PIP CVS02350
Roadway and Area Paving
Construction Specification
PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

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PUBLISHING HISTORY

April 2002   Issued
July 2012    Complete Revision
January 2017 Complete Revision

Not printed with State funds
# PIP CVS02350
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1. **Scope**

   This Practice provides requirements for construction of roadways and area paving within plant boundaries.

2. **References**

   Applicable parts of the following Practices and industry codes and standards shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles will be used herein where appropriate.

2.1 **Process Industry Practices (PIP)**

   - PIP CVI02350 - *Roadway and Area Paving General Notes and Typical Details*
   - PIP CVS02100 - *Site Preparation, Excavation, and Backfill Specification*
   - PIP STS03001 - *Plain and Reinforced Concrete Specification*

2.2 **Industry Codes and Standards**

   - ASTM International (ASTM)
     - ASTM D977 - Standard Specification for Emulsified Asphalt
     - ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
     - ASTM D1883 - Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils
     - ASTM D2026/D2026M - Standard Specification for Cutback Asphalt (Slow-Curing Type)
     - ASTM D2027/D2027M - Standard Specification for Cutback Asphalt (Medium-Curing Type)
     - ASTM D2028/D2028M - Standard Specification for Cutback Asphalt (Rapid-Curing Type)
     - ASTM D2041/D2041M - Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
     - ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
     - ASTM D2940/D2940M - Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports
     - ASTM D2950/D2950M - Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
– ASTM D3282 - Standard Practice for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
– ASTM D3628 - Standard Practice for Selection and Use of Emulsified Asphalts
– ASTM D6373 - Standard Specification for Performance Graded Asphalt Binder
– ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
– ASTM D7113/D7113M - Standard Test Method for Density of Bituminous Paving Mixtures in Place by the Electromagnetic Surface Contact Methods

3. Definitions

constructor: Party responsible for supplying materials, equipment, tools, supervision, and labor for installation of roadway and area paving work in accordance with contract documents. The term constructor shall apply also to constructor’s subcontractor(s) and vendor(s).

contract documents: Any and all documents including codes, studies, design drawings, specifications, sketches, practices, and data sheets that purchaser has transmitted or otherwise communicated, either by incorporation or reference, and made part of the legal contract agreement or purchase order between purchaser and constructor.

engineer of record: Purchaser’s authorized representative with overall authority and responsibility for engineering design, quality, and performance of civil works, structures, foundations, materials, and appurtenances described in contract documents. Engineer of record shall be licensed as defined by laws of the locality in which the work is to be constructed, and be qualified to practice in the specialty discipline required for the work described in contract documents.

inspector: Party responsible for verifying quality of all materials, installations, and workmanship furnished by constructor. Inspector shall be qualified by training and experience and hold certifications or documentation of their qualifications. Unless otherwise specified in contract documents, inspector shall be an independent party retained by purchaser.

owner: Party who has authority through ownership, lease, or other legal agreement over site wherein roadway and area paving will be used.

purchaser: Party who awards contract to constructor. Purchaser may be owner or owner’s authorized agent.
4. **Requirements**

4.1 **Quality Control/Assurance**

4.1.1 **Quality Control and Submittals**

4.1.1.1 A written Quality Control Program document that provides details of how compliance with requirements of this specification and contract documents will be achieved shall be submitted to purchaser for approval at least 15 days before start of construction.

4.1.1.2 Certified laboratory test data for materials and products to be used in the work shall be submitted to purchaser for approval at least 15 days prior to shipping of materials and products.

4.1.1.3 Results of quality control tests required during the performance of work shall be submitted to purchaser within 48 hours of completion.

4.1.2 **Quality Assurance**

4.1.2.1 Unless otherwise specified in the contract documents, an inspection and testing agency will be retained by purchaser to perform field and laboratory testing and/or evaluations to verify compliance of the work with requirements of this Practice and to ensure the achievement of the intents and purposes of the work.

4.1.2.2 Each portion of work (i.e., subbase, base, etc.) shall be approved by Purchaser prior to continuing to the next phase of work.

4.1.2.3 Performance or lack of performance of tests and inspections by purchaser’s inspector shall not be construed as granting relief from requirements of this Practice or other contract documents.

4.2 **Materials**

4.2.1 **General**

General requirements for soil and aggregate classification shall be in accordance with ASTM D2487, ASTM D2940/D2940M, and ASTM D3282.

4.2.2 **Water**

4.2.2.1 Unless approved by the engineer of record, water used in construction shall be free of salts, oils, acids, alkalis, organic matter, or other deleterious substances. Water shall be fresh and not brackish or from the ocean. Water used for concrete shall be in accordance with PIP STS03001.

4.2.2.2 Source for locally available water suitable for construction shall be obtained from owner.

4.2.3 **Asphalt**

4.2.3.1 Performance graded (PG) binder shall meet requirements of ASTM D6373. Performance grade provided shall be as specified in contract documents. If no performance grade is specified, Performance Grade provided shall be PG 64-22.
4.2.3.2 If temperature range for the performance grade specified is 92°C or greater, an elastic recovery test in accordance with ASTM D6084/D6084M shall be provided and binder shall be polymer modified. If temperature range for the performance grade specified is less than 92°C, asphalt binder shall not be polymer modified unless otherwise specified in contract documents.

4.2.3.3 A dense-graded mix-type shall be provided unless otherwise specified in contract documents.

4.2.3.4 Cutback asphalt shall be in accordance with ASTM D2026/D2026M, ASTM D2027/D2027M, or ASTM D2028/D2028M.

4.2.3.5 Emulsified asphalt shall be in accordance with ASTM D977 and ASTM D3628.

4.2.3.6 Liquid asphalt for prime coat shall be grade MC-70 or grade MC-250 in accordance with ASTM D2027/D2027M; or grade RC-70 or grade RC-250 in accordance with ASTM D2028/D2028M.

4.2.3.7 Asphalt cement for tack coat shall be viscosity grade AC-20 in accordance with ASTM D3381/D3381M.

4.2.4 Aggregate for Subbase, Base and Untreated Gravel Surfaces

4.2.4.1 Materials for aggregate pavement base and subbase (if required) shall consist of durable and sound crushed gravel, crushed stone.

4.2.4.2 Aggregate materials shall be free from organic matter, lumps of clay, clay coatings, or other objectionable matter; and shall be in accordance with ASTM D2940/D2940M.

4.2.4.3 Aggregate shall have a soaked California Bearing Ratio (CBR) of 80% minimum when tested in accordance with ASTM D1883, and a percentage of wear not greater than 45% when tested in accordance with ASTM C131/C131M.

4.2.4.4 Aggregate gradation for untreated gravel surfaces shall conform to base requirements of ASTM D2940/D2940M except that a minimum of 8% shall pass 75 µm (No. 200) sieve.

4.2.5 Aggregate for Asphaltic Concrete Paving

4.2.5.1 A dense graded aggregate mix-type shall be provided.

4.2.5.2 The nominal maximum aggregate size shall be 1/2 in (12.5 mm) for surface layer and 1 in (25 mm) for intermediate/binder and base courses unless otherwise specified in contract documents.

4.2.6 Concrete

4.2.6.1 Materials for concrete construction shall be in accordance with PIP STS03001.

4.2.6.2 Concrete mix design in accordance with PIP STS03001 and meeting the requirements for the specified exposure category shall be used for concrete pavement.
4.2.6.3 Unless otherwise specified in contract documents, the mixture shall attain a minimum 28-day compressive strength of 4,000 psi (28 MPa).

4.2.6.4 Hot applied joint sealant shall be in accordance with design drawings.

4.2.6.5 Cold applied joint sealant shall be in accordance with design drawings.

4.2.6.6 For slip-formed concrete, slump shall be 2.5 inches (65 mm) or less.

4.3 Subgrade Preparation, Subbase, and Base Course

4.3.1 Subgrade Preparation and Subbase

4.3.1.1 Clearing, grubbing, stripping, removal of waste, source of borrow, and construction drainage shall be in accordance with PIP CVS02100.

4.3.1.2 Fill material, compaction, and testing shall be in accordance with PIP CVS02100.

4.3.1.3 Subgrade preparation for base and subbase course placement shall be in accordance with PIP CVS02100.

4.3.1.4 Proof roll the compacted subgrade with a 25-T (222-kN) pneumatic tire roller or a fully loaded dump truck. Moisture content of subgrade should be near optimum. Proof roll at least two complete passes, each trip offset by at most one tire width of the roller. Operate roller at a speed between 2 and 6 mph (3 and 10 kph). Observe for visible deformations such as rutting, cracking, rolling or elastic rebound (springing).

4.3.1.5 Rutting or base springing movement greater than 1 in (25 mm) shall be considered as unacceptable. Substantial cracking or lateral movement shall also be considered unacceptable and shall be removed and replaced in accordance with PIP CVS02100.

4.3.1.6 Upper surface of in situ subgrade soils shall be stabilized after stripping is complete in accordance with requirements specified in contract documents.

4.3.1.7 Where shown and specified in contract documents, geotextile and/or geogrid shall be installed in accordance with manufacturer’s instructions.

4.3.1.8 Unless otherwise specified, thickness of the subbase (if required) shall be 4 in (100 mm) and carried 1 ft (300 mm) minimum beyond the width of the base course.

4.3.2 Base Course

4.3.2.1 New Construction

1. Aggregate base course shall not be constructed when atmospheric temperature is below 35°F (2°C), or if other weather conditions may detrimentally affect quality of the base course.

2. Base course shall be placed in accordance with PIP CVS02100.

4.3.2.2 Thickness Requirements

1. Thickness of base course shall be measured at intervals of 500 yd² (420 m²) maximum of completed base course.
2. Thickness measurements shall be taken by making test holes, 3 in (75 mm) in diameter minimum, through base course.

3. No single base course thickness measurement shall have a deficiency greater than 1/2 in (13 mm).

4. The average thickness of base course, determined by computing average of the depth measurements, shall not under run specified thickness by greater than 1/4 in (6 mm).

5. If measured thickness is greater than 1/2 in (13 mm) thicker than specified, measured thickness shall be considered to be equal to specified thickness plus 1/2 in (13 mm) for determining the average.

6. Correct thickness deficiencies by scarifying, adding mixture of proper gradation, reblading, and recompacting affected areas.

4.3.2.3 Density Test

Test base course to the density specified in *PIP CVS02100* in accordance with *ASTM D6938*. Test every 250 yd² (210 m²) of each lift and a minimum of one test each day base material is placed.

4.3.2.4 Maintenance

1. Debris, rubbish, and excess material shall be removed from jobsite after completion of base course and disposed at location designated by purchaser.

2. After construction has been completed, base course shall be protected until final acceptance. Protection shall include drainage, rolling, shaping, and watering as necessary to maintain base course in proper condition.

3. Areas of base course damaged by freezing, rainfall, or other weather conditions shall be restored in accordance with previous requirements.

4.4 Surfacing

4.4.1 General

4.4.1.1 Paving surfaces shall be gravel, asphalt, or concrete as shown on the design drawings.

4.4.1.2 The surface of the area to be paved shall be clean and kept from accumulating materials that would contaminate the mixture, prevent bonding, or interfere with placement operations.

4.4.2 Gravel

4.4.2.1 Compaction shall be continued until 95% of maximum dry density is achieved in accordance with *ASTM D1557* and verified in the field using nuclear density testing in accordance with *ASTM D6938*, or other appropriate density test method approved by engineer of record.

4.4.2.2 Sampling of compacted mixes from roadway shall be in accordance with *ASTM D3282*. 
4.4.3 Asphaltec Concrete

4.4.3.1 General

1. Air temperature shall be above 40°F (4°C) for duration of the application of prime coat, tack coat, and asphalt surface courses.

2. Air temperature readings shall be taken in shade and away from artificial heat.

3. Prime coat, tack coat, and asphalt surface courses shall not be applied in unsuitable weather conditions. Unsuitable weather shall include the following conditions:
   a. Dense fog
   b. Rain
   c. Wind that is blowing at such a rate that proper compaction cannot be attained because of cooling of the mixture
   d. Wind that is blowing at such a rate that proper bonding cannot be achieved because sand, dust, or other debris is being deposited on the underlying surface

4. Asphalt that is discolored, indicating bitumen has been overheated, shall not be used.

5. Surfaces of curbs, gutters, manholes, and other structures where asphaltic concrete paving is to be placed against shall be covered with a thin, uniform coat of liquid asphalt.

6. Where asphaltic concrete paving is to be placed against the vertical face of an existing pavement, vertical face shall be cleaned to remove foreign substances and coated with liquid asphalt at a rate of approximately 0.25 gal/yd² (1.14 L/m²).

4.4.3.2 Prime Coat

1. Prime coat shall be applied to approved subgrade or base and cured 24 hours minimum before asphaltic concrete paving is placed.

2. Prime coat shall be of medium curing type cutback asphalt.

3. Apply prime coat at a rate not less than 0.15 gal and not more than 0.33 gal/yd² (0.7 to 1.5 L/m²) of surface.

4. If asphalt is not entirely absorbed by base course within 24 hours, excess asphalt shall be blotted with light, dry sand.

5. Damaged prime coat shall be repaired immediately.

4.4.3.3 Tack Coat

1. Tack coat shall be applied in advance of asphaltic concrete paving operation under the following conditions:
   a. Placing asphaltic concrete over existing pavements
   b. Between asphaltic concrete courses if more than one asphaltic concrete course is used
2. Holes, ruts, and depressions in the existing asphaltic concrete course shall be cleaned out down to the hard surface and dried, and asphaltic concrete surface shall be thoroughly swept clean.

3. Broken surfaces in existing asphaltic concrete course shall be repaired as follows:
   a. Lightly coated with rapid curing type cutback asphalt
   b. Filled with surface asphaltic concrete
   c. Compacted to form an even surface

4. Tack coat shall be rapid curing cutback asphalt.

5. Apply tack coat at a rate not less than 0.04 gal/yd² (0.18 L/m²) and not more than 0.07 gal/yd² (0.32 L/m²) of surface.

6. Tack coat shall be applied sufficiently in advance of placement operation of asphalt mixture to permit volatiles to evaporate from asphalt cement, but not so far in advance that tack coat becomes covered with dust or other foreign substances.

4.4.3.4 Hot Mix Asphaltic Concrete (HMAC)

1. Debris shall be removed from tack coat before HMAC is applied.

2. In no case shall maximum production temperature be more than 350°F (177°C). The HMAC temperatures shall be within the following requirements from production to finish rolling:
   a. Production temperature: 350-300°F (177-149°C)
   b. Breakdown rolling: 320-275°F (160-135°C)
   c. Intermediate rolling: 275-200°F (135-93°C)
   d. Finish rolling: 200-180°F (93-82°C)

3. Minimum roadway surface temperatures are shown in Table 1.

<table>
<thead>
<tr>
<th>High Temperature Binder Grade</th>
<th>Subsurface Layers or Night Paving Operations</th>
<th>Surface Layers Placed in Daylight Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG 64</td>
<td>45°F (7°C)</td>
<td>50°F (10°C)</td>
</tr>
<tr>
<td>PG 70</td>
<td>55°F (13°C)</td>
<td>60°F (16°C)</td>
</tr>
<tr>
<td>PG 76</td>
<td>60°F (16°C)</td>
<td>60°F (16°C)</td>
</tr>
</tbody>
</table>

4. HMAC shall be placed to required width and thickness; true to line, grade, and cross section.

5. Paver shall also be capable of providing a smoothly struck finish with uniform density and texture.
6. If specified thickness of finished paving is greater than 3 in (75 mm), equal lifts consisting of a leveling-up course and a surface course shall be placed.

7. If specified thickness of paving is 3 in (75 mm) or less, finished paving shall be placed in one layer.

8. A sufficient amount of material shall be placed to assure specified pavement thickness after compaction. The average thickness of the course or of combined courses shall be within 1/4 in (6 mm) of specified thickness.

9. Compaction shall be continued until further compaction cannot be obtained and all compactor marks are eliminated. Paving shall be discontinued if unable to achieve specified density prior to the mixture cooling to 175°F (79°C) and Purchaser shall be notified.

10. Actual bulk density for full depth of compacted HMAC in accordance with ASTM D2726/D2726M shall range between 92% and 97% of theoretical maximum density in accordance with ASTM D2041/D2041M.
   
   a. Surface density of pavement shall be tested using electromagnetic surface contact methods in accordance with ASTM D7113/D7113M or with nuclear density methods in accordance with ASTM D2950/D2950M.
   
   b. Compaction tests results shall average between 92% to 97% with no test result below 91%. Each test shall consist of an average of four readings at each test location.
   
   c. Tests shall be performed on each placed width of paving at a minimum of 250 ft (75 m) intervals.

4.4.3.5 Joint Construction

1. Each HMAC layer shall be placed as continuously as possible to minimize joints.

2. Joints shall be made in such a manner as to create a continuous bond between the old and new pavement construction courses.

3. If pavement construction involves two or more courses, longitudinal joints in successive courses shall be offset by 6 in (150 mm) minimum.

4. If placing of material is discontinued or if material in place cools to less than 140°F (60°C), a joint running perpendicular to direction traveled by paver shall be made. Before placement continues, edge of previously placed pavement shall be trimmed to a straight line perpendicular to paver and cut back to expose an even vertical surface for full thickness of the course. When placement continues, paver shall be positioned on transverse joint so that sufficient hot mixture can be placed to create a smooth joint after compaction.
5. Joints that are not completed before the previously laid mixture has cooled to a temperature of 140°F (60°C) shall be coated with liquid or emulsified asphalt just before paving is continued.

4.4.4 Concrete Pavement

4.4.4.1 Execution

1. Pavement placement shall use either slip-form paving or fixed-form paving methods.

2. Pavement placement shall comply with provisions of PIP STS03001 where applicable.

3. In addition to provisions of PIP STS03001 for hot weather placement, when the maximum daily air temperature is likely to exceed 85°F (29°C), the following precaution shall be taken:

   Concrete shall be placed at coolest temperature practicable, and temperature of concrete when placed shall not exceed 95°F (35°C).

4. Test entire surface before initial set and correct irregularities or undulations before finishing. Surface shall not have irregularities greater than 1/4 in (6 mm) when checked with a 10-ft (3-meter) straight edge in any direction or location on the pavement.

5. Finish concrete pavement with broom or artificial turf drag. Broom finish walks and small areas.

6. If paving concrete placement is discontinued for more than 30 minutes, a construction joint shall be installed in accordance with details shown in PIP CVI02350 at location of the nearest contraction or expansion joint. Excess concrete beyond location of the construction joint shall be removed.

7. Pavement shall be closed to vehicular traffic until the concrete is at least four days old and has reached a minimum compressive strength of 3000 psi (21 MPa) or 75% of the specified minimum 28-day compressive strength, whichever is greater.

8. After concrete is at least 4 days old and has reached a minimum compressive strength of 3000 psi (21 MPa) or 75% of the specified minimum 28-day compressive strength, whichever is greater, pavement may be opened to limited traffic with wheel loads not to exceed 5,000 lb (22 kN).

9. After concrete has reached the specified minimum 28-day compressive strength as verified by tests, equipment with wheel loads exceeding 5,000 lb (22 kN) may be permitted on pavement.
4.4.4.2 Curing

1. Curing concrete pavement shall comply with provisions of PIP STS03001.

2. Concrete surfaces subjected to heavy rainfall within 3 hours after curing compound has been applied shall be re-sprayed unless protected by sheeting.

3. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be immediately re-sprayed.

4.4.4.3 Joint Construction

1. Joints shall be located as shown on contract documents and constructed as specified in PIP STS03001.

2. Joints shall align with existing or adjacent joints where possible.

3. Before sawing a joint, concrete shall be examined closely for cracks, and the joint shall not be sawed if a crack has occurred within 10 ft (3 m) from planned joint location. Sawing shall be discontinued when a crack develops ahead of the saw cut and the purchaser shall be contacted for guidance before continuing work.

4. Sealant materials for joints shall be installed in accordance with written manufacturer’s instructions.

4.4.4.4 Jointed Reinforced Concrete Pavement (JRCP)

1. Reinforcement, ties, and dowels shall be placed as shown in contract documents.

2. Reinforcement installation shall be in accordance with PIP STS03001.

3. Unless otherwise specified in contract documents, see PIP CVI02350 for detail for reinforcing re-entrant corners to reduce cracking. Re-entrant corners commonly occur at footings or inlets.

4. Dowels shall be aligned perpendicular to the joint, parallel to each other and parallel with the bottom and top surfaces of pavement. Dowels shall be securely supported on chairs.

5. Place bar steel reinforcement after properly preparing the subgrade. Place longitudinal bars on top of the transverse bars. Securely tie bars together to prevent movement during concrete placement. Support assembled bars on bar chairs at a depth shown in contract documents. Bar chairs shall be sufficient in strength and number to hold steel reinforcement in position during construction.

6. Arrangement of splices and splice lap lengths shall be as shown in contract documents.

7. Install dowels or tie bars at joints as shown in contract documents.

8. Protect all bar steel reinforcement left protruding from the slab for any extended period from deterioration caused by exposure.
9. Do not bend bar steel reinforcement or subject to loading or forces that distort the steel or weaken the bond to concrete.

10. Tie coated bars using procedures, equipment, and materials that do not damage or cut the coating. Use one or more of the following materials to tie coated bars:
   a. Purchaser-approved plastic or nonmetallic material
   b. Stainless steel wire
   c. Nylon, epoxy, or plastic-coated wire

4.4.4.5 **Jointed Plain Concrete Pavement (JPCP)**

1. Dowels or tie bars shall only be used in JPCP if shown in contract documents.

2. Transverse contraction joints in roadway paving shall be located and sawed in accordance with contract documents.