SPECIAL PROVISION 959 - HOT MIX ASPHALT (HMA) PAVEMENT (SUPERPAVE)

959-1 DESCRIPTION

959-1.01 Scope -

a. This work shall consist of designing and constructing one or more courses of hot mix asphalt (HMA) pavement (**Superpave**) on a prepared foundation in accordance with these specifications, and in conformance with the lines, grades, thickness, typical cross sections and smoothness shown on the plans. Superpave mixes will be classified as leveling (**SPL**), base (**SPB**), and surface (**SPS**).

b. This work shall also consist of providing, furnishing and maintaining in good condition one or more wood frame or metal buildings for the exclusive use of the Authority during the construction period as an Acceptance laboratory for acceptance of HMA within the producer's plant premises at a location acceptable to the Authority. The buildings shall be as described herein. However, with the prior written approval of the Engineer, the Contractor may provide equivalent laboratory office spaces that meet the requirements of this specification. The alternatives may be suitable mobile trailers, prefabricated buildings, or space in existing buildings. When trailers are provided, these shall be furnished with air conditioning equipment.

c. In addition, the work shall also include the application of any required tack and prime coats as specified in Specifications 407 and 408 respectively.

959-2 TRAFFIC LEVELS, CATEGORIES AND TYPES OF MIXES, AND THICKNESS REQUIREMENTS

959-2.01 Traffic Levels - The requirements for Superpave Mixes are based on the design traffic of the project, expressed in 18,000 pounds Equivalent Single Axle Loads (ESAL's). The Traffic Levels are as shown in Table 959-1. The Traffic Level(s) for the project are as specified in the contract documents. The Average Daily Traffic (ADT) included in the table below is just for guidance purposes. If the Traffic Level is not included in the contract documents, the Contractor shall design and produce the Superpave mixes included in the project based on a Traffic Level #4.

TABLE 959-1

Superpave Traffic Levels		
Traffic Level	*** Traffic Level (1 x 10^6 ESAL's)**	**Approximated Average Daily Traffic (ADT)**
1	< 0.3	< 1,200
2	≥ 0.3 to < 3	≥ 1,200 to < 12,000
3	≥ 3 to < 10	≥ 12,000 to < 40,000
4	≥ 10 to < 30	≥ 40,000 to < 120,000
5	≥ 30	≥ 120,000

***** Cumulative ESAL's for a 20-year design life.

SPECIAL PROVISION 959 - HOT MIX ASPHALT (HMA) PAVEMENT (SUPERPAVE)

959-2.02 Categories of Superpave Mixes – Superpave mixes as designed and produced under this specification shall be categorized as either coarse-graded or fine-graded as defined in AASHTO M 323.

959-2.03 Types of Superpave Mixes – Superpave mixes as designed and produced under this specification shall be of the following types:

a. Superpave leveling mixes (**SPL**) - Leveling mixes for all Traffic Levels shall be categorized as fine-graded or coarse-graded mixes, containing, after blending of all aggregates, a Nominal Maximum Aggregate Size[1] of 3/8-inch (9.5 mm).

b. Superpave base mixes (**SPB**) – Base mixes for all Traffic Levels can be categorized as either fine-graded or coarse-graded mixes, containing, after blending of all aggregates, a Nominal Maximum Aggregate Size of 3/4-inch (19 mm) or 1-inch (25 mm).

c. Superpave surface mixes (**SPS**) - Surface mixes for all Traffic Levels can be categorized as either fine-graded or coarse-graded mixes, containing, after blending of all aggregates, a Nominal Maximum Aggregate Size of 1/2-inch (12.5 mm).

The Contractor will select, for all types of mixes describe herein, the category (fine-graded or coarse-graded) of the Superpave mix to be designed, produced and placed in the project. Also, the Contractor will select for base mixes the Nominal Maximum Aggregate Size (3/4-inch (19 mm) or 1-inch (25 mm)) of the Superpave mix to be designed, produced and placed in the project. The selection by the Contractor of the above mix properties shall be based upon mix compliance with all specification requirements.

[1]*Nominal Maximum Aggregate Size (NMAS) is defined as being one sieve larger than the first sieve to have a percent passing less than 90 percent by weight.*

959-2.04 Layer (course) Thickness – Compacted thickness for each course of Superpave mix shall be as indicated in Table 959-2 below.

TABLE 959-2

SUPERPAVE MIX	**COMPACTED THICKNESS FOR EACH COURSE (inches)** Fine-Graded **(Min – Max)**	**COMPACTED THICKNESS FOR EACH COURSE (inches) Coarse-Graded (Min-Max)**
SPL (NMAS = 3/8-inch)	1.25 – 2.00	1.50 – 2.25
SPB (NMAS = ¾-inch)	2.25 – 4.00	3.00 – 4.50
SPB (NMAS = 1-inch)	3.00 – 5.00	4.00 – 6.00
SPS (NMAS = ½-inch)	1.50 – 2.50	2.00 – 3.00

SPECIAL PROVISION 959 - HOT MIX ASPHALT (HMA) PAVEMENT (SUPERPAVE)

959-3 MATERIALS

959-3.01 Asphalt Binder - The asphalt binder shall conform to the requirements of Section 702-1 of Specification 702 – Bituminous Materials.

959-3.02 Aggregates - Aggregates, including mineral filler, shall meet the following requirements:

a. Grading of the coarse aggregates and fine aggregates shall be such that when it is blended in the proper proportion, the resultant aggregate mixture, at both the mix design process and during the production process, will be between the control points specified in AASHTO M 323 and meeting the requirements of article 959-2.03 above for the type of Superpave mix specified in contract documents.

b. Coarse aggregate fraction of the aggregate mixture (fraction not passing the Primary Control Sieve as defined in AASHTO M 323 for the applicable type of Superpave mix) shall be crushed stone or crushed gravel meeting the following requirements:

(1) It shall have an Angularity, measured using the percent fractured faces procedure as stated in ASTM D 5821, that meets the requirements of AASHTO M 323 for the Traffic Level and depth of the pavement layer specified in the contract documents.

(2) The maximum percentage of wear (loss by abrasion) when tested in accordance with AASHTO T 96 shall be less than 40 percent.

(3) It shall have a maximum percent of flat and elongated particles[2], measured using ASTM D 4791, except as noted in AASHTO M323, that meets the requirements of AASHTO M 323 for the Traffic Level specified in the contract documents.

[2]*A flat and elongated particle is one where the ratio of the longest dimension to the shortest dimension exceeds 5 (ratio of 5:1).*

(4) It shall be of such gradation that when blended in the proper proportion with the other constituents, the resultant aggregate mixture will meet the requirements of article 959-3.02(a) for the type of Superpave mix specified in the contract documents.

c. Coarse aggregate source(s) used in Superpave surface mixes shall have a minimum polishing value of 48 as determined by ASTM D 3319.

d. Fine aggregate fraction of the aggregate mixture (fraction passing the Primary Control Sieve defined in accordance with AASHTO M 323 for the type of Superpave mix specified in the contract documents) shall consist of natural sand, stone screenings, or a combination thereof and shall conform to the following requirements:

(1) It shall have an Angularity (un-compacted void content), that when tested in accordance with AASHTO T 304, Method A, meets the requirements of AASHTO M 323 for the traffic level and depth of the pavement layer specified in the contract documents.

(2) It shall conform to the requirements of AASHTO M 29, except that the soundness test (AASHTO T 104) is not required.

(3) It shall be of such gradation that when blended in the proper proportion with the other constituents, the resultant aggregate mixture will meet the requirements of article 959-3.02(a) for the type of Superpave mix specified in the contract documents.

(4) It shall have a minimum Sand Equivalent (percent), as determined by AASHTO T 176, that meets the requirements of AASHTO M 323 for the Traffic Level specified in the contract documents.

(5) It shall be free from soft and disintegrated pieces, clay, and organic or other deleterious matter as determined by AASHTO T 267.

e. Mineral Filler - Mineral filler for bituminous paving mixtures, if required, shall conform to the requirements of AASHTO M 17.

f. Hydrated Lime - Hydrated lime, if used, shall meet the requirements of AASHTO M 303 . The Contractor shall submit certified laboratory reports on tests of the proposed hydrated lime showing its compliance with the above requirements.

g. Chemical Anti-Strip Agent - The Contractor shall submit for approval the certified laboratory reports of the proposed chemical anti-strip agents.

h. The use of chemical anti-strip agents and/or hydrated lime is mandatory in all Superpave mixes. The Contractor shall be responsible for verifying the affinity/compatibility of the proposed quantity and source of anti-strip agent and/or hydrated lime with all mix components. The quantity of anti-strip agent and/or hydrated lime shall be determined based upon an optimization testing procedure (test mixes for moisture susceptibility (AASHTO T 283) at least at three different dosages of anti-strip agent and/or hydrated lime).

959-3.03 Composition of Mixtures -

a. General - The Superpave mix shall consist of a mixture of aggregates (coarse and fine), mineral filler, if required, chemical anti-strip agent and/or hydrated lime and performance graded binder **PG 64-22**, **PG 67-22** or **PG 70-22**. The gradation of all the aggregates and mineral filler, if required, used shall be such that when blended meets the requirements of Article 959-3.02 (a) above for the type of Superpave mix specified in the contract documents.

b. Job-Mix Formula[3] (JMF) - The Contractor shall develop and submit in writing for the Engineer's approval, at least six weeks in advance of the date he intends to start paving operations, a job-mix formula based upon a Superpave mix design, meeting the requirements of article 959-3.03 (c) below, for each type of Superpave mixture to be used in the project. Each job-mix formula shall be supported by AASHTO Accredited laboratory test data used in the Superpave mix design process including, but not limited to, the design charts used. The submission shall also identify the

proposed sources of the asphalt binder and aggregates to be used, including the FHWA 0.45 power gradation chart of the proposed Superpave mix. The six-week lead requirement may be waived at the discretion of the Authority. The submittal shall show the compliance of the proposed job-mix formula with all specification requirements. Each proposed job-mix formula and Superpave mix design shall be designed and submitted to the Authority's Materials Testing Office on a three year basis or when the Acceptance and/or Contractor Quality Control Plan test results shows significant difference in mix properties, which ever occur first. No mix shall be placed on this project without an approved job-mix formula and a corresponding Superpave mix design.

Verification of the proposed Superpave mix design may be performed at the Authority's Bayamon Central Laboratory at the time of submission of JMF. When determined by the Authority, the Contractor shall coordinate with the Authority the sampling of all materials proposed for use in the mix. Verification of Superpave mix design will consist in checking the selection of the optimum asphalt content made by the Contractor. Furthermore, the above procedure will also include verification of moisture susceptibility requirements established in this specification.

[3]*Job-mix formula (JMF) is the proposed combined aggregate gradation, percent of asphalt binder, dust to effective asphalt ratio and volumetric properties used to establish target values for mix production based upon a mix design prepared following the requirements of AASHTO R 35.*

c. Superpave Mix Requirements - Each Superpave mix shall be designed according to the AASHTO R 35, except as provided in the specification. Superpave mix design procedures shall be pre-approved by the Authority. All samples for mix design and volumetric determination shall be aged in accordance with AASHTO R 30 (Short Term Aging). Also, all gyratory specimens shall be compacted to the design number of gyrations (N_{design}) specified in AASHTO M 323 for each Traffic Level so as to determine its volumetric properties.

(1) Gyratory Compaction Requirements – The mix shall be compacted in accordance with AASHTO T 312 using the number of gyrations as defined in AASHTO M 323 for the Traffic Level specified in the contract documents.

(2) Air Voids Content (Va) Requirements – The mix shall have an air void content of 4.0 percent at the design number of gyrations (N_{design}) in accordance with AASHTO M 323. The mix shall also meet the requirements of AASHTO M 323 for the Traffic Level specified in the contract documents.

(3) Voids in Mineral Aggregate (VMA) Requirements – The mix shall have a VMA (percent), in accordance with AASHTO M 323 for the design number of gyrations (N_{design}) and Nominal Maximum Aggregate Size specified in the contract documents.

(4) Voids Filled with Asphalt (VFA) Requirements – The mix shall have a VFA (percent), in accordance with AASHTO M 323 for the design number of gyrations (N_{design}) and Traffic Level specified in the contract documents.

(5) The Dust to Effective Asphalt Binder ratio (DEAR) of the mix, computed by dividing the percentage of material passing the No. 200 sieve by the percent of effective asphalt binder (Pbe) in the mix, shall be as indicated in **Table 959-3**:

Table 959-3

Mix Category	Dust to Effective Asphalt Binder Ratio (DEAR) / Specification Limits (Min – Max)
Fine-Graded	0.6 – 1.2
Coarse-Graded	0.8 – 1.6

(6) Laboratory Mixing Temperature – Mixing temperature shall be the temperature at which the binder viscosity is approximately 0.17 +/- 0.02 Pa-s in accordance with AASHTO T 312. This mixing temperature will be for laboratory use only.

(7) Laboratory Compacting Temperature – Compacting temperature shall be the temperature at which the binder viscosity is approximately 0.28 +/- 0.03 Pa-s in accordance with AASHTO T 312. This compacting temperature will be for laboratory use only.

(8) Moisture Susceptibility Requirements – Superpave mixes shall meet the following requirements:

a. AASHTO T 283 for Laboratory Mixed - Laboratory Compacted Specimens:

1. For AASHTO T 283 testing procedures the freeze and thaw cycle shall be used. In addition, all samples shall be compacted to 7 +/- 0.5 percent air voids using the Superpave Gyratory Compactor (AASHTO T 312). The diameter of the test specimens shall be 6 inches for all types of Superpave mixes.

2. Tensile Strength – The minimum dry and unconditioned tensile strength shall be 100-psi for Superpave surface mixes (**SPS**), 90-psi for Superpave base mixes (**SPB**), and 80-psi for Superpave leveling mixes (**SPL**).

3. Retained Tensile Strength Ratio (TSR) – Minimum 80 percent of Tensile Strength.

d. Mix Values - Each job-mix formula submitted shall propose definite values for:

(1) The type of Superpave mix to be used (**SPS**, **SPB**, **SPL**).
(2) The category (fine-graded or coarse-graded) of the Superpave mix to be designed.
(3) Nominal Maximum Aggregate Size (NMAS) of the aggregate mixture.
(4) Traffic Level and number of Gyrations ($\mathbf{N_{design}}$).
(5) The source and materials to be used, including geological and mineralogical descriptions.
(6) Single percentage of aggregates passing each required sieve size.

(7) Single percentage of asphalt binder (Pb) to be added based on total weight of the mixture.
(8) The kind and percentage of mineral filler to be used, if any.
(9) Production Temperature - The target temperature at which the mixture is to be discharged from the asphalt plant.
(10) Target Roadway Temperature - The target temperature at which the mixture is to be compacted during lay-down operations.
(11) Bulk Specific gravity and Apparent Specific gravity of each separate mixture component.
(12) Specific gravity of the Binder at 25 degrees Celsius.
(13) Polish Stone Value (PSV) of coarse aggregate (Only for SPS mixes).
(14) Consensus and source properties of aggregate mixture used (Coarse Aggregate Angularity, Fine Aggregate Angularity, Flat and Elongated Particles, Sand equivalent, percent wear (abrasion loss), etc.).
(15) Design Gradation on FHWA's 0.45 Power Gradation Chart.
(16) Bailey Method Ratio's for each Superpave mix (for information purposes only)
(17) Provide all the physical properties achieved at the different asphalt binder contents used to determine the optimum asphalt content.
(18) Percent Asphalt Binder Content (Pb) (optimum) and Effective Asphalt Binder Content (Pbe).
(19) Dust to Effective Asphalt Binder Content Ratio (D/EAB).
(20) Theoretical Maximum Specific Gravity and Density of Asphalt Paving Mixtures (Gmm (AASHTO T 209) @ Target Binder Content).
(21) Bulk Specific Gravity, Effective Specific Gravity of Mix @ $\mathbf{N_{design.}}$
(22) Air Void Content (Va) @ $\mathbf{N_{design}}$
(23) Voids in Mineral Aggregate (VMA) @ $\mathbf{N_{design.}}$
(24) Voids Filled with Asphalt (VFA) @ $\mathbf{N_{design.}}$
(25) Laboratory Density in Lb/ft^3.
(26) Required In-place Compaction.
(27) Asphalt film thickness for each Superpave mix (for information purposes only).
(28) Densification curve (%Gmm versus Number of gyrations) for each Superpave mix proposed.
(29) Type and quantity of chemical anti-strip agent and/or hydrated lime used in each mix, including all data to perform the optimization procedure.
(30) Hamburg Curve with test parameters in accordance with Hamburg Wheel-Track Test (AASHTO T 324) - Stripping inflection Point (SIP), number of passes to SIP, number of passes to failure and rut depth at failure. The thickness of the specimens tested shall be the same as the one indicated on the plans for each mix. A minimum of six samples shall be tested and averaged per each proposed job-mix formula. Test results will be used for information purposes only.
(31) Moisture Susceptibility data sheet of the proposed mix in accordance with AASHTO T-283.
(32) Retained tensile strength ratio, tensile strength (dry and unconditioned) and tensile strain (dry and unconditioned).
(33) Relative permeability of the proposed Superpave mix (for coarse-graded mixes only) determined at 7 +/- 0.5 percent air voids in accordance with the Florida

Department of Transportation Method (FM) 5-565. The thickness of the specimens tested shall be the same as the one indicated on the plans for each mix. A minimum of six samples shall be tested and averaged per each proposed job-mix formula. Test results will be used for information purposes only.

e. Superpave Mix Specification Limits - After the JMF is approved, all mixtures furnished for the project shall conform to the following specification limits included in Tables 959-4, 959-5 and 959-6 below:

TABLE 959-4
(AASHTO T-164 / AASHTO T-30 / AASHTO T-11)

Acceptance Quality Characteristic (AQC)[4]	Specification Limits
Asphalt Binder Content (Pb)	Target Value[5] +/- 0.50

TABLE 959-5
(AASHTO T-209 / AASHTO T-312 / AASHTO T-166)

Acceptance Quality Characteristic (AQC)	Specification Limits
Air Void Content (Va)	Target Value +/- 1.55

TABLE 959-6
(AASHTO T-209 / AASHTO T-166 – Determined from field cores)

Acceptance Quality Characteristic (AQC)	Specification Limits
In-Place Compaction	95.0 % of Gmm -2.0

[4]*Acceptance Quality Characteristic (AQC) – Characteristic or property of a mix that is measured for acceptance purposes.*

[5]*Target Value – Mix design values as reported in JMF for each acceptance quality characteristic.*

f. Mix Changes - Should a change in sources and/or proportions of materials occur or be proposed, or should a job-mix formula prove unsatisfactory as determined by the Engineer and/or the Contractor Quality Control Program, a new job-mix formula shall be submitted by the Contractor for approval by the Engineer based upon a new Superpave mix design prior to production and use. Acceptance of any tonnage of Superpave bituminous mixes produced under an approved job-mix formula is subject to compliance with all specification requirements.

959-4 ACCEPTANCE SAMPLING AND TESTING

959-4.01 Sampling and Testing -

a. Acceptance sampling and testing will be performed by the Authority. Samples of the mix material being produced for delivery to the project will be taken by the Engineer at the plant following the procedures established in **Table 959-7**.

TABLE 959-7

Description	Procedure Designation
Qualification of Hot Mix Asphalt (HMA) Laboratories	PRHTA Q 401-10
Determination of Random Sampling Location	PRHTA M 401-10
Sampling of Asphalt Binder	AASHTO T-40
Sampling of Aggregates	AASHTO T-2
Sampling of Bituminous Paving Mixtures	AASTHO T-168/FM 1 T 168 (Dense Graded Mixes)
Reducing Samples of Hot-Mix Asphalt to Testing Size	AASHTO R47
Sampling of Compacted HMA Pavement	PRHTA M 401-20

[6] *Random Sample – A sample drawn from a lot in which each element in the lot has an equal probability of being chosen.*

b. The Contractor shall provide at the mixing plant, for acceptance sampling and testing, a laboratory (Acceptance Laboratory) and all the equipment, tools, supplies and other apparatus required for sampling the mix, preparing specimens and testing for compliance of the mix being produced and its components with all the requirements specified in Article 959-3.03.

The Acceptance Laboratory building shall be 6.10 m (20 ft.) by 4.88 m (16 ft.) and shall provide a minimum area of 29.76 square meters (320 square feet). It shall be divided into an office section and a laboratory section. Each section shall have an area of 14.88 square meters (160 square feet).

The Acceptance Laboratory shall comply with the general requirements and construction (general, maintenance) requirements for buildings as stated in specification 611, except that the buildings shall be constructed at the producers plant, at a location acceptable to the Engineer. The acceptance laboratory shall be qualify as per **PRHTA Q 401-10 - Qualification of Hot Mix Asphalt (HMA) Laboratories**

(1) The equipment listed below shall be provided by the Contractor in addition to the laboratory sampling and testing equipment required in this specification. This equipment shall be equal or similar to the specific equipment indicated.

(a) Digital Camera and photographic printing in accordance with specification 611
(b) Asphalt sample splitters (AASHTO R47) (for Authority's Acceptance and Independent Assurance Procedures).
(c) One desk top computer or one laptop computer with complete hardware and software (in accordance with requirements stated in specification 611). Software – the latest release of the following software:
    (a) Windows XP Professional
    (b) Office XP Professional
    (c) Norton Antivirus
(d) Internet Access (equal or similar to requirements stated in specification 611)

(e) One (1) Laser Color Printer (letter and legal sizes) (in accordance with requirements stated in specification 611)
(f) One (1) Scanner (in accordance with requirements stated in specification 611)
(g) One (1) Photocopier (in accordance with requirements stated in specification 611).
(h) Private Fax and telephone lines (in accordance with requirements stated in specification 611). This shall include monthly payment for the telephone bills.
(i) One (1) Battery Backup in accordance with requirements stated in specification 611.
(j) Other related office equipment including but not limited to: two (2) standard office desks 30"x60" with plastic laminated top, six drawers and its adjustable executive type chair; one (1) standard 4 drawer metal filing cabinet; one (1) 36" x 72" office table with plastic laminated top and four (4) office chairs.

(2) Each Acceptance laboratory's testing equipment shall be calibrated by the contractor using the frequency of calibration/verification/standardization/verification/checks indicated in AASHTO R-18 by an independent laboratory qualified to perform such calibration.

(3) The Contractor shall also be responsible for maintenance and repair of all the equipment provided at the Acceptance Laboratory during the project.

(4) The Acceptance Laboratory (AL) shall be available at all times to the Authority. One Contractor representative may be present, if so desired, to observe sampling and testing in the Acceptance Laboratory and may report any inconsistencies in procedures in writing to the Authority at the end of each day. Said report shall include the specific articles/sections of the procedures of the alleged inconsistencies.

c. The Contractor shall provide the following sampling equipment and their respective operator:

(1) Coring machine and personnel at the project site to take full depth 6-inch diameter cores from the in-place bituminous pavement as required for testing and acceptance.

d. The Authority will take, at its discretion, random samples of the asphalt binder, the aggregates, and Superpave mix at any point prior to mix production, during mix production and/or after the final placement of the mix to test for the compliance of any mix design property as established on this specification.

e. Samples of the mix material being produced for delivery to the project will be taken by the Engineer at the plant for acceptance testing by the Authority for compliance with acceptance quality characteristics (asphalt binder content (Pb), volumetrics (volumetrics is defined as air voids at N_{design}) and In-place Compaction) and, at its discretion, other specification requirements such as, but not limited to, aggregate properties, moisture susceptibility of the mix and other mix design properties.

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The control unit for sampling, testing and acceptance purposes will be a lot which is defined as 1,600 tons, subdivided into four equal sub-lots of 400 tons each, of Superpave bituminous mix or fraction thereof. Lots shall only include production of Superpave mix based upon one approved mix design.

A partial lot is defined as a lot size that is less than a full lot (four sub-lots). A partial lot may occur due to the following:

l. The completion of a given mix type or mix design on a project.

2. A lot termination due to a 20 day or greater delay in production (time periods other than 20 days may be used if agreed to by both Engineer and Contractor).

3. All partial lot will be evaluated based on the number of tests available, and will not be redefined.

4. When the Engineer determines a partial payment or pay adjustment is imminent, and if a plant or material adjustment resulting in probable correction of the mixture has been made. However, this provision is intended for use when an obvious plant or roadway malfunction, or testing error, has occurred and is not intended to circumvent the PWL process.

f. Acceptance testing will consist of evaluating the number of samples as indicated in **Table 959-8** below per each lot. Each sample shall provide enough material to adequately perform all testing as determined in each individual test procedure. Also, additional material will be required to be sampled and stored for each sublot as part of the referee retesting system. The contractor shall provide all necessary boxes necessary to properly store the material in the Acceptance laboratory as a subsidiary obligation of the specification. Referee samples will be discarded after two weeks from the completion of the lot. Acceptance testing procedures are as follows:

TABLE 959-8

Procedure Designation (AASHTO)	Frequency	Testing
AASTHO T-164 or AASHTO T-308	1 per sub-lot (use average of split sample[7] for acceptance per sublot)	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures / Determining the Asphalt Binder Content by the Ignition Method
AASHTO T-30/11B		Mechanical Analysis of Extracted Aggregate / Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing Using a Wetting Agent
AASHTO T-209 (including Section #11)/ PRHTA T 401-50	1 per sublot (use average of split sample for acceptance per sublot)	Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt Paving Mixture
AASHTO T-312	1 per sub-lot (use average of split sample for acceptance per sublot)	Preparing and Determining the Density of Hot-Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
AASHTO T-166 / T-275		Bulk Specific Gravity of Compacted Hot Mix Asphalt Mixtures Using Saturated Surface Dry Specimens / Bulk Specific Gravity of Compacted Hot Mix Asphalt Mixtures Using Paraffin-Coated Specimens
AASHTO T-269		Percent Air-Void in Compacted Dense and Open Asphalt Mixtures
PRHTA T 401-10	As required	Mixture conditioning for determining volumetric properties of HMA
PRHTA T 401-20	8 per lot / 2 per sub-lot	Determination of HMA in-place compaction and layer thickness
PRHTA T 401-30	As required	Determination of HMA pavement density profile
PRHTA T 401-40	As required	Determination of asphalt binder content of compacted HMA

[7]*Split sample – A sample that has been divided into two portions representing the same material using AASHTO R47 procedure.*

g. The Authority may, at its discretion, take samples of the mix being delivered to the project site for testing at any location including behind the paver before compaction. Test results will be used for information purposes only.

h. The sampling for determining in place compaction of the mix shall be accomplished by cutting 6-inch cores from the compacted pavement in accordance with **PRHTA-M 401-20-Sampling of Compacted HMA Pavements.** Two (2) cores shall be extracted per each sub-lot, a total of eight (8) samples per lot. Testing of the core samples shall be performed in accordance with **PRHTA T 401-20** – **Determination of HMA In-Place Compaction and Layer Thickness.** Sampling and testing for layer thickness shall be performed in accordance with **PRHTA T 401-20.**

959-4.02 – Reporting Results – The following mix properties shall be determined, calculated and reported for each sub lot:

a. Bulk Specific Gravity (**Gmb**) – AASHTO T-166 / AASHTO T-275 as applicable

b. Maximum Specific Gravity (**Gmm**) - AASHTO T-209 (including Section #11) / PRHTA T 401-50

c. Asphalt Binder Content (**Pb**) – AASHTO T-164

d. Air Voids Content (**Va**) – AASHTO T-269

e. Voids in Mineral Aggregate (**VMA**)

f. Voids Filled with Asphalt (**VFA**)

g. Effective Asphalt Binder Content (**Pbe**)

h. Effective Specific Gravity of Mix (**Gse**)

i. Mass Retained (g), Mass Retained (percent), Percent Passing for the following sieve designations: 1-1/2", 1", ¾", ½", 3/8", 1/4", No. 4, No. 8, No. 16, No. 30, No. 50, No. 100, No. 200 – AASHTO T-30 / T- 11 B.

j. Dust to Effective Asphalt Binder Content Ratio (**DEAR**).

k. In-Place Compaction

959-5 CONSTRUCTION REQUIREMENTS

959-5.01 Production Start-Up Procedures – Use these start-up procedures when producing material for the first time in the project, when using materials from different plants, or when resuming production after a termination of production due to unsatisfactory quality as determined by the Engineer.

a. **Control Strip Section –** Produced, place, and compact the proposed HMA in order to establish that the equipment and the processes planned for placement and compaction are satisfactory. Provide 14 days notice before beginning production of an asphalt concrete mix.

On the first day of production, produce sufficient mix to construct a 300 to 600 tons control strip, as determined by the Contractor, one-lane wide, and at the designated lift thickness. Construct the control strip on the project at an approved location.

Construct the control strip using mix production, lay-down, and compaction procedures intended for the entire mix. The mix is acceptable with full payment if all test results are in conformity with specification limits with a CPAF equal or greater than 0.70. Mix that is not acceptable will be removed at no cost to the Authority and shall be replaced during full production operation through applicable hot plant bituminous mix pay items.

1) **Mixture.** Take and test at least three control strip asphalt concrete mix samples and evaluate according to article 959.3.03.e.

2) **Compaction.** Take nuclear density readings behind each roller pass to determine the roller pattern necessary to achieve required density. Keep records of compaction effort frequency and amplitude settings of equipment used.

At a minimum of five locations within the control strip, take nuclear gauge readings, and cut and test core samples according to article PRHTA T 401-20. Density is acceptable if all tests are within the specification limit. Furnish the Engineer with the nuclear gauge readings and correlations of the readings to the core specific gravities.

The purpose of the construction of a control strip is to ensure that HMA material is produced and placed in conformance with the specification requirements. The Contractor shall address any production and/or placement deficiencies identified by the Contractor and the Engineer during this operation as part of the quality control and acceptance plan during the Pre-paving meeting. Tests used for the control strip will not be included in the evaluation for payment according to article 959-5. Based on the Contractor's evaluation of the initial control strip, paving may continue at the Contractor's risk once the Pre-paving meeting per section 959.5.01(b) is completed.

(b) **Pre-paving Meeting** – After the construction of a control strip and at least 7 days before the start of any paving operation, the Engineer shall arrange for a pre-paving meeting. Attendance of Contractor, the Contractor's Paving Quality Assurance Manager, subcontractors, and all other applicable suppliers is mandatory. At the meeting the Contractor's Paving Quality Assurance Manager shall submit and discuss the proposed production and lay-down operations plan. After the meeting, the contractor shall submit a written final detailed plan (at least 3 days before the proposed start of paving operations) to be revised by the Engineer that as a minimum includes the following:

(1) Proposed schedule of paving operations;

(2) List of all necessary equipment and key personnel used in the production and construction of the work;

(3) Proposed traffic control plan for paving operations including provisions for pavement drop-offs and moving operations;

(4) Contractor quality control and materials acceptance plan, corrective action plan[8] in accordance with this specification

(5) Placement operation including production, delivery, placing, finishing, compacting, and smoothness procedures. Include also the proposed rolling patterns, frequency and amplitude to be utilized in the placement operations.

(6) Production and placement strategies to minimize segregation of HMA. Prior to the start of using the paver for placing plant mix, the Contractor shall submit for approval a full description in writing of the means and methodologies that will be used to prevent bituminous paver segregation. Use of the paver shall not commence prior to receiving approval from the Engineer.

[8]*Corrective Action Plans - Contractor's proposed strategies and related work to be performed to prevent repeated deficiencies.*

959-5.02 Bituminous Mixing Plant - Plants used for the preparation of bituminous mixes shall conform to AASHTO M 156 modified and supplemented as follows:

a. For verification of weights and measures, character of materials and determination of temperatures used in the preparation of the paving mix, the Engineer, or his authorized representative, shall have access, at all times, to all portions of the mixing plant, aggregates plant, storage yards, and other facilities for producing and processing the mix materials.

b. Scales shall be inspected and sealed as often as the Engineer may deem necessary, but not less than once a year, to assure their continued accuracy, by the Division of Weights and Measures of the Commonwealth Department of Commerce. Any cost involved in the inspection and sealing of the scales shall be at the Contractor's expense.

c. All projects involving 2,000 Tons or more of bituminous mixture shall be served by a plant having automatic controls, which coordinate the proportioning, timing and discharge of the mixture.

d. All plants shall have silos and shall be equipped with air pollution control devices, which meet the requirements of the Environmental Quality Board.

e. Intentionally omitted.

f. As specified in Article 959-4.01 (b), the plant shall have a Acceptance laboratory adequately equipped to perform AASHTO T 312 and all other testing required for quality assurance and mix design verification.

g. The Contractor shall provide to the Engineer upon request the asphalt plant computer printout of the proportions of the materials used during production. Said printouts will be used for information purposes only.

959-5.03 Hauling Equipment - Trucks used for hauling bituminous mixtures shall have tight, clean, smooth metal 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. No gas oil or diesel fuel will be allowed for preventing the mixture adhering to the truck bed, if this condition occurs the truck will not be allowed to leave the plant. Each truck shall have a cover of canvas or other suitable material of such size as to protect the mixture and for use during hauling operations. No truck will be allowed to leave the plant without covering the mix with the cover of canvas. The Contractor shall provide to the Engineer at the end of each day, a certification attesting to the compliance (before delivery to the project) of each delivery truck with these requirements.

959-5.04 Delivery Tickets - Before unloading at the site of the work the bituminous mix supplier shall furnish to the Engineer a delivery tickets containing the following information concerning the bituminous mix in the truck:

a. Name of bituminous mixing plant
b. Serial number of ticket
c. Date, time and truck number
d. Name of Contractor
e. Specific designation of job (name, number and location)
f. Type of Superpave mix
g. Weight of mix in the truck
h. Space for signature of Authority's site and plant inspector

959-5.05 Bituminous Pavers -

a. Bituminous pavers shall be self-contained, power propelled units with a vibrating or tamper screed and strike-off assembly covering the full lay-down width, heated if necessary, and capable of spreading and finishing courses of bituminous plant mix material which will meet the specified typical section, thickness, smoothness, and grade. Pavers used for shoulders and similar construction shall be capable of spreading and finishing courses of bituminous plant mix material in the widths shown on the plans.

b. The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed. The screed and strike-off assembly shall effectively produce a finished surface of the required smoothness and texture without segregating, tearing, shoving, or gouging the mixture.

c. The paver shall be capable of operating at forward speeds consistent with satisfactory laying of the mixture.

d. The paver shall be equipped with a grade and slope control system capable of automatically maintaining the screed elevation as specified herein. The control system shall be automatically actuated from either a reference line or surface through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. When directed, the transverse slope control system shall be made inoperative and the screed shall be controlled by sensor directed automatic mechanisms, which will independently control the elevation of each end of the screed from the reference lines or surfaces. The controls shall work in conjunction with any of the following attachments:

(1) Ski-type device, floating beam of not less than 30 feet (9.14 m) in length and short ski or shoe to match adjoining lanes either fresh or old layer or as directed by the Engineer.

(2) Taut stringline wire set by the Contractor to the specified grade.

(3) A non-contacting laser or sonar-type ski with at least four referencing stations may be used with a reference at least 24 feet (7.3 m) long.

e. Except as presented on Article 959-6.05(h) below, the Contractor shall furnish as a minimum automatic control systems such as long ski, short ski/shoe or furnish and install all required stakes and wire for a taut string line. Should the automatic control system become inoperative during the day's work, the Contractor may be permitted, at the discretion of the Authority, to finish the day's paving work using manual controls. However, work shall not be resumed thereafter until the automatic control system has been made operative.

f. Intentionally Omitted.

g. The Contractor may be exempt from the use of the automatic control system at locations where the Engineer determines that pavement geometry or widths makes its use impracticable.

h. Laser Control and/or Profilograph Control equipments may be used by the Contractor. The use of this equipment shall be subject to the following requirements at no cost to the Authority:

1. The Contractor shall present a written notice to the Engineer at the beginning of the project proposing the use of such equipment. The written notice shall include, as a minimum, the brand, type, model and manufacturer of the proposed equipment.

2. The Contractor shall provide a copy to the Engineer of the manufacturer's instruction and operation manual as well as any other literature related to computer software.

i. The bituminous paver shall be equipped with a means of preventing the segregation of the coarse aggregate particles from the remainder of the bituminous plant mix when that mix is carried from the paver hopper back to the paver augers. The means and methods used shall be approved by the paver manufacturer and may consist of chain curtains, deflector plates, or other such devices and any combination of these.

SPECIAL PROVISION 959 - HOT MIX ASPHALT (HMA) PAVEMENT (SUPERPAVE)

The following specific requirements shall apply to the identified bituminous pavers:

(1) Blaw-Knox bituminous pavers shall be equipped with the Blaw-Knox Materials Management Kit (MMK).

(2) Cedarapids bituminous pavers shall be those that were manufactured in 1989 or later.

(3) Caterpillar bituminous pavers shall be equipped with deflector plates as identified in the December 2000 Service Magazine entitled "New Asphalt Deflector Kit {6630, 6631, 6640}".

959-5.06 Rollers - Rollers may be of the vibratory or tandem steel wheel type. Rollers shall be in good condition, be capable of reversing without backlash, and shall be operated at speeds slow enough to avoid displacement of the bituminous mixture. The number, type, weight, amplitude and frequency of rollers shall be sufficient to compact the mixture to the required In-place Compaction without detrimentally affecting the compacted material. For leveling mixes (**SPL**), at least one pneumatic tire roller shall be used.

959-5.07 Weather Limitations - Bituminous plant mix shall not be placed on any wet surface or when weather conditions prevent the proper handling or finishing of the bituminous mixture.

959-5.08 Preparation of Surface to be Paved -

a. The surface to be paved shall be true to line and grade, dry and free from loose or deleterious material immediately before the placing of bituminous mixture. If necessary, the surface shall be cleaned by brooming or other approved means.

b. When the surface of an existing pavement or old base to be paved is irregular, it shall be brought to uniform grade and cross section by a leveling course as directed by the Engineer, said course shall be compacted to the satisfaction of the Engineer before placing subsequent paving courses.

c. When a leveling mix (**SPL**) is not required, all depressions and other irregularities shall be patched or corrected in a manner satisfactory to the Engineer. All fatty and unsuitable patches, excess crack or joint filler, and all surplus bituminous material shall be removed from the area to be paved. Blotting of excessive deposits of asphalt with sand or stone will not be permitted.

d. Where the area to be paved is an untreated soil or aggregate, it shall be compacted to the required density and then primed in accordance with the provisions of Specification 408 - Bituminous Prime Coat. The prime coat shall be allowed to cure properly in accordance with the provisions of Specification 408 before any further operations are permitted on the primed area.

e. Before spreading the mixture upon a Portland cement concrete surface or any bituminous surface a tack coat in accordance with the provisions of Specification 407 - Bituminous Tack Coat shall be applied.

f. Contact surfaces of curbing, gutters, manholes, and other structures shall be painted with a thin, uniform coating of bituminous material as specified for the tack coat prior to the bituminous mixture being placed against them.

959-5.09 Preparation of Bituminous Material - The bituminous material shall be heated in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature within the regents specified in **Table 959-9.** Asphalt binder shall not be heated above 350 degrees F at any time after delivery to the plant.

TABLE 959-9

Asphalt Binder	Storage Temperature Range (Minimum – Maximum) (°F)
PG 64-22	285-315
PG 67-22	295-320
PG 70-22	300-325

959-5.10 Mixing -

a. The aggregates 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. The materials shall be mixed until a complete and uniform coating of the particles and a thorough distribution of the bituminous material throughout the aggregate is secured.

b. Mixes shall be produced at a temperature of +/- 20 degrees Fahrenheit of the production temperature indicated in the approved job-mix formula.. Mixes with temperature greater than + 20 degrees Fahrenheit of the production temperature will be rejected.

c. All mixes shall be delivered at the paving site at a temperature of not less than 250 degrees Fahrenheit. Also, all mixes shall have at least 250 degrees Fahrenheit prior to its placement in the paver.

959-5.11 Transporting, Spreading and Finishing -

a. The mixture shall be transported from the mixing plant to the paving site in vehicles conforming to the requirements of Article 959-5.03. The required protective cover shall be placed over the mix prior to departing the plant and retained in place until the mix is delivered.

b. The bituminous mixture shall be laid upon an approved clean surface, spread and struck off to the established grade and elevation. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable.

c. The longitudinal joint in one layer shall be offset from that in the layer immediately below by approximately 6-inch; however, the joint in the top layer shall be at the center line of the

pavement if the roadway comprises two lanes of width, or at lane lines if the roadway is more than two lanes in width, unless otherwise directed.

d. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture may be spread and finished by hand tools. For such areas the mixture shall be dumped, spread and screeded to provide the required section and compacted thickness. The Contractor shall provide suitable heating equipment for keeping hand tools free from asphalt. The temperature of the tools when used shall not be greater than the temperature of the mix placed. Only heat shall be used for cleaning hand tools. The use of petroleum oils, diesel fuel or volatiles in the transportation, spreading and finishing of the asphalt mix will not be permitted and will be cause for rejection of the Superpave mix.

e. If the Contractor opts for using a Material Transfer Vehicle (MTV) during lay-down operations, a paver hopper insert shall be used at all times.

959-5.12 Compaction -

a. Immediately after the bituminous mixture has been spread, struck off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. The surface shall be rolled when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking or shoving. The number, weight, type, amplitude and frequency of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in workable condition. The sequence of rolling operations and the selection of roller types shall be such as to provide the required In-Place Compaction. However, the use of pneumatic tire rollers is mandatory for compacting leveling mixes (**SPL**).

b. Unless otherwise directed, rolling shall begin at the sides and proceed longitudinally parallel to the road centerline, gradually progressing to the crown of the road. Trip overlaps of the roller shall be a minimum of 6-inch (15 cm.). When paving in echelon or abutting a previously placed lane, the longitudinal joint shall be rolled first followed by the regular rolling procedure. On super-elevated curves the rolling shall begin at the low side and progress to the high side by overlapping of longitudinal trips parallel to the centerline.

c. Rollers shall move at a slow but uniform speed with the drive roll or wheels nearest the paver except when rolling an incline, then the procedure is reversed.

d. Any displacement occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected at once by the use of rakes and addition of fresh mixture when required. Care shall be exercised in rolling not to displace the line and grade of the edges of the bituminous mixture. To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with very small quantities of detergent or other approved material.

e. Along forms, curbs, headers, walls and other places not accessible to the rollers, the mixture shall be thoroughly compacted with mechanical tampers. On depressed areas, a trench or

small vibratory roller may be used, or cleated compression strips may be used under the roller to transmit compression to the depressed area.

f. Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture, which shall be compacted to conform with the surrounding area. Any area showing an excess or deficiency of bituminous mix material shall be corrected to the satisfaction of the Engineer.

959-5.13 Joints, Trimming Edges and Cleanup -

a. Notched-wedge edge tool (or similar) or cut-back joints are allowed for layers no more than 2 inches in thickness. For layers exceeding 2 inches in thickness, the contractor should have the option of using the notched-wedge joint (or similar), or pulling all adjacent lanes to a common terminus at the end of each day's production prior to opening all lanes to traffic or construction a notch wedge which will be cut-back on the next production date. The selection by the Contractor of the type of longitudinal joint shall be consistent with the maintenance of traffic requirements stated in the contract. The use of either of the above in the project will be a subsidiary obligation of the contract. The notched wedge, when used, shall have a 0.5 to 0.75 inch notch at the top of the joint, with a 12:1 tapered slope into the space where the next lane will be laid.

b. Placing of the bituminous mix shall be as continuous as possible. Rollers shall not pass over the unprotected end of a freshly laid mixture unless authorized by the Engineer. Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course. A brush coat of bituminous material of the type being used in the mix shall be used on the contact surfaces of transverse joints just before additional mixture is placed against the previously rolled material.

c. At the beginning or ending of a project connecting to an existing pavement the feathering of the new surface course (**SPS**) and base course (**SPB**) to match the existing grade of the old pavement will not be permitted. To transition and match the grades, the old pavement shall be undercut to a depth equal to the compacted depth of the new surface course being connected to it. This work shall be a subsidiary obligation of the Contractor under the new pavement pay items.

d. Material trimmed from the edges and any other discarded bituminous mixture shall be removed from the roadway and disposed of by the Contractor outside the project limits or in an approved area out of sight from the road.

959-5.14 Protection of Pavement - Sections of newly finished work shall be protected from traffic of any kind until the mixture has cooled down to a temperature equal or lower than 150 degrees Fahrenheit. The contractor will establish the necessary strategies and practices as part of its quality control procedures to comply with this requirement. Also, the Contractor shall provide to the Authority a calibrated infrared thermometer capable of measuring temperatures in the range of 100 degrees Fahrenheit and 350 degrees Fahrenheit. All of the equipment indicated above shall be a subsidiary obligation of the contract.

959-6 BASIS OF ACCEPTANCE

959-6.01 Measured Conformance –

a. The acceptability of the quality of the hot plant mix bituminous pavement (Superpave) will be based on the results of the sampling and testing performed as called for in Article 959-4.01 above as compared to the specification limits for acceptance quality characteristics (asphalt binder content (Pb), and volumetrics (volumetrics is defined as air voids at N_{design}) and In-place Compaction (IPC)), acceptance quality levels stated in the specification and conditions provided in subsequent paragraphs herein.

As part of the basis of acceptance, percent of material within specification limits (PWL) and price adjustment factors (individual and composite) will be determined for each acceptance quality characteristic (Pb, Va and IPC) as described in b, c and d below:

b. Percent within limits (PWL) - The variability-unknown, standard deviation method will be used to determine the estimated percentage of the LOT that is within specification limits. The number of significant figures used in the calculations will be in accordance with requirements of AASHTO R 11, Absolute Method. PWL will be calculated as described below. Variables used in the calculations are as follows:

x = individual test value (sub-lot)
n = number of tests (sub-lots)
s = sample standard deviation
$\Sigma(x^2)$ = summation of squares of individual test values
$(\Sigma x)^2$ = summation of individual test values squared
Q_U = upper quality index
USL = upper specification limit (target value plus upper specification limit)
Q_L = lower quality index
LSL = lower specification limit (target value minus lower specification limit)
P_U = estimated percentage below the USL
P_L = estimated percentage above the LSL

(1) Calculate the arithmetic mean of the test values:

$$\overline{X} = \frac{\sum x}{n}$$

(2) Calculate the sample standard deviation (s):

$$s = \sqrt{\frac{n\sum\left(x^2\right)-\left(\sum x\right)^2}{n(n-1)}}$$

(3) Calculate the upper quality index (Q_U):

$$Q_U = \frac{\text{USL} - \overline{\text{X}}}{\text{s}}$$

(4) Calculate the lower quality index (Q_L):

$$Q_L = \frac{\overline{X} - LSL}{s}$$

(5) From Table 959-9 below, determine the percentage of work below the USL (P_U).

(6) From Table 959-9 below, determine percentage of work above the LSL (P_L).

(7) If Q_U or Q_L is a negative number, then calculate the percent within limits for Q_U or Q_L as follows: enter Table 959-10 with the positive value of Q_U or Q_L and obtain the corresponding percent within limits for the proper sample size. Subtract this number from 100.00. The resulting number is the value to be used in the next step (Step 8) for the calculation of quality level.

(8) Calculate the percent within limits (PWL) = (P_U + P_L) - 100

TABLE 959-10

Percent Within Limits (PWL)		
Q Index	**Sample Size**	
	3	**4**
	PWL for Selected Sample Size	
0	50	50
0.05	51.38	51.67
0.1	52.76	53.33
0.15	54.15	55
0.2	55.54	56.67
0.25	56.95	58.33
0.3	58.37	60
0.35	59.8	61.67
0.4	61.26	63.33
0.45	62.74	65
0.5	64.25	66.67
0.55	65.8	68.33
0.6	67.39	70
0.65	69.03	71.67
0.7	70.73	73.33
0.75	72.5	75
0.8	74.36	76.67
0.85	76.33	78.33
0.9	78.45	80
0.95	80.75	81.67
1	83.33	83.33
1.05	86.34	85
1.1	90.16	86.67
1.15	97.13	88.33
1.2	100	90
1.25	100	91.67
1.3	100	93.33
1.35	100	95
1.4	100	96.67
1.45	100	98.33
1.5	100	100

Note: PWL for a Quality Index higher than 1.5 shall be taken as 100.

c. Individual Price adjustments factors (PAF) – PAF will be determined for each mixture properties (Pb, Va, and In-place Compaction). PAF will be calculated using the following equation:

Price Adjustment Factor (PAF) = (55 + 0.5 x PWL) / 100

In cases in which there is **Two or Less Sublot Test Results** Pay Adjustment Factor will be calculated as per the Table Below (Small Quantity Table)

TABLE 959-11 SMALL QUANTITY PAY TABLE

Pay Adjustment Factor	1 Sublot Test Deviation	2 Sublot Test Average Deviation
Asphalt Binder Content (Pb)		
1.05	0.00-0.23	0.00-0.16
1.00	0.24-0.45	0.17-0.32
0.90	0.46-0.55	0.33-0.39
0.80	>0.55	>0.39
Air Voids (Va)		
1.05	0.00-0.55	0.00-0.39
1.00	0.56-1.10	0.40-0.78
0.90	1.11-2.00	0.79-1.41
0.80	2.01-2.25	1.42-1.59
0.70	2.26-2.50	1.60-1.77
0.55	>2.50	>1.77
In-Place Compaction (IPC)		
1.05	0.00-0.50	0.00-0.35
1.00	0.51-1.00	0.36-0.71
0.95	1.01-1.50	0.72-1.06
0.90	>1.50	>1.06

d. Composite Price Adjustment Factor (CPAF) (value of work): A Composite Price Adjustment Factor for the lot will be calculated based on the individual Price Adjustment Factors (PAF) with the following weighting applied: 20 percent asphalt content (Pb), 30 percent air voids (Va and 50 percent In-place Compaction (IPC). Calculate the CPF by using the following formula:

CPAF = [(0.2 x PAF Pb) + (0.3 x PF Va) + (0.5 x PF IPC)]

The price adjustment for each lot shall be computed by multiplying the Composite Price Adjustment Factor (CPAF) by the contract unit price per ton of Superpave mix.

e. Acceptable Quality Level[9] (AQL):

(1) A lot with all Acceptance Quality Characteristics with PWL equal to or greater than 90 percent will have a Pay Factor equal or greater than 1.

f. Rejectable Quality Levels [10](RQL):

(1) **PAF Below 0.85 (PWL below 60 percent) -** In the event that an individual PAF for the Pb and Va acceptance quality characteristics of a lot falls below 0.85, the material represented by that lot will be considered rejected. However, at the discretion of the Authoritythe material represented by the rejected lot may remain in place but at a 50 percent reduced unit price.

(2) **PAF Below 0.80 (PWL below 50 percent) -** In the event that the individual PAF for the IPC acceptance quality characteristic of a lot falls below 0.80, the material represented by that lot will be considered rejected. However, at the discretion of the Authoritythe material represented by the rejected lot may remain in place but at a 50 percent reduced unit price.

(3) **CPAF Less Than 0.75** - In the event that the CPAF is less than 0.75, the material represented by that lot will be considered rejected. However, at the discretion of the Authority the material represented by the rejected lot may remain in place but at a 50 percent reduced unit price.

[9]*Acceptable Quality Levels – Minimum level of quality at which the material is consider acceptable.*

[10]*Rejectable Quality Levels – Maximum level of actual quality at which the material can be considered unacceptable (rejectable).*

g. Moisture Susceptibility - At the option of the Authority the acceptability of the Superpave mix for moisture susceptibility requirements will be determined as follows using both Field Mixed – Laboratory Compacted[11] and Field Mixed – Field Compacted[12] conditions:

(a) For all samples, AASHTO T 283 testing procedures including freeze and thaw cycles shall be used. The diameter of the specimens or cores for all types of Superpave mixes shall be 6-inch.

(b) All Field Mixed – Laboratory Compacted samples shall be compacted to 7 +/- 0.5 Air Void Content using the Superpave Gyratory Compactor (AASHTO T 312).

(c) Tensile Strength – The production mix shall have a minimum of 85 percent of the Superpave mix design Tensile Strength.

(d) Retained Tensile Strength Ratio (TSR) – The production mix shall have a minimum of 85 percent of the Superpave mix design TSR.

(e) The Authority could refuse further deliveries of mixes from the plant until the deficiencies have been corrected including the submission of a new job-mix formula.

[11]Field Mixed – Laboratory Compacted condition - Sampling is performed on the Superpave mix produced by the asphalt plant. Testing is done on samples compacted using the Superpave Gyratory Compactor.

[12]Field Mixed – Field Compacted condition – Sampling and testing are performed on the Superpave mix placed and compacted at the project site (cores).

h. The acceptability of the quality of the hot plant mix bituminous pavement (Superpave) will also be based on the results of any additional random sampling and testing performed on any mix design property (acceptance quality characteristics) as established on Section 959-3 above as determined by the Engineer at any point during production, lay down, or after final placement. In case of non compliance of the aggregate, asphalt binder, chemical anti-strip agent, mix produced and/or mix placed and compacted to meet the requirements of the specification, the Authority could refuse further deliveries of mixes from the plant until the deficiencies have been corrected including the submission of a new job-mix formula. Material already delivered to the project site will be paid for at 50 percent of the unit price.

i. Retesting – Retesting will be conducted as follows:

Retesting will be permitted for the In-place Compaction (IPC) Acceptance Quality Characteristic described in this specification.

Request for retesting for other Acceptance Quality Characteristics (Pb and Va) will be evaluated by the Authority in a case by case basis. Evaluation of the request for retesting of a lot will consist in statistically comparing Contractor Quality Control test results with Authority Acceptance test results. The statistical comparison will be made using the F-test and t-test and by using a level of significance of 0.05. If from the above statistical analysis it is determined that there is a difference between tests results, retesting will be conducted as describe below. Retesting will be performed by using the material represented by the lot and stored at the plant laboratory. At the option of the Contractor, the Authority's AASHTO Accredited Laboratory can perform free of charge the retesting of samples. The Contractor may also choose to propose another AASHTO Accredited Laboratory to serve as a referee laboratory. Test results of either the Authority's or Referee Laboratory will be used for acceptance purposes. Cost related to Referee laboratory will be at no cost to the Authority.

j. Acceptability of Segregated HMA (segregated areas and/or longitudinal streaks sections) – The acceptability of HMA pavement were segregation[13] is perceived to be present will be determined in conformance with **PRHTA T 401-30 - Determination of HMA Pavement Density Profile** and based upon the following criteria:

1. Will be considered acceptable if both of the following conditions are met:

   a. Maximum - minimum density range is less than 5.0 pcf.

   b. Mean – minimum density range is less than 3.0 pcf.

2. Will be rejected if any of the requirements above are not met. The section(s) shall be removed at the contractor expense and replaced.

[13]*Segregation - The non-uniform distribution of HMA coarse and fine aggregate components. Segregation can be determined visually as pavement sections that have a significantly different texture than the surrounding material.*

k. Acceptability of HMA with Bleeding - The acceptability of HMA pavement were bleeding[14] is perceive to be present will be determined in conformance with **PRHTA T 401-40 - Determination of Asphalt Binder Content of Compacted HMA** and based upon the following criteria:

1. Will be considered acceptable if the following condition is met:

a. Asphalt content (Pb) is within the range of +/-0.60 from JMF.

2. Will be rejected if it does not meet the requirement above. The section(s) shall be removed at the contractor expense and replaced.

[14]*Bleeding (Excess surface asphalt) - A shiny, black surface caused by liquid asphalt migrating to the pavement surface. The result can mean a loss of surface texture on the pavement.*

959-6.02 Sampling Repairs - The Contractor shall, at his expense, refill all core holes and other sampling cuts in the pavement courses which are accepted with mix of the appropriate type, placed and compacted to the satisfaction of the Engineer. On roadways open to traffic, the repairs shall be made on the same day the cuts and cores are taken.

959-7 METHOD OF MEASUREMENT

959-7.01 Plant-mix bituminous pavement courses will be measured by the ton of compacted mixture placed in the accepted work, as called for in the contract documents. Measurement will be by weighing the delivery trucks at approved scales. Batch weights will not be accepted as a method of measurement.

959-7.02 Due to possible variations in the specific gravity of the aggregates, the tonnage used may vary from the contract quantities and no adjustment in the contract unit price will be made because of such variation.

959-7.03 Work prescribed under Article 959-5.08, Preparation of Surface to be paved, except for the leveling course and mix material used for patching and correcting irregularities in old surfaces, will not be measured directly for payment, but will be considered as a subsidiary obligation of the Contractor under the various items of hot plant-mix bituminous pavement. Hot plant-mix material used for patching and leveling in this work will be measured for payment under the respective unit prices.

959-7.04 The Acceptance Laboratory will not be measured directly for payment. It shall be considered as a subsidiary obligation of the Contractor with its costs included in the several pay items under this specification. (Rev.: November 16, 2010)

SPECIAL PROVISION 959 - HOT MIX ASPHALT (HMA) PAVEMENT (SUPERPAVE)

959-8 BASIS OF PAYMENT

959-8.01 The completed and accepted quantities of each class of hot plant mix pavement (Superpave), measured as provided above, will be paid for at the contract unit price per unit of measurement except as specified in article 959-6.01 above. Such prices and payment shall constitute full compensation for the cost of the mix design and other related costs, preparation of the surface to be paved; the furnishing and placing of any required prime or tack coat; and the furnishing, placing, compacting and finishing of all required materials for the pavement; smoothness of the final pavement surface and for all labor, equipment, tools and incidentals necessary to complete each item of work, including the quality control plan, as required by the plans and specifications.

959-8.02 – INTENTIONALLY OMITTED (Rev.: November 16, 2010)

959-8.03 Control Strip Section – Control Strip Section will be paid for at the contract unit price per unit of measurement. Such prices and payment shall constitute full compensation for the cost of cold milling, if required, preparation of the surface to be paved; the furnishing and placing of any required prime or tack coat; and the furnishing, placing, compacting and finishing of all required materials for the control strip section; and for all labor, equipment, tools and incidentals necessary to complete said work.

959-8.04 Payment will be made under: (Rev.: November 16, 2010)

Pay Item	Pay Unit
Hot Plant-Mix Bituminous Pavement Superpave Mix (**SPS**).....	Ton
Hot Plant-Mix Bituminous Pavement Superpave Mix (**SPB**).....	Ton
Hot Plant-Mix Bituminous Pavement Superpave Mix (**SPL**).....	Ton
Control Strip Section …….	Ton