

**Division 9.2**  
**BITUMINOUS CONCRETE**

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**PART 1 GENERAL**

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**1.1 SECTION INCLUDES**

- A. Composition of a bituminous concrete mix.

**1.2 REFERENCES**

**A. AASHTO Standards:**

- M323 Superpave Volumetric Mix Design, Single User Digital Publication
- R18 Standard Recommended Practice for Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- R30 Mixture Conditioning of Hot-Mix Asphalt (HMA)
- T324 Hamburg Wheel-Track Testing of Compacted Hot-Mix Asphalt (HMA)

**B. AI Standards:**

- MS-2 Asphalt Mix Design Methods.

**C. ASTM Standards:**

- C29 Unit Weight and Voids in Aggregate.
- C88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- C117 Materials Finer Than 0.075mm (No. 200) Sieve in Mineral Aggregates by Washing.
- C131 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- C136 Standard Method for Sieve Analysis of Fine and Coarse Aggregate.
- C142 Clay Lumps and Friable Particles in Aggregates.
- D75 Sampling Aggregates.
- D140 Sampling Bituminous Materials.
- D242 Mineral Filler for Bituminous Paving Mixtures.
- D979 Sampling Bituminous Paving Mixtures.
- D995 Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
- D2041 Theoretical Maximum Specific Gravity of Bituminous

## Paving Mixtures.

- D2172 Standard Test Methods for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures.
- D2419 Sand Equivalent Value of Soils and Fine Aggregate.
- D3203 Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.
- D3515 Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
- D3665 Random Sampling of Construction Materials.
- D3666 Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials.
- D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- D4552 Classifying Hot-Mix Recycling Agents.
- D4791 Flat or Elongated Particles in Coarse Aggregate.
- T283 Effect of Moisture on Asphalt Concrete Paving Mixtures.
- D5444 Mechanical Size Analysis of Extracted Aggregate.
- D5821 Determining the Percentage of Fractured Particles in Coarse Aggregate.
- D6307 Determining Asphalt Content of Hot-Mix Asphalt by Ignition Method.
- D6373 Performance Graded Asphalt Binder.

**D. Other:**

Zeida, W., Underwood, S., Stemphiar, J., "Extraction of Aramid Fibers from Fiber Reinforced Asphalt Concrete – Special Test Method", Arizona State University, May 11, 2016.

## 1.3

**DEFINITIONS**

**A. Mix Designator:** An alphanumeric code that identifies binder grade, aggregate grade, and compaction level for a bituminous concrete mix. For example:

- *PG64-34, SP-1/2, 75Nd*: PG64-34 is a Performance Graded Asphalt Binder. SP-1/2 is the aggregate gradation. 75Nd is the compaction level using Superpave mix design process.
- B. Bituminous Binder:** A graded bituminous cement composed of any of several viscous or solid mixtures of hydrocarbons and their nitrogen and sulfur derivatives, whose combined properties meet a defined standard.
1. Virgin Asphalt Binder: A refined or manufactured bituminous

cement known as performance graded asphalt binder (PG or PGAB) meeting the requirements of UDOT standard specification 02745.

2. Recycled Asphalt Binder: A bituminous cement contained in recycled asphalt pavement known as performance graded asphalt binder (PG or PGAB).

C. **Mean of Deviations:** The sum of the absolute values of the variance between each screen target value and each measured value divided by the number of tests in the Lot.

D. **Nominal Maximum Size:** One sieve size larger than first sieve size retaining more than 10 percent of the Sample. One hundred percent of the aggregate might be able to pass through the nominal maximum size sieve but not more than 10 percent will be retained on the sieve below. The **maximum size** sieve will be one (1) sieve size larger than the nominal maximum size.

E. **RAP:** Acronym for reclaimed asphalt pavement. A granular product recovered from a bituminous pavement containing aggregate and an Asphalt Binder.

F. Fiber Reinforced Asphalt Concrete:

1. Fiber reinforced asphalt concrete (FRAC): A mixture of hot or warm mix asphalt and high tensile strength aramid and polyolefin fiber blend specially formulated to reinforce hot mix asphalt that has greater resistance to rutting, thermal cracking, fatigue cracking, and reflective cracking as compared to conventional non-fiber asphalt mixes.

G. **Quality Control:** Sampling, testing and inspection efforts performed by the Contractor to control the mix production and placement operations. Locations, times, practices and personnel (other than Lab AMRL Accreditation and minimum requirements in Article 3.3) are the contractor's decision.

1. Requirements for Quality Control that will be used in acceptance decisions will be defined by the Owner in Article 3.3 of this specification.

H. **Quality Assurance:** Sampling, testing and inspection efforts, and personnel/laboratory qualifications that are utilized by the Owner to verify compliance of the mix production and placement with specifications. Locations, times, practices and personnel are at the Owner's decision.

I. APWA: American Public Works Association, Utah Chapter, current edition.

J. UDOT: Utah Department of Transportation

## 1.4 SUBMITTALS

### A. General:

1. Pre-approved Mix Design: Submit name and address of Supplier.
2. Allow ENGINEER 10 days to evaluate mixing equipment and mix design submittals.
3. Once a mix design is accepted, a new mix design submittal is required if the following occurs.
  - a. Asphalt Binder grade is changed.
  - b. Aggregate source is changed. When this occurs, submit a physical properties report on the proposed aggregates.
  - c. Fiber source is changed.

### B. Quality Assurance:

1. Certified Laboratory: Submit names, certification levels, and years of experience of Quality Control field technicians that are assigned to the Work. Verify laboratory complies with ASTM D3666 or AASHTO R-18, and follows APWA Section 01 45 00 requirements.
2. Mix Production Equipment: Submit verification by an individual acceptable to ENGINEER, that plant equipment complies with requirements of ASTM D995.
3. Testing Report: Submit a report of source quality control testing performed by CONTRACTOR and Suppliers.in accordance with article 3.3 of this specification.
4. Testing Report: Submit Quality Control data to the Engineer within 3 working days after completion of each day of paving or prior to the start of the next paving day, whichever is sooner.
5. Plant Production Report: Submit daily plant production records to the Engineer within 1 working day after completion of each day of paving and prior to the start of the next paving day.
  - a. Plant report must include weights of all individual aggregates, bitumens, water and other additives incorporated in mix, including RAP, lime, mineral filler, fiber or other additives.

### C. Mix Design: Submit the following.

1. Date of mix design. If the date is not from the current paving season (calendar year), the mix design is deemed invalid and 1) must be accompanied with a letter from the Asphalt Supplier certifying that the mix design is still valid for the current paving season, or 2) a new mix design must be substituted.

- a. Mix designs dated prior to the previous paving season are invalid.
  - b. Mix designs are invalid if aggregate source, fiber source or binder grade are changed.
  - c. Invalidated mix designs must be revalidated for volumetric properties (minimum 4 pucks), or a replaced with a new mix design.
2. Binder source type, and grade. Disclose if RAP is used in the mix.
  3. Fiber source and type.
    - a. Representative fiber blend product sample.
    - b. Fiber blend product data sheet and certification from the Manufacturer certifying Reinforcement blend must contain virgin aramid and pololefin fibers. Non-aramid fiber blends, aramid fiber blends with dosages less than 1 pound per ton, or ton equivalencies will not be considered as an acceptable alternative to this specification.
    - c. Manufacturer's instructions and general recommendations
    - d. Submit a minimum of 5 unique project examples and references where the reinforcing fiber blend product was used within a 250 mile radius of the project location.
  4. Optimum compaction temperature at the project site.
  5. Theoretical maximum specific gravity.
  6. Compaction density at design target air voids.
  7. Target Grading Curve for aggregate.
  8. Binder target percentage, dust to binder ratio, and the following:
    - a. Voids in the mineral aggregate (VMA)
    - b. Voids filled with Asphalt (Bituminous Binder) also known as VFA
    - c. Hamburg Wheel Tracker results.
  9. Percentages of 1) mineral filler, 2) anti-strip (if required), 3) reclaimed bituminous pavement (RAP), 4) recycle agent in the mix, 5) virgin aggregate and 6) Aramed Fiber
  10. Aggregate physical properties (this section article 2.2). The information is for suitability of source and not for project control. A new report may be required if aggregate source is changed. Test results shall not be older than two (2) calendar years from the date of submission.

## 1.5 MATERIALS QUALITY

- A. Do not change aggregate source or binder grade until the ENGINEER accepts new grades and new or revalidated mix design.
- B. HMA Mixing Plant: Capable of meeting ASTM D995 requirements or use UDOT Qualified Plant.
- C. Perform Quality Control efforts in accordance with Article 3.3 of this specification.
  1. Submit Quality Control data to the Engineer. Submit data within 3 working days after completion of each day of paving or prior to the start of the next paving day, whichever is sooner.

## 1.6 MATERIALS ACCEPTANCE

### A. General:

1. Acceptance is by Lot. One (1) Lot is one (1) days' production. At Engineer's discretion and in concurrence with the contractor, multiple small lots may be combined into one lot. Obtain concurrence prior to placement of lots.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring material as part of its installation, APWA Section 01 29 00.
3. If test results are not within this section's limits, options include correction of production procedures or production of an alternate mix design acceptable to ENGINEER.
4. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements in APWA Section 01 35 10 are met.

### B. Mix Sampling and Testing: (Quality Control and Assurance)

1. Sub-lot size is 500 tons or part thereof.
2. Sampling Protocol: ASTM D3665 and ASTM D979. Collect at least one (1) random Sample per sub-lot from behind paver and before compaction. For placements with a design thickness of 2 inches or less, samples may be taken at the plant. Any sample collected because of non-uniform appearance shall not be used in determining a pay factor for the Lot.
  - a. Sampling binder, ASTM D140. At owner's request, take 1 qt. sample and provide to owner's representative.
3. Quality Control (Performed by the Contractor) and Assurance Testing Protocol (Performed by the Owner's Quality Assurance Organization at the Owner's discretion):

- a. Project Less than 1000 tons – Mix samples will be compacted in the laboratory and tested for:
    - 1) Binder content, ASTM D6307.
    - 2) Aggregate gradation, ASTM D5444.
    - 3) Maximum Specific Gravity (Rice), ASTM D2041
    - 4) Fiber distribution.
  - b. Project greater than 1000 tons - Mix samples will be compacted in the laboratory and tested for:
    - 1) Air voids, ASTM D3203.
    - 2) Voids in the mineral aggregate, AI MS 2.
    - 3) Binder content, ASTM D6307.
    - 4) Aggregate gradation, ASTM D5444.
    - 5) Maximum Specific Gravity (Rice), ASTM D2041
4. Reporting: If used, the Quality Assurance organization will provide the contractor with acceptance results within 3 working days after completion of each day of paving, or prior to the start of the next paving day, whichever is sooner.
- C. **Lot Acceptance:** The materials in a Lot are acceptable if binder content and aggregate gradation test average deviations are within pay factor 1.00 limits in Table 1 and no sub-lot deviation exceeds 0.85 pay factor limit.
- E. **Un-Accepted Lots (Owner Issued Contracts):** At the Engineer’s discretion, a lot with an average deviation that does not meet 1.00 pay factor and does not have a sub-lot test deviation greater than pay factor 0.85 limits may be accepted with a pay factor in accordance with Table 1.
- 1. Lots with a pay factor lower than 0.85 or with a sub-lot with a test deviation greater than the pay factor 0.85 limits, and with Engineer and Contractor concurrence, are subject to an Engineering Analysis.

Table 1 – Pay Factors					
Criteria	Pay Factor	Range of Mean of Deviations of Tests Results in Percentage Points from Binder and Gradation Targets			
		500 Tons	1,000 Tons	1,500 Tons	≥ 2,000 Tons
Binder Content	1.00	0.0 – 0.46	0.0 – 0.41	0.0 – 0.38	0.0 – 0.35
	0.95	0.47 – 0.58	0.42 – 0.52	0.53 – 0.58	0.47 – 0.52
	0.90	0.59 – 0.64	0.53 – 0.56	0.59 – 0.64	0.53 – 0.56
	0.85	0.65 – 0.69	0.57 – 0.61	0.65 – 0.69	0.57 – 0.61

Nominal Sieve	1.00	0.0 – 6.3	0.0 – 5.6	0.0 – 5.3	0.0 – 5.0
	0.95	6.4 – 7.9	5.7 – 7.0	5.4 – 7.9	5.1 – 7.0
	0.90	8.0 – 8.7	7.1 – 7.7	8.0 – 8.7	7.1 – 7.7
	0.85	8.8 – 9.5	7.8 – 8.4	8.8 – 9.5	7.8 – 8.4
No. 8 Sieve	1.00	0.0 – 4.8	0.0 – 4.3	0.0 – 4.0	0.0 – 3.8
	0.95	4.9 – 6.0	4.4 – 5.3	4.1 – 5.0	3.9 – 4.3
	0.90	6.1 – 6.6	5.4 – 5.8	5.1 – 5.6	4.4 – 4.8
	0.85	6.7 – 7.2	5.9 – 6.4	5.7 – 6.2	4.9 – 5.4
No. 50 Sieve	1.00	0.0 – 3.8	0.0 – 3.3	0.0 – 3.0	0.0 – 2.8
	0.95	3.9 – 5.0	3.4 – 4.3	3.1 – 4.0	2.9 – 3.3
	0.90	5.1 – 5.6	4.4 – 4.8	4.1 – 4.6	3.4 – 3.8
	0.85	5.7 – 6.2	4.9 – 5.4	4.7 – 5.2	3.9 – 4.4
No. 200 Sieve	1.00	0.0 – 2.0	0.0 – 1.8	0.0 – 1.8	0.0 – 1.8
	0.95	2.1 – 2.4	1.9 – 2.2	1.9 – 2.2	1.9 – 2.2
	0.90	2.5 – 2.7	2.3 – 2.4	2.3 – 2.4	2.3 – 2.4
	0.85	2.8 – 3.0	2.5 – 2.6	2.5 – 2.6	2.5 – 2.6
NOTES					
(a) Test binder content using a burn-off oven, ASTM D6307.					
(b) Determine aggregate gradation by extraction, ASTM D5444.					

#### F. Engineering Analysis:

1. Submit an Engineering Analysis, performed and stamped by a Utah Registered Professional Engineer or Mix Supplier QC Manager with commensurate experience in materials and pavements performance, for approval within one week of receipt of test results or at least 24 hours before performing any work that may prevent the evaluation, correction, or removal of the lot in question.
2. Include information, engineering analysis, statistical analysis, and test results related to the dispute.
  - a. Reasons for disputing the acceptance or verification test results.
  - b. The Contractor's project quality control test results, including any split sample test results.
    - 1) Test results must be from a UDOT qualified laboratory using UDOT qualified technicians, or results must be verified and certified (stamped) by a Utah Registered Professional Engineer.
    - 2) Include all supporting test data and calculations for reported values.
  - c. Successful laboratory correlation information when required by material specification.
  - d. Statistical analysis or identification of potential outliers.
  - e. Procedures or issues leading to disputed acceptance test results.

**G. Installation:** See APWA [Section 32 12 16.13 ACCEPTANCE](#) requirements for density and thickness. Determine density on Trails, Class 1 and Class 2 roads by nuclear gauge. Determine density and thickness on Class 3 roads by coring.

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## PART 2 PRODUCTS

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### 2.1 BINDER

**A. Performance Graded Asphalt Binder (PGAB):** See UDOT standard specification 02745.

1. Use the following minimum final mix binder grades unless otherwise specified.

Table 2 –Virgin Binder Grade at USU Locations			
All Roadways: PG 64-34			PG 70-28
Logan	Tooele	Delta	St George
Brigham City	Salt Lake	Junction	
Tremonton	Orem	Panguitch	
Kaysville	Beaver	Cedar City	
Park City	Nephi	Kanab	
Heber City	Richfield	Moab	
Vernal	Price	Monticello	
Roosevelt	Castle Dale	Monument Valley	
	Ephraim	Blanding	
	Bicknell	Montezuma Creek	
All Parking Lots: PG 64-34			
Notes: A. Virgin Binder grade is the grade of asphalt binder received from binder supplier and added to the mix. Design Binder grade is the grade of virgin asphalt binder specified when using 15% or less RAP. B. Use of grades exceeding minimum Virgin grade is acceptable.			

2. Limit mix designs to 15% RAP by mix weight or 15% RAP binder by binder weight, whichever results in less RAP.

## 2.2 AGGREGATE

- A. Crushed stone, crushed gravel, slag, sand, or combination.
- B. Use Table 3 to determine suitability of aggregate source.

<b>Table 3 – Aggregate Physical Properties</b>				
		Standard	Road Class	
			I & II	III
<b>Coarse Aggregate</b>				
Angularity, percent, minimum	One Fractured face	D5821	90	95
	Two Fractured faces		90	90
Wear (hardness or toughness), percent, maximum		C131	35	35
Flats or elongates (3:1 length to width), percent, maximum		D4791	--	20
<b>Fine Aggregate</b>				
Angularity (uncompacted void content), percent, minimum		T304	40	45
Sand equivalent, percent, minimum		D2419	45	60
Plastic limit, maximum		D4318	0	0
<b>Blended Physical Properties</b>				
Dry-rodded Unit Weight, lb/ft <sup>3</sup> , minimum		C29	75	75
Weight Loss (Soundness), percent, maximum		C88	16	16
Friable particles, percent, maximum		C142	2	2
NOTES				
(a) Road Class is defined in Section 2.4.E .				
(b) Course aggregate does not pass No. 4 sieve. Fine aggregate does pass.				
(c) Angularity is determined by weight.				
(d) Wear of aggregate may have higher values if aggregate source is known to have higher values.				
(e) Sand equivalent is waived for RAP or ROSP aggregate but applies to the remainder of the aggregate blend.				
(f) Plastic limit, passing No. 40 sieve. Aggregate is non-plastic even when filler material is added to the aggregate.				
(g) Weight loss, using sodium sulfate.				
(g) Friable particles are clay lumps, shale, wood, mica, coal passing the No. 4 sieve, and other deleterious materials.				

## 2.3 ADDITIVES

- A. Mineral Filler: ASTM D242.
- B. Recycle Agent: ASTM D4552.
- C. Anti-strip Agent: Heat stable cement slurry, lime slurry, or chemical liquid as required to meet TSR or Hamburg test requirements.

- D. RAP: Free of detrimental quantities of deleterious materials.
  - 1. Allowed up to 15 percent by weight of RAP or binder, whichever is lesser, with no change in virgin binder grade.
  - 2. Determine RAP binder content by chemical extraction.
- E. Reinforcing Fibers for Asphalt:
  - 1. Reinforcing Fiber Properties
    - a. Provide a reinforcing fiber blend of Polyolefins and VirginAramids that meets the requirements in Table 4 below.

Table 4

<b>Reinforcing Fiber Material Properties</b>			
<b>Property</b>	<b>Test Method</b>	<b>Polyolefin</b>	<b>Aramid</b>
Form	Manufacturer Certification	Serrated	Monofilament
Tensile Strength (psi)	ASTM D7269	NA1	400,000
Length (in)	Manufacturer Certification	0.75	0.75

- b. FORTA-FI<sup>®</sup>, fiber reinforcement, HMA blend by FORTA Coproration is an approved product and meets the performance and material properties standard.

Technical Contact:

Nolan Poulson  
(801) 793-7259

Nolan@PacificGeoSource.com

Non-aramid fiber blends, aramid fiber blends with dosages less than 1 pound per ton, or ton equivalencies will not be considered as an acceptable alternative to this specification.

**2 FIBER STORAGE, MIXING AND MIX PRODUCTION**

- a. Store, mix and produce the fiber reinforced HMA mixture in accordance with the following requirements:
  - 1. Deliver fiber-reinforcement in sealed, undamaged containers to location where it will be added to each batch or loaded into the mixer.
  - 3. Store materials covered and off the ground. Keep sand and dust out of boxes and do not allow boxes to become wet.

4. Add aramid and polyolefin reinforcing fiber blend at a dosage rate of one (1) pound fiber per one (1) ton of asphalt. Non-aramid fiber blends, aramid fiber blends with dosages less than 1 pound per ton, or fiber ton equivalents will not be accepted.
5. Have a fiber manufacturer's representative on site during mixing and production. This requirement can be waived if fiber manufacturer and asphalt producer can supply evidence of manufacturer's brand of fiber being successfully produced a minimum of three times at the asphalt plant to be used for the project.
6. Batch Plant. When a batch plant is used, add fiber to the aggregate in the weigh hopper and increase both dry and wet mixing times. Ensure that the fiber is uniformly distributed before the injection of asphalt cement into the mixture.
7. Drum Plant: a. Inject fibers through the RAP collar manually or by feeding them with a metered air blown system to promote rapid and complete fiber dispersion. Rate the feeding of fibers with the rate the plant is producing asphalt mix. If there is any evidence of fiber bundles at the discharge chute, increase the mixing time and/or temperature or change the angle of the fiber feeder line to increase dry mixing time. b. Add fibers continuously and in a steady uniform manner. Provide automated proportioning devices and control delivery within  $\pm 10\%$  of the mass of the fibers required. Perform an equipment calibration to the satisfaction of the fiber manufacturer's representative to show that the fiber is being accurately metered and uniformly distributed into the mix. Include the following with the air blown system:
  - Low & No-flow level indicators
  - A printout of feed rate status in pounds/minute
  - A section of transparent pipe in the fiber supply line for observing consistency of flow or feed.
  - Manufacturer's representative's approval of fiber addition system

## 2.4 MIX DESIGN

### A. Preparation:

1. Mix Designator and Road Class as defined in section 2.4.E.
2. Use paragraph 1.4C to determine submittal requirements.

**B. Aggregate Gradation:** See Table 4. The Target Gradation Curve for the specified aggregate grade must lie within the Master Grading Band limits. The target grading band limits for the Target Grading Curve are the appropriate grading limits for pay factor 1.00 in Table 1.

The target grading band limits are allowed to extend outside of the Master Grading Band limits.

1. Use SP-1/2 unless otherwise identified.

<b>Table 5 - Master Grading Bands - Superpave Mix Design</b>		
Sieve	Gradation Limits of Target Gradation	
	SP-1/2	SP-3/8
1 inch	–	--
3/4 inch	100.0	–
1/2 inch	90.0 – 100.0	100.0
3/8 inch	< 90	90.0 – 100.0
No. 4	–	< 90
No. 8	28.0 – 58.0	32.0 – 67.0
No. 200	2.0 – 10.0	2.0 – 10.0
<p>NOTES</p> <p>(a) Gradation is expressed in percent passing by weight per ASTM C136. Percentage of fines passing No. 200 sieve determined by washing per ASTM C117.</p> <p>(b) The alpha portion of the grade designator (SP) represents Superpave mix. The numerical portion (1/2, 3/8) represents the <b>nominal maximum</b> sieve size.</p>		

D. **Design Parameters:** Determined by AI MS-2 and in accordance with Table 5.

<b>Table 6 - Mix Design Parameters</b>		
	SuperPave	
Compaction Level	<i>Road Class I/II, Paths</i>	50Nd
	<i>Road Class III</i>	75Nd
Design Air Void Target, percent (b)	3.5	
Voids in Mineral Aggregate (VMA) relative to nominal sieve size grading and calculated using Gsb(dry), percent, minimum	ASTM D3203	
	Nominal Grading	
<i>Road Class II/III</i>	1/2	14.2
<i>Road Class I</i>	3/8	15.2
RAP specific gravity for calculations	Gsb (dry) by chemical extraction	
Dust to Binder Ratio, maximum	1.6	
Tensile Strength Ratio (moisture sensitivity), minimum (c,e)	AASHTO T283	
<i>Road Class I</i>	80%	
Rutting (Hamburg Rut Test) (a,d,e)	AASHTO T324	
<i>Road Class II</i>	15 mm/10,000 passes	

<i>Road Class III</i>	10 mm/20,000 passes
<p>NOTES</p> <ul style="list-style-type: none"> <li>(a) Road Class is defined in Section 2.4.E.</li> <li>(b) Design Density Target: See ASTM D2041 T209. Percent of maximum theoretical specific gravity.</li> <li>(c) Tensile Strength Ratio (moisture sensitivity): Use one cycle of Freeze-thaw conditioning. Compact test specimen to seven (7) percent plus or minus one (1) percent air voids.</li> <li>(d) With testing performed at temperatures representing the specified binder grade in the Hamburg rut test, the average rut depth of two (2) mix design test samples is less than the amount shown for the respective Road Classes.</li> </ul>	

#### E. Road Classification

1. Class I: Parking lots, other low traffic/lightly loaded asphalt pavements. Parking lots may be moved to a higher class in the project documents.
2. Class II: All roads not classified I or III and all patches.
3. Class III: Roads listed herein on the Logan Campus
  - a. Aggie Blvd
  - b. 900 N
4. Trails: Walking and Bike Trails

F. Meet the requirements of UDOT 02743 for walking and bike trails.

G. Design all pavements with Fiber. When using fiber, , design asphalt mix without fiber and do not alter the final mix design for the addition of fiber blend at the plant.

## **PART 3 EXECUTION**

### 3.1 CONSTRUCTION EQUIPMENT

- A. Mixing Plant: Capable of meeting ASTM D995 or UDOT Qualified Plant. Provide:
  1. Positive means to determine the moisture content of aggregate.
  2. Positive means to sample all material components.
  3. Sensors to measure the temperature of the mix at discharge.
  4. Ability to maintain discharge temperature of mix.
  5. Capability of maintaining plus or minus five (5) percent tolerance on component percentages in final mix.
  6. Ability to document control efforts.

### 3.2 **INSTALLATION**

- A. Pavement placement, APWA Section 32 12 16.13.
- B. Provide pavement thickness as follows unless otherwise noted in the design documents.
  - 1. Road Class I and Trails: 3”
  - 2. Road Class II: 3”
  - 3. Road Class III: 4”

### 3.3 **QUALITY CONTROL**

- A. For all projects, test temperature of mix placed in the transport vehicle at the production plant.
  - a. Reject mixes exceeding the limits identified in the mix design.
- B. For all projects, collect mix samples randomly from the plant (from truck or hot-drop) or the field (windrow or behind paver), ASTM D3665.
  - 1. Sampling bituminous paving mixture, ASTM D979, minimum one sample per sub-lot.
- C. For projects less than 500 tons, provide one of the following:
  - 1. Plant Report; or
  - 2. Test results for binder content and combined gradation of mix
- D. For projects between 500 and 1500 tons, provide the following for each 500 tons:
  - 1. Combined aggregate gradation in the mix, ASTM D5444.
  - 2. Binder content in the mix, ASTM D6307.
  - 3. Maximum Specific Gravity (Rice), ASTM D2041.
- E. For projects greater than 1500 tons, provide the following for each 500 tons:
  - 1. Combined aggregate gradation in the mix, ASTM D5444.
  - 2. Binder content in the mix, ASTM D6307.
  - 3. Air voids, ASTM D3203.
  - 4. Voids in the mineral aggregate, AI MS 2.
  - 5. Maximum Specific Gravity (Rice), ASTM D2041.
- F. Warm Mix Testing: When rutting or moisture susceptibility tests are required on warm mix produced at temperatures below 275 deg F, condition the warm mix material before testing for two (2) hours at design mixing temperature plus or minus five (5) deg F per

AASHTO R30 (short term aging). The material may be cooled to room temperature before conditioning.

- G. Evaluate fiber reinforced mix dispersion visually according to the following:
1. Aramid Dispersion Visual Test: Collect a 10kg sample of mix from the discharge chute during first 50 tons of production. Visually assess the state of aramid fibers in the sample as “Pass” or “Fail” as described below.
    - a. “Pass” = All fibers exist in an Individual State and no Undistributed Clips or Agitated Bundles of fiber are detected.
    - b. “Fail” = One or more Undistributed Clips or Agitated Bundles are detected.
  2. If a sample is rated as “Fail”, adjust mixing operations to improve fiber dispersion and repeat Step 1 above.
  3. If Visual Test results in three consecutive “Fail” ratings, contact the fiber manufacturer for corrective measures.
  4. In addition to Visual Test, use a shovel to inspect FRAC mix in the back of first three trucks and every tenth truck thereafter to confirm adequate blending of the fiber.
  5. Remove any observed fiber bundles from placed mixture and adjust operations per the manufacturer’s recommendation to eliminate future fiber bundle development, and repeat Steps 1 through 3 above to confirm adequate aramid fiber dispersion.

END OF SECTION