. The ~~e~~ Contractor shall submit with each emulsion bill of lading a certificate of compliance from the emulsion supplier verifying that each delivery of emulsion is in compliance with the contract requirements.
- G. If uniform thickness cannot be met with one application due to irregularities in pavement surface, multiple applications shall be made.
1. Where multiple applications are required, as determined by the Engineer, each application shall be thoroughly cured before another application is placed.
 2. Any additional applications will be paid at the unit price bid.
- H. No streaks caused by oversized aggregate particles or buildup of slurry mix on squeegees shall be left in the finished surface.

412.03.07 JOINTS

- A. The longitudinal joint between adjacent lanes shall have no visible lap, pinholes, or uncovered areas.
- B. Thick spots caused by overlapping shall be smoothed immediately with hand squeegees before the emulsion breaks.
- C. Overlaps ~~which that~~ occur at transverse joints shall also be smoothed before the emulsion breaks, ~~so that to obtain~~ a uniform surface ~~is obtained which contains~~ with no discontinuities.

412.03.08 PRODUCTION

- A. The Contractor shall average a minimum of ~~twenty thousand (20,000)~~ square yards (~~17,000 square meters~~) of material, in place, per working day for work within the public right-of-way.
- B. At the direction of the Engineer, parking lot applications, heavy application rates, and areas not feasible to close ~~the entire~~ ly ~~area~~ are excluded from the required production rate.

412.03.09 LINES

- A. Care shall be taken to ~~insure~~ ensure straight lines along curbs and shoulders.
- B. No runoff on these areas will be permitted.
- C. Lines at intersections shall be kept straight to provide a good appearance.

412.03.10 HANDWORK

- A. Approved hand squeegees, with burlap drags, shall be used to spread slurry in areas not accessible to the slurry spreader box.
- B. Care shall be exercised in leaving no unsightly appearance from ~~and work~~ handwork.

412.03.11 CURING

- A. Areas receiving slurry seal will be allowed to cure from ~~four (4)~~ to ~~twenty-four (24)~~ hours or until the treated pavement will not be damaged by traffic.
- B. Areas receiving micro-surfacing shall be sufficiently cured to be open to traffic within ~~one (1)~~ hour.
- C. The Contractor ~~will~~ shall protect the area for the full curing period with suitable barricades or markers.
- D. Areas ~~which~~ that are damaged within ~~twenty-four (24)~~ hours of application of slurry or prior to moving to new work locations shall be repaired by the Contractor at ~~his expense~~ no additional cost to the Contracting Agency.

412.03.12 ROLLING

- A. Slurry seal placed on parking lots, alleys, or low traffic volume areas as determined by the Engineer shall be compacted with a smooth pneumatic tire roller, with a minimum weight of ~~four (4)~~ tons (~~3.6 metric tons~~).
- B. The roller shall be equipped with a water tank and a sprinkler apparatus which shall be used to keep the wheels damp and to prevent the adherence of slurry seal on the wheels during the rolling process.
- C. Steel wheel rollers may be used in a supplementary capacity when approved by the Engineer.
- D. Rolling shall start when the slurry seal/micro-surfacing has set sufficiently to prevent any pick-up of material and rolled a minimum of ~~three~~ 3 coverages by the roller or until a uniform surface is obtained.

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412.03.13 WEATHER LIMITATIONS

- A. Slurry seal or micro-surfacing shall be applied only when the atmospheric temperature is ~~sixty-five (65) degrees F. (18 degrees C.)~~ and rising and when the temperature is not expected to fall below ~~sixty (60) degrees F. (16 degrees C.)~~ during working hours.
- B. Application of slurry seal or micro-surfacing when the atmospheric temperatures are expected to exceed ~~one hundred five (105) degrees F. (40 degrees C.)~~ will not be allowed.
- C. The maximum and minimum temperatures may be adjusted by the Engineer.
- D. High relative humidity or overcast conditions causing prolonged cure times or undesirable color shall be cause for stopping the work.

412.03.14 MAINTAINING TRAFFIC

- A. The seal coat shall be applied to alternating streets to provide sufficient public parking for those residents living on streets ~~which~~that have been closed.
 - 1. Traffic will not be allowed on the newly placed bituminous material until, in the opinion of the Engineer, the bituminous material has sufficiently set and bonded to prevent damage by vehicular traffic.
 - 2. Areas ~~which~~that are subject to an increased rate of sharp turning vehicles may require additional time to allow for a more complete cure of the slurry seal mat to prevent damage.
 - 3. Street closures shall be opened as soon as the material has sufficiently set and bonded.
- B. The eContractor shall cooperate with and give written notice to all emergency agencies, public entities, each home, homeowners' association, business, and school that will be affected by any part of the construction process, particularly concerning temporary interruptions to vehicular access. To accomplish the notification process, the eContractor shall provide a minimum of ~~two~~2 notifications:
 - 1. The first written notice of the approximate schedule and explanation of the work process shall be distributed at least ~~seven (7)~~ days prior to the commencement of work in the area.
 - 2. A second written notice shall be distributed at least ~~twenty-four (24)~~ hours prior to construction to remind all affected parties of the construction to take place.
- C. The eContractor shall employ a qualified traffic control supervisor to be ~~on~~on-site locally at all times when traffic control devices are being used or when notifications have been sent out.

412.03.15 TRAFFIC MARKINGS

- A. Prior to removal of street closure barricading, all raised pavement markers shall be exposed.
- B. Temporary reflective polyurethane plastic marker tabs shall be installed prior to the application of slurry seal on streets where permanent markings are scheduled for replacement.
- C. Temporary traffic markings shall comply with Section 6, "Temporary Traffic Control", of the MUTCD.

412.03.16 STORAGE OF EQUIPMENT AND MATERIALS

- A. Materials shall be stored in an area to prevent water saturation and contamination of stockpiled aggregates.
- B. Written authorization to use private property to store equipment and materials shall be obtained from the property owner and submitted prior to mobilization and use. The Contractor shall also submit a letter of indemnification to the ~~Owner~~Contracting Agency and the property owner.

412.03.17 CLEANUP

- A. All material swept or blown onto the sidewalks, all trash, all discarded slurry seal material, ~~or and~~ other refuse shall be collected on a daily basis, removed from the site, and disposed of to a site approved by the Engineer.
- B. All applied slurry seal/micro-surfacing surfaces shall be swept by the Contractor with an approved sweeper to remove any excess raveled material ~~which~~that becomes dislodged from the street surface after ~~five (5)~~ days.
 - 1. Dislodged material from the street shall be disposed of to a site approved by the Engineer.
 - 2. Sweeping required beyond the initial ~~five (5)~~ days cure, due to "normal raveling" shall be paid for under the appropriate bid item for sweeping.

412.03.18 CONTRACTOR'S RESPONSIBILITY TO THE PUBLIC

- A. The Contractor ~~is~~shall be responsible ~~for~~for answering and resolving any conflicts that may arise between a homeowner or business owner and ~~himself~~the Contractor during the construction process.

04 METHOD OF MEASUREMENT**412.04.01 MEASUREMENT**

- A. The quantity of slurry seal or micro-surfacing measured for payment will be the number of square yards ~~(square meters)~~ of Type-I, Type-II, or Type-III material applied and conforming to all the requirements of the completed work.
- B. Surface preparation prior to the application of slurry seal or micro-surfacing shall be the number of hours spent performing grinding operations.
- C. Ravel sweeping, including disposal of excess material, shall be based on the number of hours spent sweeping at the direction of the Engineer.
- D. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

05 BASIS OF PAYMENT**412.05.01 PAYMENT**

- A. Payment at the unit price bid for the accepted quantity of slurry seal or micro-surfacing measured as provided in Subsection ~~408-12.04.01~~12.04.01, "Measurement," shall be full compensation for developing the mix design, furnishing the material, mixing, hauling, loading, placing, rolling, and any incidentals for doing all the work involved in placing the material.

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- B. Payment at the unit prices bid for surface preparation and ravel sweeping shall be full compensation for all work involved to complete the items.
- C. Payment at the unit price bid for the addition of carbon black to the slurry seal or micro-surfacing mixture shall be full compensation for all work involved in its use.
- D. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- E. Payment will be made under:

PAY ITEM	PAY UNIT
Application of Polymer Modified Type I, II, or III Slurry Seal	Square Yard (Square Meter)
Application of Type III Micro- <u>s</u> urfacing	Square Yard (Square Meter)
Surface Grinding	Hour
Ravel Sweeping	Hour
Carbon Black Additive (optional)	Gallon (Liter)

SECTION 413**PLANTMIX BITUMINOUS GAP-GRADED SURFACE**

DESCRIPTION

413.01.01 GENERAL

- A. This work shall consist of placing a gap-graded wearing course, bonded to the surface, in accordance with these specifications and in conformity with the lines, grades, thickness, and the typical cross sections shown on the plans or established by the Engineer.
- B. The bonded wearing course shall consist of an application of a warm polymer modified asphalt emulsion to create a polymer modified membrane (PMM) followed immediately with a hot gap-graded ultra-thin asphalt concrete surface course (UTACS).
- C. This work shall not be started until the Contractor has completed all heavy equipment work or any other work that could scar or mar the finished gap-graded surface.
- D. The requirements of Section 401, "Plantmix Bituminous Pavements – General," shall be applicable to this work, except as hereinafter specified.

413.01.02 REFERENCE CODES AND STANDARDS

~~(a) Uniform Standard Specifications for Public Works' Construction Off-site Improvements, Clark County Area, Nevada that will henceforth be referred to as "US" Specifications and Drawings~~

~~(b) Contract Special Provisions and Drawings~~

~~(c) NRS 338.176, NAC 625.550~~

~~(d) Most current ASTM, AASHTO, or NDOT test procedures~~

- A. ~~(e)~~ Related Interagency Quality Assurance Committee (IQAC) procedures at:

www.accessclarkcounty.com/pubworks/iqac/IQAC.htm

413.01.03 REQUIREMENTS

- A. Persons involved with the placement of UTACS shall be trained by the manufacturer and/or the Nevada T2 Program.

MATERIALS

413.02.01 GENERAL MATERIALS

- A. The materials shall conform to ~~the requirements as specified in~~ Subsections 401.02.01, ~~"Plantmix Bituminous General~~ Composition of Mixtures," with the following exceptions: ~~detailed in Subsections 403-2.02.01 "Certification".~~
 1. Prior to starting work, the Contractor shall submit a proposed job-mix formula in writing for review and approval by the Engineer.
 2. The proposed job-mix formula shall be determined by an AASHTO Certified testing laboratory, using Nevada Alliance for Quality Transportation Construction (NAQTC) certified technicians, based on the tests required to determine the gradation and surface capacity for coarse aggregate.

3. The gradation shall be ~~†Type "S1", "S2", or "S3" as per in accordance with~~ Subsection ~~705.03.0208~~, ~~"Plantmix and Roadmix Asphalt Concrete Surface Course UTACS Type S1 through S3."~~ and the contract ~~Sspecial Pprovisions.~~
4. The bituminous materials shall be ~~"PG76-22CC" as per in accordance with~~ Section ~~703.03.02, "Asphalt Cements."~~

413.02.02 COMPOSITION OF GAP-GRADED (UTACS) MIXTURE

- A. The plantmix gap-graded Ultra-Thin Asphalt Concrete Surface (UTACS) mixture shall be composed of aggregates and bituminous materials as described in these specifications. The criteria for the design is based on Subsection ~~403-213.02.01~~, "General Materials," ~~above~~ and the following:
 1. ~~a) Film Thickness, (µm):~~
 - a. Gradation surface area factor using the ~~F~~ilm thickness calculation based on effective asphalt content and aggregate surface area according to Asphalt Institute MS-2 ~~table-Table~~ 6.1.
 - b. The minimum film thickness shall be 10 µm.
 2. ~~b) Specimens for AASHTO T-283 testing are to shall~~ be compacted using the Superpave gyratory compactor applying ~~one hundred (100)~~ gyrations or using the Marshall compactor applying ~~fifty (50)~~ blows on each side of the ~~four (4-inch)~~ diameter sample.
 - a. Use mix quantity necessary to obtain compacted samples 2.5 ~~inches~~ ±0.05 inch in height.
 - b. Further test compacted samples regardless of air void levels achieved after ~~one hundred (100)~~ gyrations or ~~fifty (50)~~ blows on each side.
 - c. Apply vacuum to samples to be conditioned for ~~twenty (20)~~ seconds and proceed without calculating percent saturation.
 - d. Mixing and compaction temperatures are to be recommended by the binder supplier.
 - e. The minimum ~~M~~oisture ~~S~~usceptibility shall be ~~eighty (80)~~ percent retained strength.
 3. ~~e) The minimum air voids shall be four (4) percent and the maximum aggregate surface shall be twenty six (26) square feet per lb pound.~~
 4. ~~d) Marshall S~~tabilities are not required.
 5. ~~e) Gradation shall be per in accordance with~~ Subsection 705.03.08, ~~"Ultra Thin Asphalt Concrete Surface Plantmix and Roadmix Asphalt Concrete Surface Course UTACS Type S1 through S3" (UTACS)~~ of Section 705, ~~"Aggregates for Bituminous Courses."~~
 6. ~~f) The binder type shall be PG76-22CC as described in Section 703, "Bituminous Materials."~~

413.02.03 POLYMER MODIFIED MEMBRANE

- A. The UTACS pavement shall consist of an application of a warm polymer modified membrane (PMM) asphalt emulsion, as specified under Section 703, ~~"Bituminous~~

PLANTMIX BITUMINOUS GAP-GRADED SURFACE

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- Materials" followed immediately with an ultra-thin surface course of quality hot mix asphalt concrete.
- B. The PMM emulsion shall be sprayed immediately prior to the application of the surface course so that no wheel or other part of the paving machine ~~shall come~~ in contact with the PMM before the surface course is applied.
- C. The process of applying the PMM, placement of the surface course, and screed compacting shall be performed in under ~~five (5.)~~ seconds during normal paving speeds, resulting in a homogeneous surface that can be opened to traffic immediately upon sufficient cooling ~~to (160° degrees F or below).~~
- D. The PMM target design application rate shall be ~~as per~~ in accordance with Table 1. The PMM application rates shall be adjusted in the field to account for the texture of the existing pavement, ~~and~~ traffic, and project uniqueness.

TABLE 1 – PMM APPLICATION RATES

Gradation Type	Application Rate
S1	0.13 gal/sq yd
S2	0.15 gal/sq yd
S3	0.17 gal/sq yd

CONSTRUCTION

413.03.01 GENERAL CONSTRUCTION

- A. The construction ~~requirements~~ shall conform to ~~the requirements as specified in~~ Subsections ~~401.03.01, "Bituminous Mixing Plant," through Subsection 401.03.1516,~~ "Surfacing Miscellaneous Areas," ~~inclusive of Section 401, "Plantmix Bituminous Pavements – General,"~~ with the exceptions ~~contained in the following subsections~~ below.

413.03.02 GAP-GRADED UTACS PAVING EQUIPMENT

- A. The Contractor shall use a self-priming paver, designed and built for the purpose of applying the PMM bond and the UTACS pavement.
- All other equipment and tools shall be approved by the Engineer.
 - All equipment and tools shall be maintained in satisfactory working condition at all times.
- B. The self-priming machine shall meet the following requirements:
- ~~b~~Be capable of spraying the PMM emulsion, applying the surface ~~coarse course~~ overlay, and providing a smooth surface to the mat in ~~one~~ 1 pass at the rate of 35.5 to 92 feet/minute ~~ten (10.) to thirty (30.) meters/minutes (35.5 to 92 ft/min).~~
 - ~~The self-priming paving machine s~~shall incorporate a receiving hopper, feed conveyor, insulated storage tank for PMM emulsion, electronic device to determine rate of emulsion application, metered PMM emulsion system, spray bar, and variable width.
 - The integrated distributor-paver shall be equipped with a full-width, heated vibratory screed that can spread and finish the bonded wearing course to the required cross section and grade that produces a uniformly finished surface free from tearing or other blemishes.

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- C. At all times during paving, the sump pump for excess spray bar emulsion shall be operating as indicated by the required warning light to prevent overflow of the tray. The screed shall have the ability to be crowned at the center, both positively and negatively, and have vertically adjustable extensions to accommodate the desired pavement profile.
- D. The PMM shall be applied in accordance with the following:
1. ~~by~~ With a mechanical pressure spray bar.
 2. ~~W~~The application rate shall be applied within a tolerance of 0.018 gallon per square yard ~~of the application rate (0.08 liter/square meter)~~.
 3. ~~The PMM shall be applied a~~At a uniform rate for the full paving width.
- E. ~~a)~~ Rollers:
1. Rolling of the wearing course shall consist of a minimum of ~~two~~ 2 passes with a steel double drum asphalt roller of minimum weight of ~~ten (10) metric~~ tons, before the material temperature has fallen below 185° degrees F.
 2. At no time shall the roller or rollers be allowed to remain stationary on the freshly placed asphalt concrete.
 3. Rolling shall immediately follow the placement of the UTACS with ~~an~~ approved asphalt roller ~~(s)~~.
 4. Rollers shall be monitored to ensure the rollers are not picking up material and that the setting process is completed while the mat is above 185° degrees F.
 5. Roller ~~(s)~~ shall be well maintained, in reliable operating condition and be equipped with functioning water system and scrapers to prevent adhesion of the fresh mix onto the roller drums.
 6. Adequate roller units shall be supplied so the rolling will be accomplished promptly following the placement of the material.
 7. A release agent (added to the water system) may be required to prevent adhesion of the fresh mix to the roller drum and wheels.
 8. Rolling shall normally be done in the static mode.
- F. Sweepers: The Contractor shall have a minimum of ~~one (1)~~ approved sweeper available at all times during the construction of the surface course to pick up loose material.
- G. Material Transfer Vehicle (MTV): ~~An Material-Transfer-Vehicle (MTV)~~ shall be used when placing UTACS, and shall meet the following requirements:-
1. ~~The MTV shall have the ability~~ Able to remix the UTACS mixture to eliminate truck end segregation, minimize material temperature loss, and deliver a uniform mixture to the paver.
 2. ~~The MTV shall be a s~~ Self-propelled machine totally independent of the paver.
 3. ~~The MTV shall have a h~~ High-capacity truck unloading system to receive UTACS mix from the haul units.
 4. ~~The MTV shall have a m~~ Minimum ~~twenty five (25)~~ ton surge capacity to minimize paver start/stops and maximize trucking efficiency.
 5. ~~The MTV shall be e~~ Equipped with a pivoting paver loading conveyor able to swing ~~fifty five (55)~~ degrees to either side to allow off-lane paving.

413.03.03 APPLICATION OF GAP-GRADED UTACS SURFACE
~~The performance of the UTACS pavement is directly dependent on the two key components: the proper application of the PMM and the use of a self-priming paver, designed and built for the purpose of applying the UTACS pavement.~~

- A. The UTACS pavement shall not be placed on a wet pavement. The pavement surface temperature shall not be less than 50° degrees F (~~10° C~~) and the ambient temperature shall not be less than 50° degrees F (~~10° C~~) and rising.
- B. The PMM shall be sprayed by a metered mechanical pressure spray bar at a temperature of 140° degrees F — 180° degrees F (~~60° — 80° C~~).
1. The sprayer shall accurately and continuously monitor the rate of spray and provide a uniform application across the entire width to be overlaid.
 2. The machine will be equipped with an electronic device by which the rate of emulsion application can be determined while the paver is in operation.
 3. The PMM shall be applied manually where the screed extension or handwork is required outside the range of the machine mounted spray bar.
 4. Over-application or double application of emulsion on the existing base shall not be permitted.
 5. The mix design target PMM shot rate shall be adjusted based upon the existing pavement surface conditions, traffic, and project uniqueness, with the approval of the Engineer.
 6. The PMM ~~field field-~~adjusted shot rate shall be reduced by 0.03 gallon/square yard within ~~one hundred and fifty (150)~~ feet of the intersection, to minimize the risk of flushing under the action of standing and slow moving traffic, unless a full-width mill transition has been specified in the plans.
 7. The Contractor and Engineer shall establish an acceptable range for the spray rate.
 8. The PMM shall have a minimum of ~~two-2~~ daily yield verifications to be reported to the ~~engineer~~ Engineer, ~~one-1~~ at midway production and ~~one-1~~ at the end of production.
 9. These reports shall be the sum of the rates documented each ~~one hundred (100)~~ linear foot by the Contractor QC Inspector.
- C. The PMM application rate ~~can may~~ be adjusted as directed by the Engineer based on the texture depth of the existing pavement measured according to ASTM ~~-E965~~ :" Measuring Surface Pavement Macro-texture Depth Using a "Volumetric Technique." Suggestions to adjust the PMM application rate as a function of texture depth of the existing pavement are shown in Table 2.
- D. No wheel or other part of the paving machine shall come in contact with the PMM before the ~~S~~ surface ~~C~~ course is applied. Contractor shall use P ~~placement operations or and~~ equipment ~~which that~~:
1. ~~do not k~~ Keep surfaces clean and free of contamination ~~or and~~ debris prior to placement of the polymer modified asphalt emulsion membrane.
 2. ~~or do not p~~ Prevent tracking through the polymer modified asphalt emulsion membrane prior to placement of the gap-graded polymer modified asphalt concrete ~~shall not be used~~.

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- E. The surface course shall be applied at a temperature of 302^o ~~degrees F~~ – 330^o ~~degrees -F~~ (150 – 165^o ~~-C~~) and shall be spread over the PMM in ~~less than five (5)~~ seconds after the application of the PMM during normal paving speeds.

TABLE 2 – PMM RATE ADJUSTMENTS DUE TO PAVEMENT TEXTURE

Pavement Type - Texture Description	Texture Depth Range (mm)	PMM Rate Correction	
		l/m2	gal/yd2
Flushed asphalt	<0.5	-0.04 to -0.27	-0.01 to -0.06
Black asphalt	0.5 to 1.0	0	0
Smooth asphalt, non-porous	1.0 to 1.2	0	0
Absorbent A asphalt, S lightly porous, oxidized	1.2 to 1.7	0.09	0.02
Slightly pocked asphalt, porous, oxidized	1.7 to 2.0	0.18	0.04
Badly pocked asphalt, porous, oxidized	>2.0	0.27	0.06
Asphalt M milled S urface	N/A	0	0
Asphalt within 150 ft of intersection without mill	N/A	-0.13	-0.03
Asphalt within 150 ft of intersection with mill	N/A	0	0

- F. When filling the emulsion tank, no emulsion shall overflow into the paver hopper.
- Should emulsion be spilled into the paver hopper, paving shall stop and all contaminated material shall be removed from the paver hopper.
 - Under no circumstances shall the contaminated material be placed on the roadway.
- G. Overlapping or hot lapping of the bonded wearing course shall not be permitted when paving miscellaneous areas in order to achieve project layout requirements.
- H. ~~m~~Material that has been placed through the paving screed or over the polymer modified asphalt emulsion membrane shall not be reintroduced into the paving process.
- I. UTACS shall be applied at a thickness such that no aggregate is fractured.
- The S3 mix shall be applied at a minimum 3/4-~~inch~~" thickness.
 - The S2 mix shall be applied at a minimum 5/8-~~inch~~" thickness.
 - The S1 mix shall be applied at a minimum of 9/16-~~inch~~" thickness.

413.03.04 SURFACE PREPARATION FOR UTACS

- A. The following items ~~will~~-~~shall~~ be performed prior to the commencement of paving operations and paid for under the appropriate bid item numbers:
- Manhole covers, drains, grates, catch basins, and ~~other such~~similar utility structures shall be protected and covered with building felt prior to paving, and ~~shall~~ also ~~shall~~ be clearly referenced for location and adjustment after paving.
 - Thermoplastic traffic markings shall be removed.
 - Pavement cracks and joints greater than 0.25 inches wide shall be cleaned and filled using an approved material and method.
 - There shall be no over-banding of cracks which will be covered by UTACS.
 - Crack sealing ~~will~~-~~shall~~ be completed at least ~~seven~~-7 days prior to paving.

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4. Surface irregularities greater than ~~one (1)~~ inch deep shall be milled and/or filled with a material approved by the Engineer. All repairs shall be completed ~~one~~ 1 week prior to paving or as recommended by the sealant manufacturer or the Engineer.
5. The entire pavement surface to be overlaid shall be thoroughly cleaned, giving special attention to accumulated mud and debris. Pressurized water and/or vacuum systems may be required to ~~insure~~ ensure a clean surface.
6. Cold planing shall be completed as specified herein.

413.03.05 JOINTS

- A. Longitudinal joints shall be constructed only on the shoulders, or at the edge of the travel lanes.

413.03.06 QUALITY CONTROL ASPECTS

- A. PMM application rate shall be checked twice per day using random sample location techniques.
- B. Determination of the application rate of the PMM shall be as follows:
 1. At the location to be sampled, immediately adjacent to the paving area, use ~~two~~ 2 pads approximately 3.3 feet ~~(1 meter)~~ wide by 3.3 feet ~~(1 meter)~~ long to determine the PMM application rate based on the average of ~~two~~ 2 application rate measurements.
 2. Capture the tare weight of each pad to be used prior to capturing the PMM sample.
 3. Place the first pad ~~five~~ 5 feet in front of spray bar on the spray paver.
 4. Place the second pad in front of the first pad ~~further~~ farther away in the travel direction.
 5. Set the machine in automatic mode; do not use manual mode when calibrating emulsion application rate.
 6. Circulate the emulsion through the spray bars for approximately ~~five (5)~~ minutes before spray calibration in order to purge the system.
 7. Select the machine ground speed/production rate to be no less ~~then~~ than ~~thirty (30)~~ feet per minute.
 8. Select the desired emulsion application rate and take a sample at this setting.
 9. Weigh each pad that has been sprayed with the PMM.
 10. Calculate the net weight of emulsion and convert it into gallons using the PMM ~~weight-weight-per-per~~ gallon information provided by the emulsion manufacturer.
 11. Divide the gallons of PMM by the pad area and compare with the target application rate in gallon per square yard.
- C. A minimum of ~~three (3)~~ daily samples of the bituminous wearing course shall be tested for asphalt content and gradation.
 1. If the average of the daily test results vary from the job mix formula ~~(JMF)~~ by more than the tolerance ~~as~~ indicated in Subsection ~~705.03.08~~, "Plantmix and Roadmix Asphalt Concrete Surface Course UTACS Type S1 through Type S3," production ~~will~~ shall stop.

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2. The ~~e~~Contractor shall identify the cause and document what corrective action will be taken.
 3. The ~~JMF~~job-mix formula may be adjusted only as approved by the Engineer.
- D. A minimum of ~~two~~2 daily UTACS mixture yield checks shall be completed, ~~one~~1 at mid day during production and ~~one~~1 at the end of the day's production, to ensure that mixture application rate requirements defined in Subsection ~~4013.03.03~~, "~~Joists~~Application of Gap-Graded UTACS Surface." are met.
- E. Placement Limitations: The UTACS and/or PMM shall not be placed on pavement that has ~~any~~ visible surface moisture.
- F. The Contractor shall immediately cease operations if any precipitation occurs. If any material is placed during the precipitation event, such material shall be removed and replaced, as directed by the Engineer, at no additional cost to the ~~Owner~~Contracting Agency.
- G. Place UTACS and/or PMM only when the pavement surface temperature is 50°F and rising and the ambient temperature is 50°degrees F and rising.
- H. The UTACS shall not be placed if the forecast low from the National Weather Service is 32°degrees F or lower for the night following any single day's paving operation.
- I. Because of the minimal depth of the surface course being placed, ~~it~~the course may be damaged if opened to traffic too quickly. Therefore, the new UTACS pavement shall not be opened to traffic until the rolling operation is complete and the material has cooled sufficiently to resist damage (approximately 160°degrees F).
- J. No more than ~~fifteen (15)~~ minutes shall be allowed to elapse between the delivery trucks carrying the UTACS mix to the paver or ~~three (3)~~ cold joints per ~~one-half~~1/2 -mile. Cold joints are defined as when the last delivery truck leaves the paver, the paver has stopped more than ~~fifteen (15)~~ minutes before the next delivery truck is brought to the paver.

413.03.07 SURFACE TOLERANCES FOR UTACS

- A. The completed surfacing shall be thoroughly compacted, smooth, and free from ruts, humps, depressions, or irregularities.
1. Any ridges, indentations, or other objectionable marks left in the surface of the bituminous mixture by blading or other equipment shall be removed by rolling or other means.
 2. The use of equipment that leaves ridges, indentations, or other objectionable marks in the bituminous mixture shall be discontinued, and other acceptable equipment shall be furnished by the Contractor.
- B. The Contractor shall produce completed surfacing which meets the requirements of Subsections ~~402.03.03.D, "Profilograph Measurement," 02 "Spreading and Finishing" of the Uniform Standard Specifications~~ when required by the Contracting Agency, with the following additions and exceptions to the profilograph measurement:
1. The Contractor shall furnish and operate a profilograph, as specified ~~in Subsection 402.03.0403.01, "Profilograph Equipment Measurement" in the subsection noted above~~ at the time and date ordered by the Engineer.
 2. Any requirement for grinding shall have a depth selected so that at least ~~eighty (80)~~ percent of the original UTACS thickness is preserved in order to minimize the risk of localized bleeding.

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3. Liquidated damages may be assessed, as required by the ~~agency~~Contracting Agency, for each such high point that is allowed to remain in place.
4. The profile index requirements herein ~~will~~shall not apply to the pavement within ~~thirty (30)~~ feet of either end of a concrete bridge deck (including approach slabs). The finished surface of such pavement shall, however, meet all other requirements of this section.

413.03.08 UTACS PAVEMENT REPAIRS

- A. The Contactor shall pay all costs of UTACS pavement repair activities and ~~their~~ implementation, except as otherwise provided herein.
- B. The Contractor shall have the right to use such pavement repairs deemed necessary to bring the UTACS pavement up to the performance criteria established in Subsection ~~4013-2.03.07~~, "Surface Tolerances for UTACS."

METHOD OF MEASUREMENT

413.04.01 MEASUREMENT

- A. UTACS Pavement will be measured as specified in Subsection 401.04.01, "Measurement," or if the Contract Documents specify payment by area, the quantity of Plantmix Bituminous Surface to be measured for payment shall be the number of square yards ~~(square meters)~~, including the asphalt cement, used in the accepted work.

BASIS OF PAYMENT

413.05.01 PAYMENT

- A. The Ultra-Thin Asphalt Concrete Surface (UTACS) bonded with a polymer modified membrane (PMM) will be paid at the ~~contract~~Contract price bid per square yard, which ~~price~~ shall include all material, mixing, loading, hauling, placing, compacting, incidentals, and for all labor, tools, and equipment necessary to complete the work as shown on the plans, as specified herein, and as directed by the Engineer.
- B. All payments will be made in accordance with Subsection ~~109.0402~~, "Scope of Payment."
- C. Partial payments for UTACS may be made as set forth under Subsection 109.06, "Partial Payments."
- D. Payment will be made under:

Pay Item	Pay Unit
Construct UTACS bonded <u>Bonded</u> with a PMM, S1 gradation <u>Gradation</u>	Square Yard
Construct UTACS bonded <u>Bonded</u> with a PMM, S2 gradation <u>Gradation</u>	Square Yard
Construct UTACS bonded <u>Bonded</u> with a PMM, S3 gradation <u>Gradation</u>	Square Yard

SECTION 495

PRESTRESSING CAST-IN-PLACE CONCRETE

DESCRIPTION

495.01.01 GENERAL

- A. This work shall consist of prestressing ~~cast-in-place~~cast-in-place concrete by furnishing, placing, and tensioning of prestressing steel in accordance with details shown on the plans, and as specified ~~herein~~.
- B. This work shall include the furnishing and installation of ~~any~~ appurtenant items necessary for the particular prestressing system to be used, including but not limited to ducts, anchorage assemblies, and grout used for pressure grouting ducts.
- C. For prestressed ~~cast-in-place~~cast-in-place concrete, the term "member" as used in this section shall be considered to mean the concrete ~~which~~that is to be prestressed.

MATERIALS

495.02.01 GENERAL

- A. Prestressing steel shall conform to ~~the applicable requirements of~~ Section 713, "Reinforcement."
- B. Wires shall be straightened, if necessary, to produce equal stress in all wires or wire groups or parallel lay cables that are to be stressed simultaneously or when necessary to ~~ensure~~ ensure proper positioning in the ducts.
- C. Where wires are to be button headed, the buttons shall be cold formed symmetrically about the axis of the wires.
 - 1. The buttons shall develop the minimum guaranteed ultimate tensile strength of the wire.
 - 2. No cold forming process shall be used that causes indentations in the wire.
- D. All prestressing steel shall be protected against physical damage and rust or other results of corrosion at all times from manufacture to grouting or encasing in concrete.
 - 1. Prestressing steel that has sustained physical damage at any time shall be rejected.
 - 2. The development of visible rust or other results of corrosion shall be cause for rejection, when ordered by the Engineer.
- E. Prestressing steel shall be packaged in containers or shipping forms for the protection of the steel against physical damage and corrosion during shipping and storage.
 - 1. A corrosion inhibitor ~~which~~that prevents rust or other results of corrosion shall be placed in the package or form, or ~~shall be~~ incorporated in a corrosion inhibitor carrier type packaging material, or when permitted by the Engineer, ~~may be~~ applied directly to the steel.
 - 2. The corrosion inhibitor shall have no deleterious effect~~ion~~ on the steel or concrete or bond strength of steel to concrete.
 - 3. Packaging or forms damaged from any cause shall be immediately replaced or restored to original condition.

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PRESTRESSING CAST-IN-PLACE CONCRETE

- F. The shipping package or form shall be clearly marked with a statement that the package contains high strength prestressing steel; ~~and the care to be used in hauling;~~ ~~and the type, kind, and amount of corrosion inhibitor used, including the date when placed;~~ safety orders; and instructions for use.
- G. If ordered by the Engineer, the Contractor shall submit the following for the corrosion inhibitor:
1. A sample, a list of chemicals and their proportions, and instructions for use.
 2. Evidence that the prestressing steel will be protected from rust and other results of corrosion.
 3. A Certificate of Compliance in accordance with ~~the provisions in~~ Subsection 106.065, "Certificate of Compliance," ~~of the Standard Specifications.~~
- H. Prestressing steel for post tensioning ~~which~~that is installed in members prior to placing and curing of the concrete, shall be continuously protected against rust or other corrosion, until grouting, ~~by means of~~with a corrosion inhibitor placed in the ducts or applied to the steel in the duct. The corrosion inhibitor shall conform to the requirements specified above.
- I. All water used for flushing ducts shall contain either quicklime (calcium oxide) or slaked lime (calcium hydroxide) in the amount of 0.1 pound per gallon ~~(12 grams per liter)~~. All compressed air used to blow out ducts shall be oil free.
- J. When acceptable prestressing steel for post tensioning is installed in the ducts after completion of concrete curing, and if stressing and grouting are completed within ~~ten (10)~~ calendar days after the installation of the prestressing steel, rust ~~which~~that may form during ~~said ten (the 10)~~ days will not be cause for rejection of the steel.
1. Prestressing steel installed, tensioned, and grouted in this manner, all within ~~ten (10)~~ calendar days, will not require the use of corrosion inhibitor in the duct following installation of the prestressing steel.
 2. Prestressing steel installed as above but not grouted within ~~ten (10)~~ calendar days shall be subject to all the requirements in this section pertaining to corrosion protection and rejection because of rust.

CONSTRUCTION

495.03.01 GENERAL

- A. Prestressing shall be performed by post tensioning methods. The method of prestressing to be used shall ~~be optional with~~at the Contractor's option, subject to the requirements specified herein.
- B. The Contractor shall submit to the Engineer for review complete details and substantiating calculations of the method, materials, and equipment ~~the Contractor~~ proposes to use in the prestressing operations, including any additions or rearrangements of reinforcing steel from that shown on the plans. Such details shall:
1. ~~e~~Outline the method and sequence of stressing, ~~and shall~~
 2. ~~i~~include complete specifications and details of the prestressing steel, ~~and~~ anchoring devices, working stresses, anchoring stresses, type of ducts, and all other data pertaining to the prestressing operations.

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3. ~~including~~ the proposed arrangement of the prestressing steel in the members, pressure grouting materials, and equipment.
- C. The Contractor shall not cast any member to be prestressed before review of the shop detail drawings is complete.
- D. Three sets of all shop detail drawings prepared specifically for the contract shall be submitted to the Engineer for review.
1. After review, ~~five~~ 5 sets shall be submitted to the Engineer for use during construction.
 2. Shop detail drawings shall be ~~twenty four (24)~~ inches by ~~thirty six (36)~~ inches (~~61 centimeters by 91 centimeters~~) in size and each drawing shall include the job site, name of structure as shown on the contract plans, the contract entity, bridge number, and contract number.
- E. At the completion of the contract, ~~one~~ 1 set of ~~either, (1) ink tracings on cloth, (2) ink tracings on polyester base drafting film, (3) silver sensitized cloth duplicate tracings, or (4) silver sensitized polyester based reproduction films with matte surface on both sides,~~ full size drawings on mylar or other approved material of all shop detail drawings for railroad bridges shall be furnished and delivered to the Engineer by the Contractor at ~~his expense~~ no additional cost to the Contracting Agency.

495.03.02 ANCHORAGES AND DISTRIBUTION

- A. All post tensioned prestressing steel shall be secured at the ends ~~by means of~~ with approved permanent type ~~of~~ anchoring devices.
- B. All anchorage devices for post tensioning shall hold the prestressing steel at a load producing a stress of not less than ~~ninety five (95)~~ percent of the specified minimum tensile strength of the prestressing steel.
- C. When headed wires are used, the outside edge of any hole for prestressing wire through a stressing washer or through an unthreaded bearing ring or plate shall not be less than 1/4 inch (~~0.64 centimeters~~) from the root of the thread of the washer or from the edge of the ring or plate.
- D. The load from the anchoring device shall be distributed to the concrete ~~by means of~~ with approved devices that will effectively distribute the load to the concrete. Such approved devices shall conform to the following requirements:
1. The final unit compressive stress on the concrete directly underneath the plate or assembly shall not exceed 3,000 ~~pounds per square inch (20.68 MPa)~~ psi.
 2. Bending stresses in the plates or assemblies induced by the pull of the prestressing steel shall not exceed the yield point of the material or cause visible distortion in the anchorage plate when ~~one hundred (100)~~ percent of the ultimate load is applied as determined by the Engineer.
 3. Materials and workmanship shall conform to ~~the requirements in Section~~ 506, "Steel Structures."
- E. Should the Contractor elect to furnish anchoring devices of a type ~~which~~ that are sufficiently large and ~~which~~ are used in conjunction with a steel grillage embedded in the concrete that effectively distributes the compressive stresses to the concrete, the steel distribution plates or assemblies may be omitted.

- F. Where the end of a post tensioned assembly will not be covered by concrete, the anchoring devices shall be recessed so that the ends of the prestressing steel and all parts of the anchoring devices will be at least ~~two (2) inches (5 centimeters)~~ inside of the end surface of the members, unless a greater embedment is shown on the plans. Following post tensioning, the recesses shall be filled with concrete conforming to the requirements for the structure and finished flush.

495.03.03 DUCTS

- A. Duct enclosures for prestressing steel shall be rigid galvanized ferrous metal, mortar tight, and accurately placed at the locations shown on the plans or approved by the Engineer.
- B. All ducts or anchorage assemblies shall be provided with pipes or other suitable connections for the injection of grout after prestressing.
- C. Ducts for prestressing steel when bars are used shall have a minimum inside diameter $\frac{3}{8}$ inch ~~(1 centimeter)~~ larger than the diameter of the bars to be used.
- D. Ducts for prestressing steel shall be securely fastened in place to prevent movement.
- E. After installation in the forms, the ends of ducts shall at all times be covered as necessary to prevent the entry of water or debris. If prestressing steel is to be installed after the concrete has been placed, ducts shall be blown out or flushed and blown out immediately prior to installation of the steel.
- F. Rigid ducts may be fabricated with either welded or interlocked seams. Galvanizing of the welded seam will not be required.
1. Rigid ducts shall have sufficient strength to maintain their correct alignment during placing of concrete.
 2. Joints between sections of rigid duct shall be positive metallic connections ~~which~~ that do not result in angle changes at the joints.
 3. Waterproof tape shall be used at the connections.
 4. Ducts shall be bent without crimping or flattening.
 5. Transition couplings connecting ~~said~~ the ducts to anchoring devices need not be galvanized.
- G. All ducts for continuous structures shall be vented within ~~three (3) feet (1 meter)~~ of the high points of the cable path.
1. Vents shall be ~~one half (1/2) inch (1.3 centimeters)~~ minimum diameter standard pipe.
 2. Connections to ducts shall be made with metallic structural fasteners.
 3. The vents shall be mortar tight, taped as necessary, and ~~shall~~ provide means of injection of grout through the vents and for sealing the vents.
 4. Ends of vents shall be removed ~~one 1 inch (2.5 centimeters)~~ below the top of top slab after grouting has been complete.

495.03.04 PRESTRESSING

- A. All prestressing steel shall be tensioned ~~by means of~~ with hydraulic jacks so that the force in the prestressing steel shall not be less than the value shown on the plans.

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1. Unless otherwise specified or shown on the plans, the average working stress in the prestressing steel shall not exceed 60 percent of the specified minimum ultimate tensile strength of the prestressing steel.
 2. The maximum temporary tensile stress (jacking stress) in prestressing steel shall not exceed 75-percent of the specified minimum ultimate tensile strength of the prestressing steel.
 3. The prestressing steel shall be anchored at stresses (initial stress) that will result in the ultimate retention of working forces of not less than those shown on the plans, but in no case shall the initial stress exceed 70 percent of the specified minimum ultimate tensile strength of the prestressing steel.
- B. Working force and working stress will be considered as the force and stress remaining in the prestressing steel after all losses, including creep and shrinkage of concrete, elastic compression of concrete, creep of steel, losses in post tensioned prestressing steel due to sequence of stressing, friction and take-up of anchorage, and all other losses peculiar to the method or system of prestressing have taken place or have been provided for.
- C. The loss in stress in post tensioned prestressing steel due to creep and shrinkage of concrete, creep of steel, and sequence of stressing shall be as indicated on the plans.
- D. The following formula and friction coefficients shall be used in calculating friction losses in tendons:

$$T^{\circ} = TX^e (Ua + KL)$$

T° = Steel stress at jacking end

T = Steel stress at any point X

X^e = Base of Napierian logarithms

U = Friction curvature coefficient

a = Total angular change of prestressing steel profile in radians from jacking end to point X

K = Friction wobble coefficient

L = Length of prestressing steel from jacking end to point X

Type of Steel	Type of Duct	K	U
Bright metal wire or strand	Galvanized-rigid	0.0002	0.25
Bright metal bars	Galvanized	0.0002	0.15

- E. Each jack used to stress tendons shall be equipped with either a pressure gagegauge or a load cell for determining the jacking stress, at the option of the Contractor.
1. The pressure gagegauge, if used, shall have an accurately reading dial at least six (6) inches (15 centimeters) in diameter and each jack. The and its gagegauge shall be calibrated as a unit with the cylinder extension in the approximate position that it will be at final jacking force, and shall be accompanied by a certified calibration chart.
 2. The load cell, if used, shall be calibrated and ~~shall be~~ provided with an indicator that will determine ~~by means of which~~ the prestressing force in the tendon ~~may be determined~~.
 3. The range of the load cell shall be such that the lower ~~ten (10)~~ percent of the manufacturer's rated capacity will not be used in determining the jacking stress.

- F. The certified calibration charts for the hydraulic jacks, pressure ~~gage~~gauge, or load cells used for tensioning prestressing steel may be checked before and during tensioning operations with agency-~~furnished~~ load cells.
1. The Contractor shall provide, at ~~his expense~~ no additional cost to the Contracting Agency, sufficient labor, equipment, and material to install and support the load cells at the prestressing tendons and to remove the load cells after the checking is complete, as ordered by the Engineer.
 2. The checking operations, except as provided ~~in this paragraph~~ above, will be conducted by the Contracting Agency ~~forces~~.
- G. Prior to placing forms for closing slabs of box girder cells, the Contractor shall demonstrate to the satisfaction of the Engineer that either the prestressing steel is free and unbonded in the duct or, if prestressing steel has not yet been placed, that all ducts are unobstructed.
- H. Prior to post tensioning any member, the Contractor shall demonstrate to the satisfaction of the Engineer that the prestressing steel is free and unbonded in the duct.
- I. Except as herein provided, ~~cast in place~~ cast-in-place concrete shall not be prestressed until at least ~~ten (10)~~ days after the last concrete has been placed in the member to be prestressed and until the compressive strength of ~~said the~~ last placed concrete has reached the strength specified for the concrete at the time of stressing.
- J. Where F'c 3500 concrete is specified on the plans for cast-~~in-~~place pre-stressed concrete, the tendons shall not be tensioned until the concrete to be prestressed has attained a compressive strength equal to the strength at the time of initial prestressing shown on the plans.
- K. The tensioning process as applied to post tensioned members shall be so conducted that tension being applied and the elongation of the prestressing steel may be measured at all times. A record shall be kept of ~~gage~~gauge pressures and elongations at all times and shall be submitted to the Engineer for approval.
- L. Prestressing tendons in continuous post tensioned members shall be tensioned by jacking from both ends of the tendon.

495.03.05 BONDING AND GROUTING

- A. Post tensioned prestressing steel shall be bonded to the concrete by completely filling the entire void space between the duct and the tendon with grout.
- B. Grout shall consist of Portland cement, water, and an expansive admixture approved by the Engineer.
- C. Portland cement shall conform to ~~the requirements of~~ Section 701, "Hydraulic Cement." ~~of the Standard Specifications.~~
- D. Water shall comply with ~~the requirements of~~ Section 722, "Water." ~~of the Standard Specifications.~~
- E. The use of admixtures shall comply with ~~the requirements of~~ Subsection 501.02.03, "Admixtures," ~~of the Standard Specifications~~ except that the admixture shall not contain chloride ions in excess of 0.25 percent by weight of admixture and the admixture may be dispensed in solid form.
- F. Water shall be ~~first~~ added first to the mixer, followed by cement and admixtures.

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1. The grout shall be mixed in mechanical mixing equipment of a type that will produce uniform and thoroughly mixed grout.
 2. The water content shall be not more than ~~five (5)~~ gallons ~~(22 liters per 50 kilograms)~~ per sack of cement.
 3. Retempering of grout will not be permitted.
 4. Grout shall be continuously agitated until it is pumped.
- G. The pump-ability of the grout shall be determined by the Engineer in accordance with the U.S. Corps of Engineers Test Method CRD-C-79. The efflux time of a grout sample immediately after mixing shall not be less than ~~eleven (11)~~ seconds.
- H. Grouting equipment shall be capable of grouting at a pressure of at least ~~one hundred (100)~~ pounds per square inch psi (689 KPa).
- I. Grouting equipment shall be furnished with a pressure gage gauge having a full scale reading of not more than ~~three hundred (300)~~ pounds per square inch psi (2068 KPa).
- J. Standby flushing equipment capable of developing a pumping pressure of ~~two hundred fifty (250)~~ pounds per square inch psi (1724 KPa) and of sufficient capacity to flush out any partially grouted ducts ~~and~~ shall be provided.
- K. All ducts shall be clean and free of deleterious materials that would impair bonding of the grout or interfere with grouting procedures.
- L. All grout shall pass through a screen with 0.07-inch ~~(.18 centimeter)~~ maximum clear openings prior to being introduced into the grout pump.
- M. When hot weather conditions would contribute to quick stiffening of the grout, the grout shall be cooled by approved methods as necessary to prevent blockages during pumping operations.
- N. Grout injection pipes shall be fitted with positive mechanical shutoff valves.
1. Vent and ejection pipes shall be fitted with valves, caps, or other devices capable of withstanding the pumping pressures.
 2. Valves and caps shall not be removed or opened until the grout has set.
 3. Leakage of grout through the anchorage assembly shall be prevented by positive mechanical means.
- O. Grout shall be pumped through the duct and continuously wasted at the outlet until no visible slugs of water or air are ejected and the efflux time of ejected grout is not less than ~~eleven (11)~~ seconds. The outlet pipe shall then be closed and the pumping pressure held momentarily. The valve at the inlet shall then be closed while maintaining this pressure.
- P. The surface of concrete against which concrete encasement over anchorage assemblies is to be placed shall be abrasive blast cleaned and clean aggregate exposed after grouting of the ducts has been completed.

495.03.06 SAMPLES FOR TESTING

- A. Sampling and testing shall conform to ~~the specifications of~~ ASTM-Designation A-416 and ASTM-Designation A-421, and as specified below.
- B. Samples from each size and each mill heat of prestressing bars, from each manufactured reel of prestressing steel strand, from each coil of prestressing wire, and from each lot of anchorage assemblies and bar couplers to be used shall be furnished for testing.

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- C. With each sample of prestressing steel wires, bars, or strands furnished for testing, there shall be submitted a certification stating the manufacturer's minimum guaranteed ultimate tensile strength of the sample furnished.
- D. All materials for testing shall be furnished by the Contractor at ~~his expense~~ no additional cost to the Contracting Agency. The Contractor shall have no claim for additional compensation in the event ~~his Contractor's~~ work is delayed awaiting approval of the materials furnished for testing.
- E. All bars of each size from each mill heat, all wire from each coil, and all strand from each manufactured reel to be shipped to the site shall be assigned an individual lot number and shall be tagged ~~in such a manner~~ so that each ~~such~~ lot can be accurately identified at the job site.
1. Each lot of anchorage assemblies and bar couplers to be installed at the site shall be likewise identified.
 2. All unidentified prestressing steel, anchorage assemblies, or bar couplers received at the site will be rejected.
- F. The following samples of materials and tendons, selected by the Engineer from the prestressing steel at the plant or job site, shall be furnished by the Contractor to the Engineer well in advance of anticipated use:
1. For wire, strands, or bars, one ~~seven (7)~~ one ~~foot (2 meter)~~ meter long sample of each size shall be furnished for each heat or reel.
 2. If the prestressing tendons ~~is~~ are to be prefabricated, ~~one~~ one completely fabricated prestressing tendon ~~five (5)~~ one ~~feet (1.5 meters)~~ meter in length for each size of tendon shall be furnished, including anchorage assemblies.
 3. If the prestressing tendon is to be assembled at the job site, sufficient wire or strand and end fittings to make up ~~one~~ one complete prestressing tendon ~~five (5)~~ one ~~feet (1.5 meters)~~ meter in length for each size of tendon shall be furnished, including anchorage assemblies.
 4. If the prestressing tendon is a bar, one ~~seven (7)~~ one ~~foot (2 meters)~~ meter length complete with ~~one~~ one end anchorage shall be furnished and in addition, if couplers are to be used with the bar, two ~~four (4)~~ one ~~foot (1.2 meters)~~ meter lengths of bar equipped with ~~one~~ one coupler and fabricated to fit the coupler shall be furnished.
- G. When prestressing systems have been previously tested and approved for Contracting Agency's projects, complete tendon samples need not be furnished, provided there is no change whatsoever in the materials, design, or details previously approved. Shop drawings shall contain an identification of the project on which approval was obtained; otherwise, sampling will be required.
- H. For prefabricated tendons, the Contractor shall give the Engineer at least ~~ten (10)~~ ten days' notice before commencing the installation of end fittings or the heading of wires. The Engineer will inspect end fitting installations and wire headings while ~~such~~ fabrication is in progress at the plant and will arrange for the required testing of the material to be shipped to the site.
- I. No prefabricated tendon shall be shipped to the site without first having been released by the Engineer, and each tendon shall be tagged before shipment for identification purposes at the site. All unidentified tendons received at the site will be rejected.
- J. Job site or site as referred to herein shall be considered to mean the structure site.

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- K. The release of any material by the Engineer shall not preclude subsequent rejection if the material is damaged in transit or later damaged or found to be defective.

METHOD OF MEASUREMENT

495.04.01 MEASUREMENT

- A. The unit of measurement for "~~Prestressing Cast-In-Place~~Cast-in-Place Concrete" shall be lump sum.
- B. All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

BASIS OF PAYMENT

495.05.01 PAYMENT

- A. The contract lump sum price paid for "~~Prestressing Cast-In-Place~~Cast-in-Place Concrete" shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in furnishing, placing, and tensioning the prestressing steel in cast-~~in-~~in-place concrete structures, complete in place, as shown on the plans, as specified ~~in the Special Provisions~~, and as directed by the Engineer.
- B. Full compensation for furnishing and placing additional deformed bar reinforcing steel required by the particular system used, ducts, anchoring devices, distribution plates, or assemblies and incidental parts, for furnishing samples for testing, for grouting recesses, and for pressure grouting ducts shall also be considered as included in the contract lump sum price paid for "~~Prestressing Cast-~~in-~~in-Place Concrete,~~" and no additional compensation will be allowed therefor.
- C. All payments will be made in accordance with Subsection 109.02, "Scope of Payment."
- D. Payment will be made under:

PAY ITEM	PAY UNIT
Prestressing Cast-In-Place <u>Cast-in-Place</u>	Lump Sum