This master should be used by designers working on Port of Portland construction projects and by designers working for PDX tenants (“Tenants”). Usage notes highlight a few specific editing choices, however the entire section should be evaluated and edited to fit specific project needs.

Use this section for the construction of hot-mix asphalt concrete (HMAC). Use Item P-401 for FAA projects.

SECTION 321200 - ASPHALT CONCRETE PAVING

1. GENERAL
	* + 1. DESCRIPTION
				1. This section describes the construction of one or more courses of dense graded hot-mix asphalt concrete (HMAC) pavement, plant mixed into a uniformly coated mixture, hot laid on a prepared foundation, compacted to specified density, and finished to a specified smoothness to the lines, grades, thickness, and cross-sections shown on the drawings.
				2. The Contractor may use warm mix asphalt concrete (WMAC) as a substitute for HMAC on all lifts. WMAC will be subject to all requirements for HMAC specified, except as modified in this section. The term WMAC is interchangeable with HMAC throughout this section.
			2. RELATED WORK SPECIFIED ELSEWHERE
				1. Section 015713, Temporary Erosion, Sediment, and Pollution Control
				2. Section 320118, Crack Sealing in Flexible Pavements
				3. Section 321123, Aggregate Base Course
			3. REFERENCES
				1. AASHTO: American Association of State Highway and Transportation Officials

AASHTO T11: Test for Materials Finer Than 75-um (No. 200) Sieve in Mineral Aggregates by Washing

AASHTO T27: Test for Sieve Analysis of Fine and Coarse Aggregates

AASHTO T90: Test for Determining the Plastic Limit and Plasticity Index of Soils

AASHTO T104: Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

AASHTO T113: Lightweight Pieces in Aggregate

AASHTO T176: Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test

AASHTO T209: Test for Theoretical Maximum Specific Gravity and Density of Hot-Mix Asphalt (HMA)

AASHTO T283: Standard Method of Test for Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage

AASHTO T308: Test for Determining the Asphalt Binder Content of Hot-Mix Asphalt (HMA) by the Ignition Method

AASHTO T329: Standard Method of Test for Moisture Content of Hot-Mix Asphalt (HMA) by Oven Method

AASHTO T335: Standard Method of Test for Determining the Percentage of Fracture in Coarse Aggregate

* + - * 1. ASTM: American Society for Testing and Materials

ASTM C1097: Hydrated Lime for Use in Asphalt Cement or Bituminous Pavements

ASTM D1417: Standard Test Methods for Rubber Latices-Synthetic

ASTM D2041: Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures

* + - * 1. ODOT: Oregon Department of Transportation

Oregon Standard Specifications for Construction

ODOT Section 00730: Emulsified Asphalt Tack Coat

Laboratory Manual of Test Procedures

ODOT TM 208: Oregon Air Aggregate Degradation

Supplemental Test Procedures for HMAC and EAC

ODOT TM 319: Preparation and Characterization of Recycled Asphalt Materials for Mix Design

Manual of Field Test Procedures

ODOT TM 225: Presence of Wood Waste in Produced Aggregates

ODOT TM 229: Determination of Elongated Material in Coarse Aggregates

ODOT TM 305: Calculating the Moving Average Maximum Density (MAMD)

ODOT TM 306: Performing a Control Strip for HMAC Pavement

ODOT TM 321: Asphalt Content of Bituminous Mixtures by Plant Recordation

ODOT TM 323: Determination of Calibration Factors for Determining Asphalt Cement Content of HMAC by Ignition Method

ODOT Contractor Mix Design Guideline

* + - 1. DEFINITIONS
				1. Base Course: All lifts of HMAC not classified as wearing course.
				2. CAT II: Certified Asphalt Technician II.
				3. CMDT: Certified Mix Design Technician.
				4. Gmm: Maximum specific gravity of mixture.
				5. Hot-Mixed Asphalt Concrete (HMAC): A hot plant-mixed, uniformly coated mixture of asphalt cement, graded aggregate, and additives as required.
				6. JMF: Job mix formula.

Levels 1 through 4 are ODOT terms that describe the relative long-term performance of the mix. The levels do not indicate aggregate size. Delete level definitions for those levels not specified.

Use Level 1 for parking areas, shoulder repairs, etc.

Use Level 2 for low-volume roads that are exposed to minimal truck loadings.

Use Level 3 for any facilities exposed to moderate truck loadings except those used for Level 4 below.

Use Level 4 for marine terminals (top-loader operating areas).

* + - * 1. Level 1 HMAC: HMAC for use in applications with very low traffic and only limited exposure to truck traffic.
				2. Level 2 HMAC: HMAC for use in applications with low traffic volumes and low volume truck traffic.
				3. Level 3 HMAC: HMAC for use in applications exposed to moderate truck traffic.
				4. Level 4 HMAC: HMAC for use in applications exposed to very heavy traffic volumes or heavy truck traffic.
				5. Lot: A lot is the total quantity of material produced per day. The following circumstances will require a different lot:

A new JMF is used. A JMF adjusted according to these specifications is not considered a new JMF.

The Port may allow material for irregular areas not completed during the main paving operations, such as driveways or guardrail flares to be evaluated as a separate lot.

The Port may elect to combine up to two days’ work into a single lot when small quantities are expected.

When more than one plant is simultaneously producing material for the job, the lot sizes shall apply separately for each plant.

If one day’s production exceeds 2,000 tons, a new lot will be designated.

A new lot will be established for WMAC technology.

* + - * 1. Maximum Density Test (MDT): The theoretical maximum density of the bituminous mixture determined by multiplying the theoretical maximum specific gravity, determined by ASTM D2041, by 62.4 pounds per cubic foot.
				2. MDV: Mix design verification.
				3. MFTP: Manual of Field Test Procedures (ODOT).

Delete MAMD for projects with less than 2,500 tons of HMAC.

* + - * 1. Moving Average Maximum Density (MAMD): A moving five test average of the most recent MDT’s. The mix design density is included in the average until five MDT’s have been completed.
				2. PWL: Percent within limits
				3. QPL: ODOT Qualified Products List
				4. RAP: Reclaimed asphalt pavement.
				5. Sublot: A sublot is 500 tons of HMAC.
				6. Surface Damp Condition (SDC): When the outside of the aggregates are damp with moisture, but little or no free water is present.
				7. TSR: Tensile strength ratio.
				8. VFA: Voids filled with asphalt.
				9. VMA: Voids in mineral aggregate.
				10. Warm Mix Asphalt Concrete (WMAC): An asphalt concrete mix following all requirements of HMAC, except that through the use of approved additives or processes, it is mixed, placed, and compacted at lower temperatures.
				11. Wearing Course: The top lift of HMAC, regardless of thickness.
			1. SUBMITTALS
				1. Submit aggregate qualification tests for aggregate used in HMAC.
				2. Submit a mix design and job mix formula for HMAC 15 days prior to the start of production of the paving mixture. Formula shall include the items identified in these specifications.

Retain if Construction Site Mixing/Formulation (Batch Plants) article is used.

* + - * 1. Prior to commencing work, submit copies of all applicable permits and a demobilization plan if any asphalt plants will be placed on Port property.
1. PRODUCTS
	* + 1. RECLAIMED ASPHALT PAVEMENT (RAP) MATERIAL
				1. Reclaimed HMAC pavement (RAP) material used in the production of new HMAC is optional. No more than 30 percent RAP will be allowed in base courses. No more than 20 percent RAP will be allowed in Level 1 and Level 2 wearing courses. No RAP will be allowed in Level 3 and Level 4 wearing courses.
				2. The amount of asphalt cement in the RAP shall be established in the mixture design phase according to ODOT TM 319 and the ODOT Contractor Mix Design Guidelines for Asphalt Concrete, or other method approved by the Port. Additional testing may be requested at any time by the Port or the Contractor during the production of the RAP mixture to verify the amount of asphalt cement in the RAP. Conduct new tests by a laboratory mutually agreed upon by the Port and the Contractor. The cost of additional testing shall be paid by the party requesting the testing. RAP shall not contain any material containing coal tar such as materials treated with sealers or rejuvenators.
			2. HOT-MIX ASPHALT CONCRETE
				1. Aggregate: Provide and stockpile new aggregates according to the following requirements:

General: Produce and stockpile aggregate as follows:

Separated Sizes: Advise the Port of the separated size(s) of coarse and fine aggregate that will be used and the proposed targets for each individual sieve size for each stockpile. A minimum of one coarse aggregate and one fine aggregate stockpile is required.

If the Contractor wishes to produce coarse and fine aggregates in separated sizes other than those specified, request the proposed size changes in writing, and state the proposed target value and specified tolerance for each of the individual sieve sizes of the proposed materials.

The number of fine aggregate separated sizes selected by the Contractor does not relieve the Contractor of providing a JMF and producing HMAC meeting the air voids, VMA, and VFA requirements specified. Perform recrushing, rescreening, or other special processing of the fine aggregates as necessary to achieve the air voids, VMA, or VFA requirements at no additional cost to the Port.

Scalping: Scalp the rock on a 3/4-inch sieve screen deck (after it has passed through the primary crusher if quarry rock is used). The material remaining may be accepted for use by visual inspection. The Port may perform verification testing of the gradation. The material shall meet the following:

|  |  |
| --- | --- |
| **Sieve Size** | **Percent Passing (by Weight)** |
| 8" | 95 ‑ 100 |
| 3/4" | 5 max. |

Soundness: Provide coarse and fine aggregate with a weighted loss not exceeding 9 percent when subjected to five cycles of the soundness test using sodium sulfate solution according to AASHTO T 104.

Durability: Provide aggregate not exceeding the following maximum values:

|  |  |  |
| --- | --- | --- |
| **Test** | **Test Method** | **Aggregates** |
| **ODOT** | **AASHTO** | **Coarse** |
| Abrasion |  | T 96 | 30.0% |
| Degradation |
|  Passing No. 20 sieve | TM 208 |  | 30.0% |
|  Sediment height | TM 208 |  | 3.0" |

Fractured Faces: Provide crushed aggregate with not less than the minimum number of fractured faces as determined by AASHTO T 335, as follows:

|  |
| --- |
| **Percent of Fracture (by Weight)** |
| Material Retained on 1 1/2", 1", 3/4", 1/2", and No. 4 Sieve (two fractured faces) | Material Retained on No. 8 Sieve (one fractured face) |
| 75 | 75 |

Harmful Substances: Do not exceed the following values:

|  | **Test Method** | **Aggregates** |
| --- | --- | --- |
| **Test** | **ODOT** | **AASHTO** | **Coarse** | **Fine** |
| Lightweight Pieces |  | T 113 | 1.0% | na |
| Wood Particles | TM 225 |  | 0.10% | na |
| Elongated Pieces (at a ratio of 5:1) | TM 229 |  | 8.0% | na |
| Plasticity Index |  | T 90 |  | 0 or NP |
| Sand Equivalent |  | T 176 |  | 45 min \* |
| \* 50 min. for Level 4 HMAC |

Coarse Aggregate:

General: Produce coarse aggregate from crushed rock or other inert material of similar characteristics. No aggregates will be allowed that are derived from blast furnace slag.

Separated Sizes: Allowable separated sizes of coarse aggregate are as follows:

| **Type of Asphalt Concrete Mixture** | **Allowable Separated Sizes** |
| --- | --- |
| **1 1/4" - 3/4"** | **3/4" - No. 4** | **3/4" - 1/2"** | **1/2" - No. 4** |
| 1" Dense | Yes | Yes | Yes | Yes |
| 3/4" Dense | - | Yes | Yes | Yes |
| 1/2" Dense | - | - | - | Yes |

Grading: Determine sieve analysis according to AASHTO T27 and AASHTO T11. Establish the target values for each allowable separated size after a maximum of 10 percent of planned stockpile quantity has been produced. Produce the aggregate within the following listed tolerances (T):

| **Sieve Size** | **Separated Sizes** |
| --- | --- |
| **1 1/4" - 3/4"** | **3/4" - No. 4** | **3/4" - 1/2"** | **1/2" - No. 4** |
| **Percent Passing (by Weight)** |
| **T** | **T** | **T** | **T** |
| 1 1/2" | - 1 | - | - | - |
| 1 1/4" | ± 5 | - | - | - |
| 1" | ± 10 | - 1 | - 1 | - |
| 3/4" | ± 5 | ± 5 | ± 7 | -1 |
| 1/2" | - | ± 8 | ± 8 | ± 5 |
| 3/8"\* | - | - | - | - |
| No. 4 | ± 3 | ± 8 | ± 8 | ± 8 |
| No. 8 | - | ± 5 | ± 5 | ± 5 |
| No. 16\* | - | - | - | - |
| No. 30 | ± 1 | ± 3 | ± 3 | ± 3 |
| No. 50\* | - | - | - | - |
| No. 100\* | - | - | - | - |
| No. 200 | - | ± 1.0 | ± 1.0 | ± 1.0 |
| \* Report percent passing sieve when no tolerance is listed. |

Fine Aggregate:

General: Produce fine aggregate from crushed rock or other inert material of similar characteristics and if allowed, blend sand. No aggregates are allowed that are derived from blast furnace slag.

Separated Sizes: Allowable separated sizes for fine aggregates are:

No. 4 ‑ 0

No. 4 ‑ No. 8

No. 8 ‑ 0

Grading: Determine sieve analysis according to AASHTO T 27 and AASHTO T11. Establish the target values for each allowable separate size after a maximum of 10 percent of planned stockpile quantity has been produced. Produce the aggregate within the following listed tolerances (T):

| **Sieve Size** | **Separated Sizes** |
| --- | --- |
| **No. 4 - 0** | **No. 4 - No. 8** | **No. 8 - 0** |
| **Percent Passing (by Weight)** |
| **T** | **T** | **T** |
| 3/8" | - 1 | - 1 | - |
| No. 4 | ± 7 | ± 10 | - 1 |
| No. 8 | ± 7 | ± 7 | ± 10 |
| No. 16\* | - | - | - |
| No. 30 | ± 7 | ± 5 | ± 8 |
| No. 50\* | - | - | - |
| No. 100\* | - | - | - |
| No. 200 | ± 3.0 | ± 2.0 | ± 4.0 |
| \*Report percent passing sieve when no tolerance is listed. |

Combination of Fine Aggregate for Testing: Blend together fine aggregate produced in two separate sizes at a 1:1 ratio when testing for sand equivalent.

Blend Sand:

No natural or uncrushed blend sand will be allowed in Level 4 HMAC unless approved by the Port. Blend sand is allowed for Levels 1, 2, and 3 mixes. For these mixes, establish the target gradation and produce all material within the following tolerances (T):

| **Sieve Size** | **Percent Passing (by Weight)** |
| --- | --- |
| **T** |
| 3/8" | -1 |
| No. 4 | ±5 |
| No. 8 | ±15 |
| No. 30 | ±20 |
| No. 200 | ±5.0 |

Determine sieve analysis according to AASHTO T27 and AASHTO T11. Do not use more than 6 percent natural or uncrushed blend sand, by weight, in the total aggregate. Provide a means for verifying and documenting the amount of blend sand added to the aggregate.

RAP Aggregate: Use RAP aggregates in the HMAC, as specified herein, that are no larger than the specified maximum allowable aggregate size before entering the cold feed. Blend the RAP material with new aggregate to provide a mixture conforming to the JMF within the tolerances specified.

Insert PG 70-22 in the blank below for pavements exposed to heavy wheel loads; use PG 64-22 for lightly traveled pavements (shoulders, parking areas, etc.).

* + - * 1. Asphalt Cement: Use \_\_\_\_\_ grade of asphalt cement. Provide asphalt cement conforming to the requirements of ODOT’s publication, “Standard Specifications for Asphalt Materials.”
				2. Asphalt Cement Additives:

Use standard recognized asphalt cement additive products of known value for the intended purpose and approved for use on the basis of laboratory tests. Asphalt cement additives shall have no deleterious effect on the asphalt material and be completely miscible. Do not use silicones as an additive.

Add the following asphalt cement additives when required by the JMF:

Anti-stripping asphalt cement additives to prevent stripping or separation of asphalt coatings from aggregates to satisfy the TSR specified herein.

Asphalt cement admixtures used to aid in the mixing or use of asphalt mixes.

When WMAC is used, select one of the WMAC technologies and process and additives types listed below or approved by the Port.

| **WMAC Technology** | **Process and Additive Type** | **Supplier** |
| --- | --- | --- |
| LEA-CO | Foaming Process | Advanced Concepts Engineering Co. |
| Eco-Foam II | Foaming Process | AESCO/Madsen |
| Redi-Set WMX | Chemical Additive | Akzo Nobel Surfactants, Inc. |
| CECABASE RT | Chemical Additive | Arkema Group |
| Aspha-Min (Synthetic Zeolite) | Foaming Process | Aspha-Min |
| Double Barrel Green System | Foaming Process | Astec Industries |
| Green Machine | Foaming Process | Gencor Industries |
| HGrant Warm Mix System | Foaming Process | Herman Grant Company |
| Qualitherm | Chemical Additive | Iterchimica |
| Aquablack Warm Mix Asphalt | Foaming Process | Maxam Equipment Inc. |
| Low Emission Asphalt  | Chemical Additive | McConnaughay Technologies |
| Evotherm | Chemical Additive | MeadWestvaco Asphalt Innovations |
| Meeker Warm Mix | Foaming Process | Meeker Equipment Corp. Inc. |
| Advera (Synthetic Zeolite) | Foaming Process | PQ Corporation |
| Sasobit | Organic Additive | Sasol Wax Americas, Inc. |
| Shell Thiopave | Chemical Additive | Shell |
| Accu-Shear Dual Warm-Mix Additive System | Foaming Process | Stainsteel |
| Tri-Mix Warm Mix Injection | Foaming Process | Tarmac Inc. |
| Warm Mix Asphalt System | Foaming Process | Terex Roadbuilding |

Submit the proposed WMAC technology to be used and a plan for its implementation.

Comply with the manufacturer’s recommendations for incorporating additives and WMAC technologies into the mix. Comply with manufacturer’s recommendations regarding receiving, storing, and delivering the additives.

Provide choice of aggregate treatment on all projects with over 2,500 tons of HMAC. For projects with less than 2,500 tons, the following may be deleted at the discretion of the engineer.

* + - * 1. Aggregate Treatment with Hydrated Lime: Aggregates shall be treated with hydrated lime at the option of the Contractor.

When lime-treated aggregate is selected by the Contractor, treat new crushed aggregates, except those in RAP materials, with dry hydrated lime meeting the requirements of ASTM C1097. Mix the dry hydrated lime, water (if necessary to achieve surface damp condition), and aggregate in a pug-mill to ensure complete and uniform coating of the aggregate before the aggregate enters the paving plant dryer. The lime proportions and aggregate moisture content shall be as specified below.

Hydrated lime (% by weight of dry aggregate): 1.0

Lime tolerance (% by weight of dry aggregate): -0.2 to +0.5

Moisture content of aggregate: SDC

Determine the quantity of lime in aggregate for each sublot according to ODOT TM 321. If the rates of application specified are not met, take corrective action. Document the corrective action and notify the Port.

* + - * 1. Aggregate Treatment with Latex Polymer: A latex polymer aggregate treatment material may be used to treat new crushed aggregates instead of lime if TSR test results on the mixture with the latex polymer treatment at the JMF meet the minimum criteria specified.

General:

Provide a system to automatically meter the latex emulsion at the proper rate and apply the emulsion uniformly to the aggregate prior to the addition of the asphalt cement. Follow manufacturer's recommendations to set up, adjust and calibrate the equipment.

Demonstrate to the Port’s satisfaction that the required application rate of latex solids is being met. If it is not, take corrective action. Document and notify the Port of the corrective action.

Latex Polymer: Use latex polymer emulsion concentrate meeting the criteria in the table below. Submit a quality compliance certificate for the polymer latex emulsion concentrate.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Minimum** | **Maximum** | **Test Method** |
| Solids Percent | 65.0 | -- | ASTM D 1417 |
| pH | 9.0 | 11.0 | ASTM D 1417 |
| Brookfield Viscosity Spindle 3, 20 RPM, cPs | 500 | 3000 | ASTM D 1417 |

Application Rate: Apply the latex emulsion to achieve a minimum of 0.75 pounds of latex solids per ton of new aggregate (0.0375%). Higher application rates may be required to meet minimum TSR limits. Determine application rate during mix design testing.

Treatment during HMAC Production:

Adjust aggregate moisture content to meet manufacturer's recommendation for emulsion application. Apply the latex emulsion at the minimum rate specified above or at a higher rate if TSR testing indicates a higher rate is required.

Apply the latex emulsion to the aggregate just prior to entry into dryer drum. Mix aggregate with the emulsion in a pugmill or in the dryer drum prior to application of asphalt cement. Heat aggregates to at least 250ºF after treatment and prior to addition of asphalt cement.

The columns in the paragraph below are based on type (maximum aggregate size) of HMAC picked by the engineer and referenced in the related bid item in Section 012200.

* + - * 1. Mix Type and Broadband Limits: Mix type and broadband limits shall meet the following:

Mix Type: Furnish the type(s) of HMAC shown or as directed. The broadband limits for each of the mix types are specified below. When the drawings allow an option of two types for a course of pavement, use only one type throughout the course.

Broadband Limits: Provide a JMF for the specified mix type within the control points listed below:

| **Dense-Graded Mixes** |
| --- |
| **Sieve Size** | **1" Dense** | **3/4" Dense** | **1/2" Dense** | **3/8" Dense** |
| **Control Points (% Passing by Weight)** | **Control Points (% Passing by Weight)** | **Control Points (% Passing by Weight)** | **Control Points (% Passing by Weight)** |
| **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1-1/2" | 100 |  |  |  |  |  |  |  |
| 1" | 90 | 100 | 100 |  |  |  |  |  |
| 3/4" | -- | 90 | 90 | 100 | 100 |  |  |  |
| 1/2" | -- | -- | -- | 90 | 90 | 100 | 100 |  |
| 3/8" | -- | -- | -- | -- | -- | 90 | 90 | 100 |
| No. 4 | -- | -- | -- | -- | -- | -- | -- | 90 |
| No. 8 | 19 | 45 | 23 | 49 | 28 | 58 | 32 | 67 |
| No. 200 | 1.0 | 7.0 | 2.0 | 8.0 | 2.0 | 10.0 | 2.0 | 10.0 |

* + - * 1. Job Mix Formula (JMF) Requirements: Do not begin production of HMAC for use on the project until the JMF is reviewed by the Port and written consent is provided to proceed. The JMF proposed for use on the project will be evaluated based on the criteria set forth in this specification and the ODOT Contractor Mix Design Guidelines for Asphalt Concrete. For all mixes, complete TSR testing at least once per calendar year on mix from the first week of production of that JMF for that year. A new JMF is required if the asphalt cement grade, any additives, or the source of the aggregate change during production. A change in the source of asphalt cement only requires a new passing TSR.

WMAC Requirements: A separate JMF will be issued for WMAC. When WMAC is used, submit the following information in addition to the requirements for HMAC.

WMAC technology and WMAC additives information.

WMAC technology manufacturer’s established recommendations of usage.

WMAC technology manufacturer’s established target rate for water and additives, the acceptable variation for production, and documentation showing the impact of excessive production variation.

WMAC technology safety data sheets if applicable.

Temperature range for mixing.

Temperature range for compacting.

Except for foaming technology, asphalt binder performance grade test data of the asphalt binder and chemical additive at the manufacturer’s recommended dosage rate.

Except for foaming technology, submit WMAC mixture performance test results for Level 3 and Level 4 mixes according to the ODOT Contractor Mix Design Guidelines for Asphalt Concrete. Perform testing for foaming technology on the production mix on specimens compacted at WMAC compaction temperatures.

Contractor-Furnished JMF: The Contractor’s CMDT shall prepare, sign, and submit a JMF to the Port for each mixture required at least 10 days prior to the anticipated use in HMAC. If requested, submit material samples 10 days prior to use.

JMF Requirements: The JMF shall meet the following mixture requirements:

| **Dense Graded Mixture** |
| --- |
|  | **Level 1** | **Level 2** | **Level 3** | **Level 4** |
| Design Method | Superpave | Superpave | Superpave | Superpave |
| Compaction Level | 65 Gyrations | 65 Gyrations | 80 Gyrations | 100 Gyrations |
| Air Voids, % | 3.5 | 4.0 | 4.0 | 4.0 |
| VMA, % minimum | 1/2 in. - 14.0 | 3/4 in. - 13.0 | 3/4 in. - 13.0 | 1 in. - 12.0 |
| 3/8 in. - 15.0 | 1/2 in. - 14.0 | 1/2 in. - 14.0 | 3/4 in. - 13.0 |
|  | 3/8 in. - 15.0 | 3/8 in. - 15.0 | 1/2 in. - 14.0 |
|  |  | 3/8 in. - 15.0 |
| VMA, % maximum | min + 2.0% | min + 2.0% | min + 2.0% | min + 2.0% |
| P No. 200 / Eff. AC ratio | 0.8 to 1.6 | 0.8 to 1.6 | 0.8 to 1.6 | 0.8 to 1.6 |
| TSR, % minimum | 80 | 80 | 80 | 80 |
| VFA, % | 70 – 803/8 in.: 70 ‑ 80 | 65 - 783/8 in.: 70 ‑ 80 | 65 - 753/8 in.: 70 ‑ 80 | 65 - 753/8 in.: 70 ‑ 80 |

Delete if the quantity of HMAC is less than 2,500 tons.

* + - * 1. Performance Testing: For each dense-graded Level 3 wearing course mixes and all dense-graded Level 4 mixes submitted for review:

Include the results of performance testing as outlined in the ODOT Contractor Mix Design Guidelines for Asphalt Concrete.

Submit test results to the Port within 30 days of submitting the mix design for review.

Delete reference to Section 012200 if project is lump sum.

* + - 1. TOLERANCES AND LIMITS
				1. For gradation, measure the sieves with a weighting factor of one or more in accordance with Section 012200, Unit Prices. Produce and place HMAC within the following JMF tolerances and limits:

| **Gradation Constituent** | **Dense-Graded HMAC Type** |
| --- | --- |
| **1'** | **3/4"** | **1/2"** | **3/8"** |
| 1 1/2" | JMF ±5% \* |  |  |  |
| 1" | 90 – 100% | JMF ±5% \* |  |  |
| 3/4" | JMF ±5% | 90 – 100% | JMF ±5% \* |  |
| 1/2" | JMF ±5% | JMF ±5% | 90 – 100% | JMF ±5% \* |
| 3/8"\*\* | -- | -- | -- | 90 – 100% |
| No. 4 | JMF ±5% | JMF ±5% | JMF ±5% | JMF ±5% |
| No. 8 | JMF ±4% | JMF ±4% | JMF ±4% | JMF ±4% |
| No. 16\*\* | -- | -- | -- | -- |
| No. 30 | JMF ±4% | JMF ±4% | JMF ±4% | JMF ±4% |
| No. 50\*\* | -- | -- | -- | -- |
| No. 100\*\* | -- | -- | -- | -- |
| No. 200 | JMF ±2.0% | JMF ±2.0% | JMF ±2.0% | JMF ±2.0% |
|  \*Maximum not to exceed 100%\*\*Report percent passing sieve when no tolerance is listed. |

| **Constituent of Mixture** | **HMAC - All Types** |
| --- | --- |
| Asphalt Cement - ODOT TM 321 (Cold Feed/Meter) | JMF ±0.20% |
| Asphalt Cement - AASHTO T 308 (Ignition) and ODOT TM 323 | JMF ±0.50% |
| RAP Content - ODOT TM 321 | JMF ±2.0% |
| Moisture content at time of discharge from the mixing plant – AASHTO T329 - dense-graded | 0.80% max. |

* + - * 1. When a JMF tolerance applies to a constituent, full tolerance will be given even if it exceeds the control points established in this specification. Full tolerance will be given for RAP content even if it exceeds the limits established in this specification.
				2. Take corrective action when the RAP content exceeds the above tolerance. If the RAP content continues to be outside tolerance, stop production until a plan for corrective action is approved by the Port.
			1. TACK COAT
				1. Tack coat shall be in accordance with ODOT Section 00730.11, CSS‑1 or CSS‑1h.

Delete if Section 320118, Crack Sealing in Flexible Pavements, is not included in the project manual.

* + - 1. CRACK SEALANT
				1. Crack sealant shall be in accordance with Section 320118.
1. EXECUTION

The following is a Port Environmental Affairs article. It is required if an asphalt plant will be used on Port property.

* + - 1. CONSTRUCTION SITE MIXING/FORMULATION (BATCH PLANTS)
				1. General:

Batch plants include, but are not limited to, asphalt plants, and rock or aggregate crushing and screening batch plants. Obtain all necessary permits and agency approvals to locate and operate portable batch plants at the work site. Prior to commencing work, submit copies of all permits to the Port.

Obtain written approval from the Port before locating any portable batch plant on Port property.

Operate batch plant and ancillary operations in accordance with all applicable permits, approvals, and regulations.

Delete if Section 015713 is not included in the project manual.

For all work that will involve the disturbance of soil or could result in the production of sediments, debris, pollutants, or other matter that may contact stormwater, comply with Section 015713.

Provide temporary facilities for the collection and proper management of all process-related waters including cooling water, wash water, rinse water, and wastewater produced by batch plant operation.

Routine washdown or cleanup of asphalt and concrete paving machines shall be confined to those areas scheduled to be surfaced in the contract documents.

If washdown or cleanup occurs outside areas where similar materials will not be applied in the course of the work, provide temporary facilities to collect all equipment washdown and cleanup residues.

Wash water shall be allowed to discharge only to a Port-approved site.

Prior to demobilization of the operation, submit a written demobilization plan to the Port that identifies all locations outside the work area defined by the contract documents where hazardous material may have leaked, dripped, spilled, been discarded, or otherwise placed on the ground. The demobilization plan shall identify:

Methods for fully decontaminating and restoring those areas to pre-construction conditions,

Type and number of environmental samples (e.g. soil samples) that will be collected to identify areas that may need to be decontaminated, and

Type and number of environmental samples that will be collected to verify that all areas have been decontaminated and fully restored to pre-construction conditions.

* + - * 1. Storage of Materials:

Transfer piping from storage tanks to batch facilities shall be secondarily contained.

Provide temporary controls to divert stormwater runoff from entering into the work area.

* + - * 1. Mobile Tanker Equipment and Storage:

Mobile tanker equipment (e.g., tanker rigs used to apply base and overlay tack oil) shall be equipped with the following:

A spill kit.

Emergency dispenser shutoff switch located in cab or opposite side of rig from pump(s).

Daily, inspect all mobile tanker equipment to verify that the dispensing nozzles are in proper working order and are not leaking. If repair work cannot be completed within 24 hours, provide leak and spill containment around the equipment when the equipment is not in active use.

* + - 1. TACK COAT
				1. Construct in accordance with ODOT Section 00730.
				2. Apply at rate between 0.06 and 0.20 gallon per square yard (residual asphalt) at a temperature between 125ºF and 165ºF (emulsified asphalt).
				3. Apply between lifts of asphalt concrete base and surface courses when lifts are separated by more than one day.
				4. Apply to existing pavement surfaces and structures that will be in contact with new asphalt concrete surface course.

Delete the following two articles if the quantity of HMAC is less than 2,500 tons.

* + - 1. HMAC PRODUCTION ACCEPTANCE AND QUALITY CONTROL TESTING
				1. Quality Control: The Port will conduct acceptance testing for all HMAC mixes used on the project.
				2. The Contractor shall establish and maintain the quality control program and testing for all HMAC mixtures. Test for asphalt cement content and gradation for every other sublot and make the asphalt cement and gradation results available to the Port within 4 hours of completion of those tests. Also split the sample with the Port to provide samples for backup testing. Results of all other testing performed on the HMAC mix shall be submitted to the Port within 24 hours of completion.
			2. MIX DESIGN VERIFICATION (MDV) AND ACCEPTANCE
				1. General:

Before beginning production and placement of WMAC, the Port will perform MDV tests on the HMAC as required at startup according to these specifications. Two consecutive running averages of four MDV test results from testing of HMAC shall be within the limits specified.

The Port will perform MDV testing on projects with Level 2, Level 3, or Level 4 dense-graded HMAC. MDV tests may be conducted on every sublot and as required at startup according to these specifications and the MFTP. Gradation and asphalt content testing may be conducted by the Port with each MDV test. The following values will be calculated for each MDV test.

Air voids.

Voids in mineral aggregate (VMA).

Voids filled with asphalt (VFA).

P 75 μm (P No. 200) / effective AC (Pbe) ratio.

* + - * 1. The running averages of four MDV results shall be within the limits given below:

| **Value** | **Average of** | **Limit** |
| --- | --- | --- |
| Air Voids | 4 samples | JMF Target ±1.0% |
| VMA | 4 samples | 11.5 - 17.0 (1" Mix) |
| 12.5 - 17.0 (3/4" Mix) |
| 13.5 - 17.0 (1/2" Mix) |
| 14.5 - 17.0 (3/8" Mix) |
| VFA | 4 samples | 65 - 75 (3/4" Mix and 1/2" Mix in Level 2, Level 3 and Level 4) |
| 65 - 78 (3/8" Mix in Level 2, Level 3, and Level 4) |
| 70 - 80 (1/2" Mix and 3/8" Mix in Level 1) |
| Passing No. 200 / Pbe | 4 samples | 0.80 - 1.60 |

* + - * 1. The Port will provide the results from the initial control strip to the Contractor for evaluation and comparison with the MDV results. If the MDV and density test results are contradictory, the Port will request that the Contractor recommend a plan to the Port for resolving the discrepancy.
				2. A request for an adjustment to the JMF targets may be made to the Port by the Contractor’s CAT II. The requested change will be reviewed and documented by the Port. If acceptable, a revised JMF will be allowed. Clearly document the sublot test for which the adjusted targets are in effect. Adjustments for gradation shall not exceed the tolerances specified for the original JMF limits. Adjustments for ACcontent shall be within 0.5 percent of the original JMF. The JMF asphalt content may only be reduced if the production VMA meets or exceeds the above requirements. Adjustments for RAP content shall be within 5 percent of the original JMF, but shall not exceed the requirements of this specification. Regardless of these tolerances, the adjusted JMF shall be within the mixture specification control points of this specification. If a redesign of the mixture becomes necessary, submit a new JMF according to the requirements of these specifications.
				3. The Port may perform a Tensile Strength Ratio (TSR) test (AASHTO T 283) on a sample obtained during the first two days of production after QC test results verify that HMAC constituents with a weighting factor greater than one are in tolerance. Stop production and make adjustments if the TSR is less than 70. Restart production only after the Port has approved proposed adjustments.
				4. Laboratory Compactor Selection: Use a gyratory compactor for MDV when a gyratory compactor is used to develop the JMF. For all other cases, use a gyratory compactor or Marshall compactor, as selected by the Contractor.
				5. MDV Requirements at Startup: The Port will perform MDV testing at the startup of the JMF production according to the following process:

Step 1: A sample shall be obtained during the first 100 tons of production and MDV testing will be performed immediately.

Step 2: If air voids and VMA are within tolerance, then the Port will continue remaining MDV testing for each sublot. If not, then go to Step 3.

Step 3: If air voids and/or VMA are out of tolerance according to these specifications, the Port will request that the Contractor then make adjustments and immediately obtain another sample and perform MDV testing. Go to Step 4.

Step 4: If air voids and VMA from the MDV testing in Step 3 are within tolerance, then the Port will continue remaining MDV testing at each sublot.

Step 5: If air voids from Step 3 are more than plus or minus 1.5 percent from the target, then the Contractor shall stop production immediately and make adjustments. If they are not, then go to Step 6. Obtain approval of the Port before restarting production. Begin MDV testing again at Step 1.

Step 6: If air voids from Step 3 are out of tolerance and 1.5 percent or less from the target, or the VMA from Step 3 is out of tolerance, then the Port will request that the Contractor make adjustments and immediately obtain another sample and perform MDV testing. Go to Step 4.

* + - * 1. The Contractor shall take corrective action when required by the MDV startup process of this specification. After the requirements have been met, take corrective action if the MDV test results show that two consecutive running averages of four samples are outside the above limits for air voids, VMA, VFA, or P 75 μm (No. 200) / Pbe ratio. Document the corrective action and notify the Port. If test results continue to be outside the tolerance, stop production and make adjustments. Restart production only after the Port has approved the proposed adjustments. If the MDV test results are outside tolerance but the mixture meets the current requirements for gradation and asphalt content, an adjustment to the JMF targets is required. Do not start a new lot as a result of the adjustment.

Delete reference to Section 012200 if not included in the project manual.

* + - * 1. Quality Assurance and Acceptance: Any quality assurance testing for Level 1 and Level 2 HMAC will be at the discretion of the Port. The Port will provide quality assurance in accordance with Section 012200, Unit Prices, for Level 3 and Level 4 HMAC. The Port’s testing results will be used for acceptance.

The following may be used when the quantity of HMAC is less than 2,500 tons or at the engineer’s discretion.

* + - 1. SMALL QUANTITY ACCEPTANCE
				1. The mixture will be accepted by visual inspection by the Port. If the mixture is considered suspect, the Port may verify that the mixture is within the tolerances and limits of this specification.
			2. EQUIPMENT
				1. Lime-Treated Aggregate Plant: When lime-treated aggregate is selected by the Contractor, provide a mixing plant that includes:

Pug Mill: A pug mill that mixes the aggregate and lime until the aggregate is uniformly coated and the lime is distributed throughout the aggregate. Provide a system for adding water to the pug mill if necessary to achieve aggregate that is in SDC. This requirement may be waived by the Port if the stockpiled aggregates are watered to the satisfaction of the Port.

Lime Metering Device: A lime metering or weighing device that determines the amount of lime incorporated within any selected time period. Provide a device that is of sufficient accuracy to supply lime within the tolerances specified herein.

* + - * 1. HMAC Mixing Plant: Provide HMAC plants that comply with the following:

Scales: Provide required scales to ensure a uniform mixture. Check and adjust scales according to these specifications.

Vibratory Scalping Devices: Provide vibratory scalping devices ahead of the mixer to reject aggregate, RAP, and lumps of cemented material that are detrimental to the mix.

Asphalt Anti-Strip Additive Metering Device: When asphalt anti-strip additive is added into the asphalt at the HMAC mixing plant, provide a means to weigh or meter the additive at a specified rate that has an accuracy of plus or minus 0.5 percent.

Thermometers: Provide the following:

A direct reading, full operating range thermometer in the asphalt feed line near the mixer unit.

A thermometric instrument that automatically registers the temperature of the materials at the discharge of the mixer.

Sampling Devices: Provide and operate a device that produces a representative sample of the quantity of material required for the appropriate tests when sampling at or around crushing, screening, or mixing plants.

WMAC Mixing Production: Modify the asphalt mixing plant as required by the manufacturer to introduce the WMAC technology. Plant modifications may include additional plant instrumentation, the installation of asphalt binder foaming systems and WMAC additive delivery systems, tuning the plant burner, and adjusting the flights in order to operate at lower production temperatures and reduced tonnage. Document the integration of plant controls and interlocks.

* + - * 1. Hauling Equipment: Provide hauling vehicles in good operating condition with tight, clean, smooth beds and truck covers, as necessary. Coat the beds with a minimum amount of an approved material to keep the HMAC from sticking to the beds. Do not use diesel fuel or other solvents that may be detrimental to the integrity of the HMAC mixture. Drain excess coating material before loading by raising the truck bed, opening belly dump gates, or operating the conveyor belt, as appropriate.
				2. HMAC Pavers: Pavers shall comply with the following:

Power and Support: Self-contained, self-propelled, supported on tracks or wheels, none of which contact the mixture being placed.

Augers and Screed: Equipped with augers and a screed or strike-off assembly, heated if necessary, which:

Can spread and finish the HMAC to a uniform texture, in the specified widths, thicknesses, lines, grades, and cross-sections.

Will not segregate, tear, shove, or gouge the HMAC.

Do not use diesel fuel or other solvent products to prevent sticking that may be detrimental to the integrity of the HMAC mixture.

Control System: Equipped with a paver control system which:

Controls the HMAC placement to specified slope and grade.

Maintains the paver screed in proper position.

Provides the specified results through mechanical sensors and sensor-directed devices actuated from independent line and grade control references.

Edit the last sentence as appropriate for the location of work.

Illumination: Provide adequate lighting to illuminate the paver and the roadway in front of and behind the paver during the period from 30 minutes after sunset to 30 minutes before sunrise, or as deemed necessary by the Port. Provide a minimum light level of 10 foot-candles as measured by the Port on the paved surface at a distance of 16 feet from the front and back edges of the paver. Shield lighting from adjacent traffic, roadways, taxiways, and runways as necessary.

* + - * 1. Rollers:

Use rollers of the vibratory, steel wheel, and pneumatic tired type. They shall be in good condition and capable of operating at slow speeds to avoid displacement of the bituminous mixture. Provide self-propelled rollers capable of reversing without backlash. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition.

Vibratory rollers shall operate within the manufacturer’s approved range. Do not operate in vibratory mode for lifts thinner than two times the maximum aggregate size for the type of HMAC being compacted. Do not operate in vibratory mode for finish rolling.

Pneumatic-tired rollers shall be fully skirted to reduce tire heat loss and mixture pick-up.

Equipment which causes excessive crushing of the aggregate will not be allowed.

Edit the last sentence as appropriate for the location of work.

Provide adequate lighting to illuminate each roller and the roadway in front of and behind the roller during the period from 30 minutes after sunset to 30 minutes before sunrise, or as deemed necessary by the Port. Provide a minimum light level of 10 foot-candles as measured by the Port on the paved surface at a distance of 60 feet from the front and back edges of each roller. Shield lighting from adjacent traffic, roadways, taxiways and runways as necessary.

* + - 1. CONSTRUCTION
				1. Season and Temperature Limitations: Place HMAC during the dates indicated below, and when the temperature of the surface that is to be paved is not less than the temperature indicated:

| **Nominal Compacted Thickness of Individual Lifts and Courses as Shown on the Typical Section of the Drawings** | **All Levels** | **Level 1 and Level 2** | **Level 3 and Level 4** |
| --- | --- | --- | --- |
|  | **All Courses** | **Travel Lane Wearing Course** | **All Other Courses** |
| **Surface Temperature\*** | **From To****Inclusive** | **From To****Inclusive** | **From To****Inclusive** |
| Less than 2 inches | 60ºF and rising | All Year\*\* | 3/15 9/30 | All Year\*\* |
| 2 inches and Greater | 40ºF and rising | All Year\*\* | 3/15 9/30 | All Year\*\* |
| Temporary | 40ºF | All Year\*\* | 3/15 9/30 | All Year\*\* |
| \* Do not use field burners or other devices to heat the pavement surface to the specified minimum temperature.\*\* If placing HMAC between March 15 and September 30, temperature requirement may be lowered 5ºF. |

* + - * 1. Pre-Paving Conference: Supervisory personnel of the Contractor, including any subcontractors who will be involved in the paving work, shall meet with the Port at a mutually agreed time to discuss methods of accomplishing all phases of the paving work.
				2. Preparation of Underlying Surfaces:

Delete reference to Section 321123 if not included in the project manual.

All bases and foundations on which the pavement is to be constructed shall meet the applicable specifications and shall be approved prior to the start of paving. Recondition existing bases and foundations in accordance with Section 321123. Clean existing surfacings of all loose material, dirt and dust by brooming, flushing with water or other approved methods. Sawcut broken or ragged edges to firm material when directed by Port.

Treat all paved surfaces on and against which HMAC is to be placed with an asphalt tack coat, in accordance with ODOT Section 00730. Immediately before applying the tack coat, clean and dry the surface to be tacked. Remove all material, loose or otherwise, that will reduce adhesion of the tack by brooming, flushing with water, or other approved methods.

Level and compact depressed areas with HMAC as specified or directed by the Port. Perform the leveling work as a separate operation and at the locations and to the extent shown or directed by the Port. Spread the leveling material with a paving machine, unless otherwise directed by the Port.

Protect all existing structures from the overlay operation and check and clean as necessary after the overlay.

The pavement surface shall be dry prior to the preparation work and paving. Remove existing pavement markers, recessed markers, and pavement legends prior to paving. Remove painted pavement legends by hydroblasting, steel shot blasting, or grinding so that the pavement surface is not damaged below a depth of 1/8 inch. Remove durable pavement legends and durable pavement markings by steel shot blasting or grinding to the pavement surface to a depth no greater than 1/8 inch, creating a smooth, flat slot of uniform depth.

* + - * 1. Drying and Heating Aggregates for HMAC:

Burner Operation: Operate the burner used to heat the aggregates to completely burn the fuel so the aggregate and asphalt are not contaminated and the asphalt is suitably aged.

Heating Temperatures: Establish the allowable mixing and placement temperature ranges determined by the JMF. The Port will measure the mixture temperature at the discharge of the mixer. The Port will measure the placement temperature behind the paver. The maximum mixture temperature of the HMAC shall not exceed that of the oil supplier’s temperature-viscosity curve at the mixer.

The maximum placement temperature for HMAC at the mixer shall be 350ºF.

The minimum placement temperature shall be 240ºF for HMAC behind the paver. The minimum placement temperature shall be 215ºF for WMAC behind the paver.

Within the above limits, the Contractor (with the approval of the Port) or the Port may adjust the temperature in 10ºF increments from the JMF as follows:

Up: If the aggregate coating, moisture content, workability or compaction requirements are no attained.

Down: If the aggregate coating, moisture content, workability and compaction requirements are attained.

* + - * 1. HMAC Storage: Temporary storage or holding of hot HMAC will be allowed only as approved by the Port. If allowed, the Contractor shall comply with the following requirements.

Flow Diverter: Provide a device to divert the flow of HMAC away from the silo when starting or stopping plant production, or at any other time necessary, so improperly proportioned mixture or incompletely mixed portions of the mixture do not enter the silo.

Batcher: Equip storage silos with a batcher, rotating chute, or similar device to prevent segregation of HMAC as it enters the silo.

Unheated Silos: Store HMAC in unheated silos only when the total elapsed time from the mixing to the placing is less than six hours.

Heated Silos: Store HMAC in heated, insulated silos no more than 72 hours only if an atmosphere is maintained in the silo at all times which prevents damage to the mixture or asphalt properties.

Discharging AC and Loading Trucks: Discharge the HMAC and load trucks so segregation is prevented. If the HMAC is segregated, dispose of segregated HMAC and stop temporary storage of the HMAC at no additional cost to the Port.

* + - 1. CONTROL OF LINE AND GRADE
				1. Use a floating beam device of adequate length and sensitivity to control the grade of the paver. Where this method is impractical, manual control of the grade will be allowed when approved by the Port.
				2. Establish references at reasonable intervals for line and grade control of placement operations for the following:

Before placing each leveling lift.

Before placing the top base course for new construction.

* + - * 1. Line and grade for the top base course of new construction and top leveling lift shall be within 1/2 inch of design line and grade.
			1. HAULING, DEPOSITING, AND PLACING
				1. Haul, deposit, and place HMAC as follows:

Hauling: Cover HMAC if rain or cold air temperatures are encountered any time between loading and placement.

HMAC will be rejected before placing if one or more of the following is found:

Below specified placing temperature limit.

Slumping or separating.

Solidifying or crusting.

Absorbing moisture.

Oil slicks.

Deliver the mixture to the paving machine at a rate that provides continuous operation of the paving machine, except for unavoidable delay or breakdown. If excessive stopping of the paving machine occurs during paving operations, the Port may suspend paving operations until the mixture delivery rate matches the paving machine operation. Any HMAC mixture placed under these circumstances will be subject to rejection based on limits found in these specifications.

Costs for removal, disposal, and replacement of rejected HMAC shall be borne by the Contractor.

Use for runways and taxiways, or when required by the pavement design report or road authority.

* + - * 1. Depositing: Deposit HMAC from the hauling vehicles so segregation is prevented. Do not deliver the HMAC directly into the paving machine for wearing courses where the continuous length of the panel is greater than 100 feet. Deliver the HMAC to the paving machine by either a windrow pick-up machine or an end-dump transfer machine. When HMAC is windrowed, the pick-up equipment shall:

Substantially pick up all of the HMAC deposited on the roadway.

Be self-supporting, not exerting any vertical load on the paving machine, nor causing vibrations or other motions which could have a harmful effect on the riding quality of the completed pavement.

Use for all other pavements.

* + - * 1. Depositing: Deposit HMAC from the hauling vehicles so segregation is prevented. When HMAC is windrowed, the pick-up equipment shall:

Substantially pick up all of the HMAC deposited on the roadway.

Be self-supporting, not exerting any vertical load on the paving machine, nor causing vibrations or other motions which could have a harmful effect on the riding quality of the completed pavement.

* + - * 1. Placing: Alternative equipment and means may be allowed by the Port if the use of a paver is impractical.

Do not place HMAC during rain or other adverse weather conditions, unless allowed by the Port. HMAC in transit at the time adverse conditions occur may be placed if:

It has been covered during transit.

The HMAC temperature is satisfactory.

It is placed on a foundation free from pools or flow of water.

All other requirements are met.

When leveling irregular surfaces and raising low areas, do not exceed 2 inches actual compacted thickness of any one lift, except the actual compacted thickness of intermittent areas of 1,000 square feet or less may exceed 2 inches, but not more than 4 inches. This may require portions of the mixture to be laid in two or more lifts.

Place the mixture in the number of lifts and courses, and to the compacted thickness for each lift and course, as shown. Place each course in one lift unless otherwise specified. Do not exceed a compacted thickness of 4 inches for any lift. Limit the minimum lift thickness to twice the maximum aggregate size in the mix.

Do not intermingle HMAC produced from more than one JMF. Each base course panel placed during a working shift shall conform to a single JMF. The wearing course shall conform to a single JMF, except for adjustments in the JMF according to this specification.

Use only for projects with more than 2,500 tons of HMAC.

* + - 1. COMPACTION (LARGE QUANTITIES)
				1. The Port will provide acceptance testing.
				2. General: Immediately after the HMAC has been spread, struck off, and surface irregularities and other defects remedied, roll it uniformly until compacted as specified.

Temperature: Complete breakdown and intermediate compaction before the HMAC temperature drops below 180ºF, unless otherwise directed or required based on the control strip. For WMAC, complete breakdown and intermediate compaction before the WMAC temperature drops below 160ºF. When the rolling causes tearing, displacement, cracking, or shoving, make necessary changes in compaction temperature, type of compaction equipment, and rolling procedures.

Rolling:

Compact the HMAC with rollers conforming to this specification. Provide sufficient rollers of the types appropriate to compact the mixture while it is still within the specified temperature. Do not use equipment which crushes the aggregate. Do not displace the line and grade of edges. Moisten steel roller wheels with a minimum amount of water, or other approved material, necessary to prevent the HMAC from sticking to them and spotting or defacing the HMAC.

Operate rollers at a slow, uniform speed recommended by the manufacturer. Drive rolls or wheels shall be nearest the paver unless otherwise approved by the Port. Operate pneumatic rollers no faster than 3 mph. Operate vibratory rollers at frequencies of at least 2,000 vibrations per minute.

Begin rolling at the sides and proceed longitudinally, parallel to the road centerline, gradually progressing to the center, unless otherwise directed by the Port. On super-elevated curves, begin rolling at the low side and progress to the high side. When paving in echelon, or when abutting a previously placed lane, roll the longitudinal joint first, followed by the regular rolling pattern. Do not make sharp turns or park rollers on hot HMAC. Stop each pass at least 5 feet longitudinally from preceding stops.

Perform finish rolling with rollers meeting the requirements of this specification, and continue until all roller marks are eliminated.

* + - * 1. Control Strip:

Compliance with the density specifications for dense-graded HMAC shall be determined by random testing of the compacted road surface with calibrated nuclear gauges. The MAMD method of compaction measurement will be used.

For Level 2, Level 3, and Level 4 mixes, construct a control strip at the beginning of work on each JMF on the project in accordance with ODOT TM 306. The purpose of the control strip is to determine the maximum density that can be achieved for the JMF, paving conditions, and equipment on the project. Additional control strips are necessary when there is a change in compaction equipment or when JMF targets are adjusted according to these specifications. The Port may waive the control strip for irregular areas or areas too small to establish a reasonable roller pattern.

Stop paving if three consecutive control strips fail to achieve the specified density. Take all actions necessary to resolve compaction problems. Remove unacceptable control strips at no additional cost to the Port. Do not resume paving until allowed by the Port.

Production paving will not be allowed until a successful control strip is achieved.

* + - * 1. Density Testing: The Port will determine the density of each sublot by averaging five tests performed at random locations with a nuclear gauge. At least one density test shall be conducted each day of production.
				2. Moving Average Maximum Density (MAMD) Method: The MAMD is the average of the current MDT and, if available, the four previous MDT’s for the JMF used. Each MDT will be determined using the Gmm determined in accordance with AASHTO T 209 and calculate the MAMD in accordance with ODOT TM 305:

When this method is used, compact the HMAC to at least the percent of the MAMD applicable for the mix type and lift as follows:

|  |  |
| --- | --- |
| **Course of Construction** | **HMAC** |
| First HMAC lift less than 3 inches placed on aggregate base | 91.0 |
| All other | 92.0 |

The surface temperature of each lift of asphalt concrete shall cool to 160ºF before the next lift is placed.

Obtain the Port’s acceptance of the foundation layer(s) for asphalt concrete before beginning construction of the asphalt concrete wearing course.

* + - * 1. Thin Pavement: Compaction to a specified density will not be required for leveling, patches, or where the nominal compacted thickness of a course of dense graded mixtures will be less than 2 inches. Perform breakdown and intermediate rolling until the entire surface has been compacted by at least four coverages of the roller(s). Perform additional coverages, as directed, to obtain finish rolling of the HMAC.
				2. Other Areas: Compaction to a specified density will not be required on temporary surfacing, guardrail flares, mailbox turnouts, driveways, pavement repair, and areas of restricted width (less than 8 feet wide) or limited length, regardless of thickness. Compact these surfaces as follows:

Perform breakdown and intermediate rolling until the entire surface has been compacted with at least four coverages by the roller(s). Perform additional coverages, as directed, to obtain finish rolling of the HMAC.

Along curbs and walls, on walks, irregular areas, and other areas not practically accessible to large compactors, compact the mixture with small, self-propelled rollers, mechanical tampers, hot hand tampers, or hand rollers. On depressed areas a trench roller may be used, or cleated compression strips may be used under the roller to transmit compression to the depressed area.

* + - * 1. Bridge Decks and End Panels: Compaction to a specified density will be not required for HMAC placed on bridge decks and end panels. Perform the same rolling pattern, without vibration, as established according to these specifications. In the absence of an established rolling pattern, perform breakdown and intermediate rolling until the entire surface has been compacted by at least four coverages of the rollers. Perform additional coverages, as directed, to obtain finish rolling of the HMAC.
				2. Longitudinal Joints: At longitudinal joints, bond, compact, and finish the new HMAC equal to the HMAC against which it is placed.

Location: Place the HMAC in panel widths which hold the number of longitudinal joints to a minimum. Offset the longitudinal joints in one panel by at least 6 inches from the longitudinal joints in the panel immediately below.

Base Course: Place base course longitudinal joints within 12 inches of the edge of a lane, or within 12 inches of the center of a lane, except in irregular areas, unless otherwise shown on the drawings.

Wearing Course: Longitudinal joints shall not occur within the width of a traffic lane. They shall be located at either skip lines or fog lines unless approved by the Port. On median lanes and on shoulder areas, the joints shall occur only at lane lines or at points of change in the transverse slopes, as shown or as directed by the Port.

Joint Requirements: Compact both sides of the joint to the specified density minus 2 percent. When tested with a straightedge placed across the joint, the joint surface shall conform to the specified surface tolerances. Joint density shall be tested a maximum of 12 inches from the joint. The Contractor may elect to sawcut cold joints prior to paving additional mix. The costs of the sawcut shall be borne by the Contractor.

Use only for projects with less than 2,500 tons of HMAC.

* + - 1. COMPACTION (SMALL QUANTITIES)
				1. Obtain the Port’s acceptance of the base course prior to beginning construction of the asphalt concrete wearing course.
				2. Compact the mixture thoroughly and uniformly to a minimum density of 91 percent for the base course and 92 percent for the wearing course of the MDT. Each MDT will be determined using the Gmm determined in accordance with AASHTO T 209, for the particular mix being used.
			2. LONGITUDINAL JOINTS
				1. Drop Offs:

Provide warning signs and markings where abrupt or sloped edge drop-offs 1 inch or more in height occur.

Protect edges from being broken down.

If unable to complete the pavement under traffic without drop-offs, do the following:

Construct and maintain a wedge of HMAC at a slope of 1V:10H or flatter along the exposed longitudinal joint.

Remove and dispose of the wedge before continuing paving operations.

Construct, maintain, remove, and dispose of the temporary wedge at no additional cost to the Port. HMAC for the temporary wedge would be paid at the pay item price.

* + - * 1. Placing HMAC Under Traffic: When placing HMAC pavement under traffic, schedule work for the nominal thickness being laid as follows:

More than 2 Inches: Schedule work so that at the end of each working shift the full width of the area being paved, including shoulders, is completed to the same elevation with no longitudinal drop-offs.

Less than or Equal to 2 Inches: Schedule work so that at the end of each working shift one panel of new travel lane pavement does not extend beyond the adjoining panel of new travel lane pavement more than the distance normally covered by each shift. At the end of each workweek complete the full width of the area to be paved, including shoulders, to the same elevation with no longitudinal drop-offs.

* + - 1. TRANSVERSE JOINTS
				1. Travel Lanes: Construct transverse joints on the travel lane portion of all specified pavement courses, except leveling courses, as follows:

Temporary End Panel:

Maintain pavement depth, line and grade at least 4 feet beyond the selected transverse joint location, and from that point, wedge down on the appropriate slope until the top of the course being laid meets the underlying surface (assuming a pavement course thickness of 2 inches) as follows:

For wedges that will be under traffic for less than 24 hours, construct an 8 foot long wedge (1V:50H taper rate).

For wedges that will be under traffic for 24 hours or longer, construct a 25 foot long wedge (1V:160H taper rate).

Construct, maintain, remove, and dispose of the temporary wedge at no additional cost to the Port. HMAC for the temporary wedge would be paid for at the pay item price.

When the pavement course thickness is different than the above 2 inch example, use the appropriate taper rate to compute the length of the wedge. The wedge length plus the 4 feet or longer panel form the “temporary end panel.”

Vertical Face: After the mixture has reached the required density:

Provide a smooth, vertical face the full depth of the course being laid at the location selected for the joint by sawing, butting, or other approved method.

Remove the HMAC material from the joint to the end of the panel. If removed before resuming paving beyond the joint, reconstruct the temporary end panel immediately by placing a bond-breaker of paper, dust, or other suitable material against the vertical face and on the surface to be occupied by the temporary end panel. Construct a full-depth temporary end panel at least 4 feet long, beginning at the sawed or cut joint, and taper it as specified.

Excess HMAC: After completing a temporary end panel as specified, dispose of unused, remaining HMAC.

Resume Paving: When permanent paving resumes, remove the temporary end panel and any bond‑breakers. Clean the surface of all debris and apply a tack coat to the vertical edge and the surface to be paved.

Joint Requirements: Compact both sides of the joint to the specified density. When tested with a straightedge placed across the joint, the joint surface shall conform to the specified surface tolerances.

* + - * 1. Abutting Bridge Ends: Compact the HMAC abutting bridge ends and other rigid type structures in the transverse and/or diagonal direction, as well as longitudinally, as directed by the Port.
				2. Bridge Deck Overlays:

Saw cut the wearing course of pavement directly over the joints in bridge decks, bridge end joints and end panel end joints as soon as practical but within 48 hours of paving each stage of the wearing course, unless otherwise directed. The saw cut shall be 3/8 inch wide, plus or minus 1/8 inch, and 1/2 inch less than the thickness of the panel of pavement, to a maximum depth of 1 1/2 inches.

Flush the saw cut thoroughly with a high-pressure water stream immediately after the cut has been made. Before the cut dries out, flow it free of water and debris with compressed air. Fill the joint with a poured filler from the QPL.

* + - 1. TEMPORARY SURFACING
				1. Provide HMAC for temporary surfacing that is a well-graded, uniform, durable commercial mix. All new materials, or a combination of new materials and reclaimed materials, may be used. The Contractor is responsible for the quality of the material furnished and for maintaining the surface in a condition appropriate for the facility. Mix used for temporary surfacing is not eligible for price adjustment under Section 012200, Unit Prices.
			2. ACCEPTANCE OF LINE AND GRADE
				1. The finished top of any base course when tested with a Contractor‑furnished 16‑foot straightedge shall not vary from the testing edge by more than 3/8 inch at any point, and shall be within 1/2 inch of specified finished grade.
				2. The finished top of the surface course when tested with a Contractor‑furnished 16‑foot straightedge shall not vary from the testing edge by more than 1/4 inch at any point, and shall be within 1/2 inch of specified finished grade.
				3. Asphalt and sand seal edges where new asphalt concrete meets existing pavement.
				4. Correction of Pavement Roughness: Immediately correct equipment or paving operation procedures when tests show the pavement smoothness does not comply with these specifications. In addition, do the following:

Correct surface roughness to the required tolerances, using one of the following methods as approved by the Port:

Base Course:

Profile to a maximum depth of 0.4 inch with abrasive grinder(s) equipped with a cutting head comprised of multiple diamond blades.

Remove and replace the base lift.

Wearing Course:

Remove and replace the wearing surface lift.

Profile to a maximum depth of 0.3 inch with abrasive grinder(s) equipped with a cutting head comprised of multiple diamond blades and apply an emulsified asphalt fog coat as directed.

Complete correction of all surface roughness within 14 days following notification, unless otherwise directed by the Port.

* + - 1. CORRECTION OF DEFECTS
				1. Correct all defects in materials and work at no additional cost to the Port, as follows:

Fouled Surfaces: Immediately repair, clean, and re-tack fouled surfaces that would prevent full bond between successive lifts of mixture.

Boils, Slicks, and Oversized Material: Immediately remove and replace boils, slicks, and oversized materials with fresh mixture.

Segregation: Take immediate corrective measures when segregation or non-uniform surface texture is occurring in the finished mat. If segregation continues to occur, stop production until a plan for providing uniform surface texture is approved by the Port.

Roller Damage to the Surface: Immediately correct surface damage from rollers with additional fresh mixture or by other means approved by the Port.

Longitudinal Joints: Take immediate corrective measures when open longitudinal joints are being constructed or when the elevation of the two sides of a longitudinal joint does not match. If problems with the longitudinal joint continue to occur, stop production until a plan for providing tight, equal elevation longitudinal joints is approved by the Port.

Corrective Measures: Take immediate corrective measures when the specified compaction density is not being achieved.

Other Defects: Remove and replace any HMAC that:

Is loose, broken, or mixed with dirt.

Visually shows too much or too little asphalt.

Is defective in any way.

Delete if project is lump sum.

Is required by PWL and acceptance calculations outlined in Section 012200, Unit Prices.

* + - 1. TRAFFIC
				1. Vehicular traffic, including heavy equipment, is not allowed on newly paved areas until surface temperatures have cooled to at least 120ºF. Measure surface temperatures by approved surface thermometers.

END OF SECTION 321200