

SECTION 32 12 16.13
PLANT-MIX BITUMINOUS PAVING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

- A. Place a bituminous concrete pavement base course, leveling course, surface course, overlay course, or an inlay course.

1.2 **REFERENCES**

A. **AASHTO Standards:**

- R9 Acceptance Sampling Plans for Highway Construction.
P68 Bulk Specific Gravity and Density of Compacted Asphalt Mixtures Using Automatic Vacuum Sealing Method.
T324 Hamburg Wheel-Track Testing of Compacted Hot-Mix Asphalt (HMA).

B. **ASTM Standards:**

- D979 Sampling Bituminous Paving Mixtures.
D1188 Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples.
D2041 Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures.
D2726 Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
D2950 Density of Bituminous Concrete in Place by Nuclear Method.
D3549 Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
D3665 Random Sampling of Construction Materials.
D5361 Sampling Compacted Bituminous Mixtures for Laboratory Testing.
D6927 Marshall Stability and flow of Bituminous Mixtures.

1.3 **DEFINITIONS**

- A. **Must Grind:** Defined in Section 32 01 31.
B. **Road Class:** Defined in Section 32 01 31.
C. Quality Control/Owner Verification Testing: Defined in Section 32 12 05

1.4 **SUBMITTALS**

- A. Bituminous Concrete Mix Design, Section 32 12 05
B. **Before Delivery:** Submit 48 hours before delivery:
1. Materials Quality Data, this section Article 1.5
2. [Traffic control plan, Section 01 55 26.](#)
3. Manufacturer's certificate of compliance for paving geotextiles. (Refer to [Section 31 05 19](#)).
4. Certification of profilograph and profilograph operator.
5. Cold weather paving plan.
C. **At Delivery:** For each batch delivered to site provide a paper or electronic (e-ticket) delivery ticket with the following:
1. Date and project description.
2. Producer and plant.
3. Name of contractor.
4. Serial number of ticket.
5. Mix identification number or code.
6. Truck number and time dispatched.

- 7. Weight of mix delivered.
 - D. **After Placement:**
 - 1. **Quality Control Test Report:** If required by Section 32 12 05S, submit density and thickness 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.
 - 2. **After Placement:** Before final payment submit summary report describing profile deviation and profile roughness. [Section 32 01 31](#).
- 1.5 **MATERIALS QUALITY**
- A. Do not change aggregate source or binder grade until ENGINEER accepts new source and new mix design.
 - B. Perform Quality Control efforts identified in article 3.8.
 - C. Reject product and work that does not meet requirements of this Section.
 - D. Remove product found defective after installation and install acceptable product at no additional cost to **OWNER**.
 - E. Foreman of paving crew has completed at least three (3) projects of similar size and nature.
 - F. For all equipment and hand tools used to mix, haul, and place the bituminous concrete, use a release agent that does not dissolve asphalt and is acceptable to ENGINEER.
- 1.6 **WEATHER**
- A. Temperature:
 - 1. April 15 to October 15: Place pavement when air temperature in the shade and the roadway surface temperature are above 50 deg F. The ENGINEER determines may provide written approval if it is acceptable to place outside of this temperature limit.
 - 2. Before April 15 and After October 15: Provide a Cold Weather Paving Plan. ENGINEER must accept the plan before proceeding. Include the following details.
 - a. Haul details.
 - b. Placement details.
 - c. Compaction aids used in production.
 - d. Additional equipment and procedures for achieving compaction.
 - e. Coordination procedure for acceptance testing.
 - B. Moisture: Do not place on frozen base, during adverse climatic conditions such as precipitation, or when roadway surface is wet or icy.
- 1.7 **NOTICE**
- A. Follow [Laws and Regulations](#) concerning when and to whom notices are to be given. Send written notice at least three (3) days before start of paving.
 - B. Indicate paving time and when new surface can be used.
 - C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.
 - D. Should work not occur on specified day, send a new notice.
- 1.8 **OWNER VERIFICATION TESTING and ACCEPTANCE**
- A. **General:**
 - 1. Acceptance is by **Lot**.
 - 2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring complying material as part of its installation, [Section 01 29 00](#).
 - 3. Dispute resolution, [Section 01 35 10](#).
 - 4. Opening a paved surface to traffic does not constitute acceptance.
 - 5. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements of Section 01 35 10 are met.
 - B. **Mix Material:** Accepted as specified for [bituminous concrete, Section 32 12 05](#), or [rubberized asphalt concrete, Section 32 12 08](#).
 - C. **Mix Temperature at Site:**

1. Reject mixes in the transport material exceeding the limits identified in the mix design.
 - a. Use calibrated temperature probes for rejection of mix. Use temperature guns for quick approximate temperature readings only.
 2. Dispose of cold mix in paver hopper as thin spread underlay.
- D. **Grade, Cross Slope:** Perform minimum one grade and one cross-slope check per sub-lot.
- E. **Compaction:** Options for acceptance are 1) core density, 2) non-destructive test density, or 3) control strip density with visual observation. Use core density unless specified elsewhere. A Lot is acceptable if density test averages are within pay factor 1.00 limits and no test is below Lowest Test limit. For remediated sublots, include remediated sub-lot tests in Lot evaluation.
1. Un-Accepted Lots: At the Engineer’s discretion, a lot with an average deviation that does not meet 1.00 pay factor and does not have an individual test deviation greater than pay factor 0.80 allowed limits may be accepted with a pay factor in accordance with Table 1.
 - a. Lots with a mat pay factor lower than 0.80 or with a sub-lot with a test deviation greater than the pay factor 0.80 limits, and with Engineer and Contractor concurrence, are subject to an Engineering Analysis.

Table 1 – Compaction Pay Factors				
Pay Factor	Mat Density, in Percent Relative to ASTM D2041 (a)		Joint Density, in Percent Relative to ASTM D2041 (a) (d)	
	Average	Lowest Test	Average	Lowest Test
0.80	More than 98.0	–	More than 98.0	–
1.00	93.0 to 98.0	90.0 or greater	91.0 to 98.0	89.0 or greater
0.90	93.0 to 98.0	Less than 90.0	91.0 to 98.0	Less than 89.0
0.80	Less than 93.0	90.0 or greater	Less than 91.0	89.0 or greater
Eng. Analysis	Less than 93.0	Less than 90.0	Less than 91.0	Less than 89.0

Notes:

- (a) For overlay design thicknesses of less than 2.0”, mat density targets are reduced by 1% and no joint density cores are taken.
- (b) Difference based on actual subplot mat density and subplot core density values.
- (c) Report and calculate all density values to 0.1%.
- (d) A paving Joint is defined as a longitudinal seam between two adjacent passes of asphalt placed during the project, and where the initial pass cools below 180 deg F prior to placement of the adjacent pass. Do not take Joint cores where the “Joint” is comprised of existing asphalt or concrete. Use 6” diameter cores for joint density determination.

2. **Core Density:** This method compares the average density of cores extracted from a pavement surface to maximum theoretical density. Contractor to take cores in the presence of and immediately deliver to the Engineer or Engineer’s representative.
 - a. **Mat Lot Size:** One (1) day production.
 - b. **Mat Sampling Protocol:** Use ASTM D3665 to randomly select in each sub-lot at least one (1) surface test location. Samples are full depth or overlay depth in overlay construction.
 - 1) Projects less than 500 Tons: Use 10 sublots and non-destructive tests. Coring may be used for dispute resolution.
 - 2) Projects between 500 and 1000 Tons: Use 4 equal sublots.
 - 3) Projects between 1000 and 1500 Tons: Use 6 equal sublots
 - 4) Projects greater than 1500 Tons: Use 8 equal sublots.
 - b. **Joint Sampling Protocol:** Use ASTM D3665 to randomly select a total of three (3) longitudinal joint test locations for each joint. Samples are full depth or overlay depth in overlay construction.
 - 1) Use 6” diameter cores, centered within 1 inch of center of joint.
 - 2) Do not core projects smaller than 250 Tons.
 - c. **Testing Protocol:** ASTM D2726 for core density and ASTM D2041 (Rice) for maximum theoretical density.
3. **Non-Destructive Density Testing by Electronic Gauge:**

- a. Lot Size: One (1) day production, with sublots as defined in Article 1.8.E 2 Core Density.
- b. Mat Sampling Protocol: Use ASTM D3665 to randomly select in each sub-lot at least two (2) surface test locations.
- c. Testing Protocol: ASTM D2950 (nuclear gauge) or AASHTO TP68 (non-nuclear gauge) and ASTM D2041 (Rice) for maximum theoretical density. A non-destructive test is the average of two (2) test samples at each test location with a minimum 90 degree offset between test samples using mix correlated gauges. Use minimum 60 second count with Nuclear Gauge.

4. **Compaction Dispute Resolution:**

- a. Submit an Engineering Analysis 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.
 - b. Include information, engineering analysis, statistical analysis, and test results related to the dispute.
 - 1. Reasons for disputing the acceptance or verification test results.
 - 2. The Contractor’s project quality control test results, including any split sample test results.
 - a) 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.
 - b) Include all supporting test data and calculations for reported values.
 - 3. Successful laboratory correlation information when required by material specification.
 - 4. Statistical analysis or identification of potential outliers.
 - 5. Procedures or issues leading to disputed acceptance test results.
5. Provide recommended corrective measures or adjusted pay factor based on engineering evaluation based on durability and serviceability relative to the specified product requirements, including expected performance compared to design life.

F. **Thickness:** A Lot is acceptable if average of test deficiencies, applied to the **total design thickness**, exceeds design thickness or is within pay factor 1.00 limits; and no subplot or individual test below 0.90 pay factor.

- 1. **Un-Accepted Lots:** 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 0.90 allowed limits may be accepted with a pay factor in accordance with Table 2.
 - a. Lots with a pay factor lower than 0.90 or with a sub-lot with a test deviation greater than the pay factor 0.90 limits, and with Engineer and Contractor concurrence, are subject to an Engineering Analysis.

Table 2 – Thickness Pay Factor	
Pay Factors	Deficiency Limits, in Inches
1.00	0.00 to 0.25
0.90	0.25 to 0.375
Remediate	>0.375

- 2. **Lot Size:** One (1) day production with 1,000 square yard sub-lots or part thereof.
- 3. **Sampling Protocol:** Use ASTM D3665 to randomly select at least one surface test location and one longitudinal joint test location in each sub-lot. Samples are full depth. Overlay construction measured only on overlay portion of core sample. Use one of the following methods for thickness determination:
 - a. Measurement of Density Cores

- b. Probe of uncooled mix – perform between intermediate and final rolling operations.
 - c. Ground Penetrating Radar (not applicable to overlay applications).
 - 1) Perform GPR evaluation by scanning and recording depth for full-width of the pavement at one random location for each subplot. Engineer will mark locations for scans. Measure HMA thickness every 6 inches on the recorded scan. Calculate the average thickness, and the percentage of the thickness below each of the tolerance levels described in Article 1.8 F 5.
4. **Testing Protocol:** ASTM D3549:
- a. Minimum Specified Thickness (Cores or Probes): A Lot specified to have minimum thickness will be accepted if all sub-lot measurements meet or exceed minimum.
 - 1) Cores not meeting full payment will be provided to the Contractor for verification of measurements.
 - 2) If thickness is deficient, additional material may be placed over the deficient thickness if rotomilling is utilized for edge tie-in; placement matches this section’s thickness tolerance; surface continues to drain; and roughness tolerance is met.
 - b. Actual Specified Thickness (Cores or Probes): A Lot specified to have actual thickness is acceptable if any sub-lot measurement does not exceed deficiency limits for thickness pay factor 1.00.
 - c. A lot is accepted for thickness based on GPR evaluation when:
 - 1) The average thickness of all scans is not more than ¼ inch less than the total thickness specified.
 - 2) No individual scan shows a deficient thickness of more than ⅜ inch for more than 5% of any scan.
5. **Thickness Dispute Resolution:**
- a. CONTRACTOR:
 - 1) Hire an [Independent Testing Agency, Section 01 45 00](#), or perform in the presence of Engineer (or their representative)
 - 2) Coring Option:
 - i. Take two (2) additional cores midway between deficient acceptance test locations, and midway between a deficient test location and the next adjacent acceptable test location.
 - ii. Patch core holes.
 - 3) Ground Penetrating Radar (GPR) Option:
 - i. Use GPR to determine extents of deficient area.
 - 4) Conduct testing at no additional cost to OWNER.
 - b. ENGINEER:
 - 1) Graph deficient areas by plotting new cores and original cores, or GRP results, to define deficient areas assuming the following.
 - a) The graph represents the thickness of the pavement.
 - b) Thicknesses vary linearly along the pavement length from core depth to core depth.
 - c) The pavement is a constant depth in the transverse direction.
 - 2) Accept Lot at full pay if new information shows minimum of 95% of sub-lot area is in compliance, or
 - 3) Accept Lot at pay reduction using new test information, or
 - 4) Reject Lot.
 - c. REJECT LOTS:
 - 1) Remediate reject thickness lots by adding additional thickness of bituminous concrete, adhering to all requirements of Sections 32 12 05

and 32 1216.13.

- 2) Utilize rotomilling as necessary to achieve proper cross-slope and elevations in relation to existing curb and gutter.

6. **Excess Thickness:** For projects paid by the ton, payment will be made for excess tonnage for thickness up to 1/2" over design thickness. Additional tonnage for thickness above 1/2" will be paid at a 50% pay factor.

G. **Profile Roughness and Profile Deviation:** [Section 32 01 31](#).

1.9 WARRANTY

- A. Joints at [Street Fixtures](#) and Portland Cement Concrete Flat Work: If wider than 1/2 inch before end of the [correction period](#) seal joints with asphalt rubber or rubberized asphalt; [Section 32 01 17](#).

PART 2 PRODUCTS

2.1 MATERIALS

- A. [Bituminous concrete, Section 32 12 05](#).
- B. [Tack coat, Section 32 12 13.13](#).
- C. [Prime coat, Section 32 12 13.19](#).
- D. [Paving geotextile, Section 31 05 19](#).
- E. [Paving geogrid, Section 31 05 21](#).

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

- A. Paver Machine: Use track equipment when operating on fabrics, geogrids or [pavement](#) mats hotter than 180 deg F
- B. Compactors: Steel wheel static or vibratory. Use pneumatic tire roller for intermediate rolling only.

3.2 PREPARATION

- A. General:
 1. Locate and preserve utilities [Section 01 31 13](#). Contact utility companies and other agencies, for dangerous concentration of combustible, flammable, or explosive matter.
 2. Lower [Street Fixtures](#) if paving machine is not capable of passing over the fixtures.
 3. Remove vegetation from cracks, edges and joints. Sweep surface clean. Blow cracks clean. Remove leaves.
 4. Fill cracks and fix [Potholes, Section 32 01 17](#).
 5. Stabilize Portland cement concrete [subgrade](#) slabs.
- B. Traffic Control:
 1. [Implement notification and traffic control plan requirements, Section 01 55 26](#). Do not proceed without certified flaggers.
 2. Apply temporary lane marking tape or paint after layout has been verified with [ENGINEER](#).
- C. Aggregate Base Course:
 1. Do not pave on aggregate base course without written confirmation from the general contractor that the aggregate base course has been inspected and meets the requirements of the project approving authority.
 2. Do not pave on uncompacted or uneven base course. Placement over uneven base course will not be acceptable justification for thickness deficiencies.
 3. If indicated, follow [Section 31 31 19 requirements for herbicide treatment](#) or [Section 32](#)

12 13.19 for prime coat applications.

3.3 **PROTECTION**

- A. Trees, Plants, Ground Cover:
 - 1. Protect trees, plants and other ground cover from damage.
 - 2. Prune trees to allow equipment passage underneath, [Section 32 01 93](#). Repair tree damage at no additional cost to **OWNER**.
- B. Protect all structures, including curb, gutter, sidewalks, guard rails and guide posts from physical damage. Remove spatter, over-coat, or mar.
- C. Do not discharge bituminous materials into borrow pits or gutters.
- D. Protect hot pavement from traffic until cool enough not to become marred.
- E. Remove saw-cut dust immediately. Protect neighborhood, storm drains and down-stream fish habitat.

3.4 **TEMPORARY SURFACING**

- A. Place, roll, maintain, remove and dispose of temporary **Pavement** surfaces.
- B. In sidewalk areas construct temporary **pavements** at least 1 inch thick and in all other areas at least two (2) inches thick. At major intersections and other critical locations a greater thickness may be required.

3.5 **LINE AND GRADE CONTROL**

- A. Provide necessary survey stakes for horizontal and vertical control.
- B. Furnish, place, and maintain supports, wire devices, and materials as required to provide continuous line and grade reference controls for placing pavement, matching existing pavement surfaces, etc.

3.6 **FABRIC PLACEMENT**

- A. [Section 31 05 19](#).

3.7 **PAVEMENT PLACEMENT**

- A. General:
 - 1. Barricade off or eliminate fall off edges.
 - 2. Provide continuous forward paver movement so temperature 10 feet behind paver is as follows:
 - a. Warm Mix Placement: 200 deg F minimum.
 - b. Hot Mix Placement:

Table 3 – Minimum Pavement Temperature in Degrees F.						
Air Temperature Deg F	Compacted Mat Thickness					
	3/4"	1"	1-1/2"	2"	3"	4"+
45 – 50	–	–	–	–	280	265
50 - 59	–	–	–	280	270	255
60 - 69	–	–	285	275	265	250
70 - 79	285	285	280	270	265	250
80 - 89	280	275	270	265	260	250
90 +	275	270	265	260	250	250

- B. Overlays or Subsequent Lifts:
 - 1. Allow new base **pavement** or new inlay **pavement** to cure (harden) before placing overlays.
 - 2. Apply tack coat per [Section 32 12 13.13](#) if inlay or sub-base **Pavement** surface is dirty or older than 24 hours.
- C. Irregular Areas: Handwork is acceptable if specified grade, slope, compaction and smoothness are achieved.
- D. Compaction:
 - 1. Test mix placement for density until a compaction pattern is acceptable to **CONTRACTOR**. Continue random quality control testing throughout placement.

2. Do not over compact or under compact.
 3. Complete compaction before mix cools to uncompactable condition. Cease compaction efforts if aggregate begins to fracture.
- E. Joints:
1. Construct joints to industry standards for texture, density and smoothness. Construct upslope matt flush or above downslope matt. Meet transverse smoothness requirements.
 2. Clean contact surfaces and apply tack coat. Ensure continuous bond between old and new **pavements**, or between successive day's work.
 3. Offset longitudinal joints a minimum of 12 inches in succeeding courses and at least six (6) feet transversely to avoid a vertical joint through more than one course. In the top course restrict longitudinal joint to 1 foot either side of lane lines.
 4. Prevent traffic, including construction traffic, from crossing vertical edges. Apply tack coat to vertical edges before making another pass with paver if mix has cooled to 90 deg F.

3.8 QUALITY CONTROL

- A. For projects less than 500 tons, perform Quality Control as identified below if identified as required by section 32 12 05s or project documents. For projects greater than or equal to 500 tons, perform Quality Control as identified below.
- B. Compaction
1. Use trained and experienced Density Technicians
 - a. Use technicians trained in the aspects of gauge operation and offsets, rolling patterns, mat temperature maintenance.
 - b. Use technicians that have controlled a minimum of 3 previous projects under the supervision of a UDOT TTQP certified (current certifications that cover sampling, density and field asphalt properties) technician.
 2. Develop Rolling Pattern for achieving density using gauges (nuclear or non-nuclear) correlated to mix being supplied.
 3. Perform systematic testing to verify full lot placement (length, width and joints) is in conformance with density requirements.
 4. Do not substitute owner Quality Assurance activities for Quality Control. Owner QA activities may be used to correlate Quality Control activities and devices.
- C. Thickness
1. Perform systematic depth determinations throughout each subplot. Determinations may be made on compacted mix, or on uncompact mix with appropriate adjustment for compaction.
 2. Perform a minimum of two depth determinations for each edge of paving pass and for center of paving pass for each subplot.
- D. Submit Quality Control Documentation to Engineer within 72 hours of placement of Lot, or prior to any subsequent overlay, whichever is sooner.

3.9 TOLERANCES

- A. Lift Thickness: If not indicated, meet the following tolerances.

Table 4 – Lift Thickness Tolerance (a)		
Mix	Minimum	Maximum
Bituminous Concrete	2.5 times <i>nominal</i> aggregate size	4.0 inches (b)
NOTES (a) Thickness is measured after compaction. (b) Maximum lift thickness may be exceeded if contractor can demonstrate ability to achieve consistent compaction from top to bottom of lift without breaking down aggregate. Determine compaction consistency by cutting a minimum of 3 random cores in half vertically and testing top and bottom half of cores. If density range between top half and bottom half of		

each core is equal to or less than 1%, compaction consistency is verified. If range exceeds 1%, placement must adhere to Maximum lift thickness requirement.

- B. Smoothness:
 - 1. Parallel to Centerline: [Section 32 01 31](#).
 - 2. Cross Slope: 1/4 inch in 10 feet except at cross section grade breaks.

3.10 **SURFACE REPAIR**

- A. Repair ride disturbing or unsafe butt joints. Repair expense is at no additional cost to OWNER.
- B. If pavement smoothness is deficient, follow Section 32 01 31 repair requirements.
- C. Corrective Action for Profile Deviations (“Must Grinds”): Grinding is acceptable. See [Section 32 01 26](#). Apply a fog seal over grind areas. See [Section 32 01 13.50](#). If depressions cannot be corrected by grinding, remove and replace.
- D. Corrective Action for Profile Roughness Index: Grinding is acceptable. Re-profile corrected segments to verify ride index meets tolerance. Apply a fog seal over grind areas. See [Section 32 01 13.50](#).
- E. When thickness is deficient, place additional material over deficient areas. DO NOT skin patch. Mill for inlay if necessary.
- F. Defective Joints, Seams, Edges: Repair.
- G. Unacceptable Paving: Remove and replace.

3.11 **OPENING TO TRAFFIC**

- A. Temperature of pavement surface is not more than 180 deg F

END OF SECTION