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### Supplemental Specifications (Section 400) of the Standard Specifications for Road and Bridge Construction, January 1, 2015

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**S T A T E**

**O F**

**T E N N E S S E E**

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January 1, 2015

**Supplemental Specifications - Section 400**

**of the**

**Standard Specifications for Road and Bridge Construction**

**January 1, 2015**

**Subsection 401.02**(pg. 278) 10-8-18, Mineral Aggregate Surface – Materials, Remove Sodium Chloride from the materials list:

**“401.02 Materials**

Provide materials as specified in:

Aggregate, Class B ..... **903.05.B**

Calcium Chloride, Type I, Type 2, or Calcium Chloride Liquor ..... **921.02**

The Engineer will accept aggregate for gradation as specified in **303.02.**”

**Subsection 401.06** (pg. 280) 10-8-18, Mineral Aggregate Surface – Method of Measurement, Remove 4. Sodium Chloride from the subsection:

**” 401.06 Method of Measurement**

The Department will measure:

1. Mineral Aggregate Surface by the ton in accordance with **109.**
2. Water added to the materials at the direction of the Engineer by the M.G. (1,000 gallons) using calibrated tanks or distributors, or accurate water meters.
3. Calcium Chloride by the ton in accordance with **303.14.D.**

When measuring Mineral Aggregate Surface, the Department will deduct the weight of all surface moisture on the aggregate at the time of weighing in excess of 8%.”

**Subsection 401.07** (pg. 280) 10-8-18, Mineral Aggregate Surface – Basis of Payment, Remove Sodium Chloride from the basis of payment list:

“The Department will pay for accepted quantities of Mineral Aggregate Surface, complete in place, at the contract prices as follows:

<i>Item Pay Unit</i>	
Mineral Aggregate	Ton
Calcium Chloride	Ton
Water	MG”

**Subsection 402.03** (pg. 282) 5-27-16; revise 0.2 to 0.05 in the range as shown in the 2<sup>nd</sup> paragraph:

“The distributor shall be designed, equipped, maintained, and operated so that bituminous material at even heat may be applied uniformly on variable surface widths at readily determined and controlled rates from 0.05 to 0.5 gallons per square yard, with uniform pressure, and with an allowable variation from any specified rate of plus or minus 0.02 gallons per square yard.”

**Subsection 403.02** (pg. 285-286) 10-8-18; Bituminous Materials, add RS-1, CRS-1 and remove emulsified from “Approved Emulsified Trackless Tack”, update Table 403.02-1 to adjust temperature range required and add approved trackless tack information:

Provide materials as specified in:  
Emulsified Asphalt, SS-1, SS-1h, CSS-1, CSS-1h, TST-1P, CQS-1h, CQS-1hp, RS-1, CRS-1.....904.03 or Approved Trackless Tack from the QPL.

Table 403.02-1: Tack Coat Application Temperatures

Material	Temperature Range
SS-1, SS-1h, CSS-1, TST-1P, CQS1h, CQS-1hp, CSS-1h,	70 to 160 °F
Approved Trackless Tack from the QPL	Per Manufacturer’s Recommendation

**Subsection 403.02** (pg. 285-286) 12-2-16; Bituminous Materials, remove trackless tack information from specifications and reference the QPL for approved Emulsified Trackless Tacks, remove trackless tacks from Table 403.02-1:

“Emulsified Asphalt, SS-1, SS-1h, CSS-1, CSS-1h, TST-1P, CQS-1h, CQS-1hp.....904.03 or Approved Emulsified Trackless Tack from the QPL.

Table 403.02-1: Tack Coat Application Temperatures

Material	Temperature Range
SS-1, SS-1h, CSS-1, TST-1P, CQS-1h, CQS-1hp and CSS-1h	60 to 140 °F

Subsection 403.02 (pg. 285-286) 11-16-15; Bituminous Materials, update the reference to 904.03, add TTT-3 to Table 403.02-1:

“Emulsified Asphalt, SS-1, SS-1h, CSS-1, CSS-1h, TST-1P, CQS-1h, CQS-1hp, TTT-1, TTT-2, TTT-3 .....904.03”

Table 403.02-1: Tack Coat Application Temperatures

Material	Temperature Range
SS-1, SS-1h, CSS-1, TST-1P, CQS-1h, CQS-1hp and CSS-1h	60 to 140 °F
TTT-1	160 to 180 °F
TTT-2	120 to 160 °F
TTT-3	100 to 180 °F

Subsection 403.05 (pg. 286) 11-16-15; A. Emulsified Asphalt, Add the following paragraph at the end of the subsection:

“Take a minimum of 3 cores throughout the length of the project for informational tack coat shear testing. Include the underlying layer. Not required for mats less than one inch thick.”

Subsection 403.05 A (pg. 287), 12-30-19; Emulsified Asphalt; Remove last paragraph:

~~a minimum of 3 cores throughout the length of the project for informational tack coat shear testing. Include the underlying layer. Not required for mats less than one inch thick.~~

Subsection 403.05 (pg. 287) 11-16-15; ) B. Test Strip, modify the 2<sup>nd</sup> paragraph to update the rate as 0.08 and 0.12:

“If placing the bituminous material upon a milled surface, apply the tack material at a rate of between 0.08 and 0.12 gallons of applied emulsion per square yard.”

Subsection 403.05 (pg. 287) 6-27-16; revise the last sentence of the 2<sup>nd</sup> paragraph:

“If placing the bituminous material upon a milled surface, apply the tack material at a rate of between 0.08 and 0.12 gallons applied emulsion per square yard.”

**Subsection 403.05** (pg. 287), 11-6-17; Revise the 1<sup>st</sup> sentence of the 1<sup>st</sup> paragraph:

“When the Contract requires bituminous material for fog sealing of shoulders, provide emulsified asphalt meeting **403.02** or an item from QPL 40A.”

**Subsection 404** (pg. 289-293) 1-6-17; Remove the entire subsection. All specifications regarding Double Bituminous Surface Treatment has been incorporated into subsection 405. All references shall be updated to subsection 405.

**Subsection 405** (pg. 294-298) 1-6-17; replace subsection 405 with the following:

**“405.01 Description**

This work consists of constructing a bituminous seal coat consisting of one or more applications each of bituminous material and cover aggregate.

**MATERIALS**

**405.02 Materials**

Provide materials as specified in:

Mineral Aggregate, Size Nos. 7, 8, 78, 89.....	903.13
Mineral Aggregate.....	903.14
Emulsified Asphalt, CRS-2p .....	904.03

Apply seal coat at a temperature range of 60 to 140 °F.

**EQUIPMENT**

**405.03 Equipment**

Provide a power broom or other mechanical sweeping equipment, equipment for heating bituminous material, a pressure distributor meeting the requirements of 402.03, pneumatic-tire and steel-wheel rollers, self-propelled mechanical aggregate spreading equipment that can be adjusted so as to spread accurately at the specified rate, and such other equipment and small tools as may be required to perform the work in a satisfactory manner.

**CONSTRUCTION REQUIREMENTS**

**405.04 Limitations**

Only apply bituminous material:

1. When the designated surface is dry, firm, and properly cured;
2. Between April 15 and October 1; and, unless otherwise directed,

3. When the ambient temperature in the shade and away from artificial heat is 70°F or more.

#### 405.05 Preparing the Designated Surface

Before placing seal coat, clean all surfaces to be sealed by sweeping with a motorized broom to remove any loose material. Clean depressions and cracks not reached by the power broom using hand brooms or pressurized air.

Cover any utility installations to prevent adherence of the bituminous mixture. Suitable covering includes plywood disks, sand, craft paper, roofing felt or other approved methods. Remove the protective coverings before opening the road to traffic. The cost for these adjustments shall be included in the bid price for other items.

The Plans will indicate whether the surface is to be constructed on a treated or untreated subbase, a granular base, an asphalt base, or on an existing surface. The surface of the base or sub-base upon which the construction is to be placed shall meet the requirements of the applicable Section of Part 3, Bases and Subgrade Treatments, of these Specifications.

Condition existing surface, if called for on the Plans, as specified in 407.10. Condition existing mineral aggregate base as specified in 310.

Construct and maintain Prime Coat or Tack Coat, if shown on the Plans, as specified in 402 or 403, respectively.

#### **405.06 Application**

##### A. Applying Bituminous Material:

Have all equipment calibrated prior to starting work. The TDOT inspector shall be present during calibration to determine aggregate spread rate and distributor rates. Distributor trucks shall have proper calibration of spray equipment. Spray nozzles should be clean, properly angled, and appropriately sized for the desired application rate. Stop work if the distributor is not applying material properly, such as gaps in application or streaking.

Place a 500 ft. test strip for the bituminous seal coat at the beginning of the project to assure proper coverage and proper equipment calibration. The test section is to verify break time of emulsion and chip retention. The test strip shall be able to carry normal traffic within 3 hours. If normal traffic cannot be carried, the emulsion shall be adjusted and another test strip is required.

At least 14 working days before the scheduled start of construction of any bituminous seal coat, submit a sample of aggregate intended for use for the determination of the appropriate application rates of bituminous material and aggregate. Apply emulsified asphalt by pressure distributor at a uniform rate in accordance with Table 405.06-1 below. The exact rate will be established by the Engineer.

Table 405.06-1: Application Rates for Bituminous Material

Aggregate Size (per 903.22)	Aggregate Spread Rate (lb/yd <sup>2</sup> )	Emulsion Shot Rate (gal/yd <sup>2</sup> )
7	25 – 30	0.30 – 0.45
78	22 – 28	0.28 – 0.38
8	20 – 25	0.20 – 0.35
89	17 – 23	0.17 – 0.28

Before beginning each spread, place building paper across the roadway surface with the forward edge exactly coinciding with the end of the preceding covered spread. Start distributors on the paper, the width of which shall allow the full force of all nozzles to be in effect before the forward edge of the paper is reached. If required by the Engineer, also stop the spread on building paper. Remove the paper immediately after its use, and dispose of properly. Immediately correct all defects in application.

The length of spread of bituminous material shall not exceed that which trucks loaded with cover material can immediately cover.

The spread of bituminous material shall not extend more than 6 inches wider than the width covered by the cover material. Do not allow the bituminous material to chill or otherwise impair retention of the cover material.

Do not allow traffic on the bituminous material until it has been covered with mineral aggregate.

Treat areas that are inaccessible to the distributor with either hand sprays or pouring pots as directed by the Engineer.

#### B. Application of Double Bituminous Surface Treatment:

##### First Application

Apply the first application of emulsified asphalt using pressure distributors at a uniform rate established by the Engineer within the range of 0.30 to 0.38 gallons per square yard. Apply each spread of bituminous material so as not to be more than 6 inches wider than the width covered by the immediate spread of cover aggregate. Each width of spread shall not be less than half the surface to be treated.

Before beginning each spread, place building paper across the roadway surface with the forward edge exactly coinciding with the end of the preceding covered spread. Start distributors on the paper, the width of which shall allow the full force of all nozzles to be in effect before the forward edge of the paper is reached. If required by the Engineer, also stop the spread on building paper. Remove the paper immediately after its use, and dispose of properly. Immediately correct all defects in application.

Treat areas that are inaccessible to the distributor with hand sprays or pouring pots as directed by the Engineer.

If treating less than the full width of the roadway, do not spread the aggregate on the inside 6 inches of either the first or second application until the adjacent lane has been treated. Immediately following each application, uniformly cover the applied bituminous material with Size No. 7 mineral aggregate that is reasonably free of surface moisture.

Spread the aggregate at a rate between 24 and 30 pounds per square yard, as established by the Engineer, using a self-propelled mechanical spreader; except on short projects of 1/2 mile in length or less, self-propelled mechanical spreading equipment will not be required. Back the truck on the aggregate being spread, without driving on or over uncovered bituminous material.

The length of bituminous material spread shall not exceed that which trucks loaded with cover material can immediately cover.

#### Second Application

Apply the second application of emulsified asphalt in the same manner as the first application, at a uniform rate established by the Engineer within the range of 0.20 and 0.35 gallons per square yard.

Spread mineral aggregate, Size No. 8, in the same manner as the first spread at a rate established by the Engineer within the range of 16 to 28 pounds per square yard.

Immediately after each spread of cover aggregate, broom to achieve uniform coverage. Use a power source, which is independent of the drive train that propels the equipment, to power the revolving brooms of mechanical sweeping equipment. Place additional aggregate by hand on thin or bare areas.

### **405.07 Spreading and Rolling Aggregate**

#### **A. Spreading**

Immediately after bituminous material has been applied, no more than two minutes, spread and embed the mineral aggregate cover in the bituminous material. Spread the aggregate as close to the application of bituminous material as is practicable, and cover each distributor load applied immediately. Aggregates shall be moistened and visually damp at the time of placement.

Spread the aggregate in accordance with the rates specified in Table 405.06-1. The exact rate will be established by the Engineer. Back the truck on the aggregate being spread, without driving on or over uncovered bituminous material. If treating less than the full width of roadway, do not spread the aggregate on the inside 6 inches of the bituminous spread until the adjacent lane is treated. Immediately after spreading the aggregate, perform hand-brooming to achieve uniform coverage. Place additional aggregate by hand on thin or bare areas.

The speed of the spreader shall be such that the aggregates are not rolling over, and starting and stopping of the spreader is minimized. Use of previously used (swept) aggregates is not permitted.

#### **B. Rolling – Bituminous Seal Coat**

Immediately after distributing the aggregate, roll the entire surface by moving in a longitudinal direction, beginning at the outer edges and progressing toward the center of the roadway, with



each trip of the roller overlapping the previous trip by half the width of the rear wheel. Perform initial rolling with a self-propelled pneumatic tire roller, and follow with steel-wheel rolling. The amount and sequence of rolling shall be as directed by the Engineer. Complete the initial rolling of the aggregate within 1 hour after applying the bituminous material.

Use power brooms to correct irregularities by sweeping the aggregates from areas of thick or heavy distribution to areas of thin or light distribution. Then continue rolling using both steel-wheel and pneumatic rollers until the aggregate is thoroughly embedded in the bituminous material. The Engineer may require additional rolling at a later date. Redistribute excess or loose aggregate that was thrown out of place.

Slow moving traffic may use the section or roadway upon which the aggregate has been spread.

### **Rolling and Curing – Double Bituminous Seal Coat**

Immediately after spreading and brooming the cover aggregate, roll the entire surface, beginning at the edges and progressing to the center. Begin rolling within 30 minutes after spreading the aggregate. Perform initial rolling with a self-propelled pneumatic tire roller, and follow with steel-wheel rolling. The amount and sequence of rolling shall be as directed by the Engineer.

Allow the first application of bituminous material and aggregate to cure for as long as deemed necessary by the Engineer before beginning the second application. Immediately before the second application of bituminous material, roll the surface with a steel-wheel roller.

For the second application of bituminous material and cover aggregate, repeat the same rolling and curing procedures as required for the first application.

The Contractor may allow slow-moving traffic to use sections of the roadway where the bituminous material has been covered with mineral aggregate.

### **405.08 Shoulders**

Restore shoulders that have been disturbed by the Contractor's construction operations at no cost to the Department. Remove all objectionable material placed on the shoulders by the Contractor as directed by the Engineer.

Construct shoulders, when specified, as provided for under **208**.

### **405.09 Maintenance and Protection**

Maintain in a satisfactory condition each completed section of seal coat until the entire Project is complete. Maintenance shall include making repairs where failures occur, and maintaining the seal coat in a smooth uniform condition; and brooming, dragging, and rolling when required.

After the final application, maintain the work in a satisfactory condition for at least 10 calendar days. If all other requirements of the Contract have been fulfilled, the Department will not charge working time during the 10-day maintenance period against the Contract time.

For final cleanup, sweep up all excessive quantities of loose, dislodged cover aggregate that may have collected along the edge of the completed seal coat, and dispose of this material as directed by the Engineer.

**405.10 Method of Measurement**

The Department will measure Mineral Aggregate and Bituminous Material by the ton in accordance with **109**. The Department may use net certified weights as a basis of measurement for mineral aggregate, subject to correction for aggregate that is lost, wasted, or otherwise not incorporated into the Work.

**405.11 Basis of Payment**

The Department will pay for accepted quantities of Bituminous Seal Coat, complete in place, at the contract prices as follows:

<i>Item</i>	<i>Pay Unit</i>
Bituminous Material	Ton
Mineral Aggregate	Ton

The Department will measure and pay for the work required to prepare the designated surface, as provided for under **405.05**, in accordance with the applicable Section or Subsection under which the work is performed.”

**Subsection 405.03** (pg. 295), 12-30-19; **Equipment**; Revise paragraph:

Provide a power broom or other mechanical sweeping equipment, equipment for heating bituminous material, a pressure distributor meeting the requirements of 402.03, two pneumatic-tire ~~and steel wheel~~ rollers, self-propelled mechanical aggregate spreading equipment that can be adjusted so as to spread accurately at the specified rate, and such other equipment and small tools as may be required to perform the work in a satisfactory manner.

**Subsection 405.05** (pg. 295) 5-14-18; Add the following as the second paragraph:

“Before placing seal coat, clean all surfaces to be sealed by sweeping with a motorized broom to remove any loose material. Clean depressions and cracks not reached by the power broom using hand brooms or pressurized air.

Remove pavement markers and adhesives. Abrade all types of existing striping. Work shall be accomplished without the pavement being gouged or damaged and in a manner which ensures the bituminous treatment will adhere in all areas applied. Work shall be performed to the satisfaction of the Engineer.”

**Subsection 405.11** (pg. 298), 12-30-19; **Basis of Payment**; Add subsection A & B:

**A. General**

The Department will pay for accepted quantities of Bituminous Seal Coat, complete in place, at the contract prices as follows:

.....

**B. Adjustments**

**Specific Gravity.** In cases where the Bulk SSD specific gravity of the mineral aggregate exceeds 2.80, the Department will adjust the tonnage of mineral aggregate for payment by multiplying the tonnage of mineral aggregate used by a specific gravity of 2.80 and dividing by the higher specific gravity.

**Subsection 407.02** (pg. 300-301) 12-2-16; Replace the 4<sup>th</sup> paragraph:

“If anti-stripping additive, other than hydrated lime, meeting 921.06.B.1 is required, use approved in-line blending equipment, as specified in 407.04.A.6, to add it at the mixing plant or inject it at the asphalt terminal. Manufacture’s documentation that asphalt binders will continue to meet requirements listed in subsection **904** after the anti-stripping additive is added shall be provided by the contractor with the mix design submittal. For mix designs submitted more than six months in advance, the documentation shall be resubmitted prior to use of the mix design with updated test results.”

**Subsection 407.02** (pg. 300) 11-16-15; Materials, add the following at the end of the fourth paragraph:

“If anti-stripping additive, other than hydrated lime, meeting **921.06.B.1** is required, use approved in-line blending equipment, as specified in **407.04.A.6**, to add it at the mixing plant or inject it at the asphalt terminal. Provide manufacture’s documentation ensuring asphalt binders will continue to meet requirements listed in Subsection **904** after anti-stripping additives are added.”

**Subsection 407.03 D.2.h.3** (pg. 308), 6-24-19; **Mix Design/Production Verification**; Revise the 1<sup>st</sup> & 2<sup>nd</sup> paragraph:

- (3) Place no more than 500 tons of mix until the verification testing, with the exception of TSR, is complete. Production may continue and mixture may be placed in excess of the first 500 tons; however, all mixture will be subject to price adjustment or removal at the discretion of the Engineer if the test results do not comply with the specifications.

Proceed, if the test results for the produced mix are within the limits required for production. The limits required for production are defined as meeting all of the following:

- (a) Meets all mix design requirements as specified in Table 407.03-2,
- (b) Gradation and Asphalt Cement Content of the mix are within the 90% pay factor for a single test per Table 407.20-2.
- (c) The average density of the test strip meets requirements per Table 407.15-1.

**Subsection 407.03 E. 1.** (pg. 313) 10-8-18, Tensile Strength Ratio, modify the second paragraph:

“1. **Tensile Strength Ratio.** Perform testing for stripping and moisture susceptibility of the mixture according to ASTM D 4867, Standard Test Method for Effect of Moisture on Asphalt-Concrete

Paving Mixtures For all mixtures requiring design, except OGFC, follow ASTM D4867. For OGFC follow ASTM D4867 except as noted:

- Modify step 8.6.1 so that the three conditioned samples are subjected to a partial vacuum of 26 inches Hg for 10 minutes to whatever degree of saturation achieved
- Subject the 3 condition samples to one freeze thaw cycle per note 6 listed in ASTM D4867 8.7. except as noted:
  - After 15h in freezer, remove samples and immediately immerse the still wrapped specimen in 77°F water for 2 hours
  - After 2 hours remove specimen from water bath and remove wrapping from specimen then immerse sample in 140°F water bath for 24 hours..

All specimens tested for stripping and moisture susceptibility shall meet the criteria specified in Table 407.03-4.”

**Subsection 407.03 E** (pg. 290), 12-30-19; **Testing Procedures;** Revise Table 407.03-04: Criteria for Stripping and Moisture Susceptibility:

**Table 407.03-4: Criteria for Stripping and Moisture Susceptibility**

Asphalt Cement	Minimum Tensile Strength	Minimum TSR
Polymer Modified	100 psi	80%
Non-Polymer Modified	80 psi	80%
411 OGFC	50 psi	80%

**Subsection 407.06** (pg. 327), 5-18-15; - A. Pavers. Replace the entire first paragraph with the following:

“Bituminous pavers shall be self-contained, power-propelled units provided with an activated screed, equipped to be heated, and capable of spreading and finishing courses of bituminous plant mix material in lane widths applicable to the specified typical section and thickness shown on the Plans. All screed extensions shall be full assembly extensions, including activated and heated screeds. Pavers shall include throw-back blades, reverse augers, or equivalent to place mix beneath the auger gearbox. Auger extensions shall be incorporated in a manner such that the maximum distance from the augers to the end plate shall be 18 inches. Screed extensions may extend beyond the 18-inch maximum from auger extensions only when extending for short-term temporary deviations in pavement width such as driveways. Do not use strike-off boxes, with the exception of sections with continuously varying width.”

**Subsection 407.09** (pg. 329-331), 5-14-18; Revise the following: 3. Add two sentences as the end of the paragraph, 4. Remove the first sentence, add two sentences as new first and second sentence, Add second paragraph as shown:

“3. Do not place bituminous plant mix, with a compacted thickness of 1.5 inches or less, between November 30 and April 1. Do not place bituminous plant mix, with a compacted thickness greater than 1.5 inches, between December 15 and March 16. Only place 411-TL, 411-TLD, and 411-OGFC mixtures when the pavement surface temperature and the ambient air temperature are a minimum of 55 °F and rising; limit placement to the period from April 1 to November 1. If the temperature meets the above requirements, outside of normal paving season, a request for a seasonal limitation waiver may be submitted for Departmental consideration. Requests shall be submitted in writing at least one week before the anticipated need.

4. If determined necessary by the Department, the Contractor may request a variance from the above required temperatures and seasonal limitations to pave at lower temperatures by submitting a Cold Weather Paving and Compaction Plan. All projects requiring a Cold Weather Paving and Compaction Plan shall utilize Intelligent Compaction to demonstrate proper coverage and compaction temperature at no additional cost to the Department; with the exception of small quantity projects, such as, but not limited to, bridge approaches, intersections, and temporary traffic shifts. Upon completion, the documentation showing appropriate coverage and compaction temperature shall be provided to the Department. Submit requests in writing at least one week before the anticipated need, and include a Paving and Compaction Plan for Cold Weather that meets the Department’s Procedure. The plan shall identify what practices and precautions the Contractor intends to use to ensure the mixture is placed and compacted to meet the specifications. The plan shall include compaction cooling curves estimating the time available for compaction, the intended production, haul, and compaction rates, with paver and roller speeds estimated. The Contractor may consider using such practices as the addition of rollers, reduced production and paving rates, insulated truck beds, and heating the existing surface.

In no cases will a cold weather paving and compaction plan or seasonal limitation waiver be approved for 411-OGFC, 411-TL, or 411-TLD.

If the specified densities are not obtained, stop all paving operations and develop a new plan. All mixture failing to meet specifications will be subject to price adjustments or removal and replacement at no cost to the Department.”

**Subsection 407.11** (pg. 332) 12-2-16; Add the following to the paragraph below Table 407.11-1:

“Minimum temperature for OGFC mixes shall be 280°.”

**Subsection 407.14** (pg. 335) 10-8-18; modify paragraph 3. 1<sup>st</sup> sentence by adding lift thickness:

“establish lift thickness or line, grade, and elevation”

**Subsection 407.14** (pg. 335), 12-30-19; **Spreading and Finishing**; Revise 5<sup>th</sup> paragraph:

Unevenness of texture, segregation (including end-of-load segregation) ~~as measured by a properly calibrated nuclear gauge~~, or tearing or shoving of bituminous mixture during the paving operation,

shall be reason to stop the paving. Only resume paving operations when the condition is corrected. Immediately remove unacceptable mix and replace at no cost to the Department. The Department will not allow excessive throwing back of the bituminous mixture. Any amount of mixture not fully adhered to the roadway shall be repaired prior to completion of the project. If the failure is not repaired the same day as originally placed, the method of repair must be approved by the Engineer prior to beginning of the repair. The repairs will be no additional cost to the Department.

**Subsection 407.15 C** (pg. 340), 12-30-19; **Test Strips**; Add to 1<sup>st</sup> paragraph:

Construct test strips for all A, B, BM, BM2, C, CW, D, and E mixes to establish rolling patterns, to calibrate nuclear gauges, to verify that the base course or surface course meets the density requirements of the specifications, and for mix design and production verification as required. Adjustments in roller patterns for mixes AS, A-CRL, CS, TL, TLD, and TLE, may be made at the direction of the Engineer.

**Subsection 407.15, C. Test Strips.** (pg. 340-341) 11-16-15; Add the following paragraph after the 7<sup>th</sup> paragraph of the subsection:

“Take an additional 3 cores after placement of the surface layer on the tack coat test strip described in subsection **403.05.B**. Include the underlying pavement layer for shear testing. These cores will be for informational testing only. Not required for mats less than one inch thick”

**Subsection 407.15 C** (pg. 341-342), 12-30-19; **Test Strips**; Remove from 8<sup>th</sup> paragraph:

~~“Take an additional 3 cores after placement of the surface layer on the tack coat test strip described in subsection 403.05.B. Include the underlying pavement layer for shear testing. These cores will be for informational testing only. Not required for mats less than one inch thick”~~

**Subsection 407.15** (pg. 341) 6-27-16; remove the 2<sup>nd</sup> sentence of the 8<sup>th</sup> paragraph:

“Take cores on the test strip at ten randomly selected locations as designated by the Engineer. Provide these cores to the Department for use in calibrating the nuclear gauge and to verify that the average density of the test strip meets the density requirements of the specifications. The Department will report all densities using the corrected nuclear gauge readings. Correction factors are specific to the nuclear gauges used during the test strip construction. If a different nuclear gauge needs to be used for acceptance, it will be necessary to cut new cores from the ongoing pavement construction to calibrate the new gauge.”

**Subsection 407.15** (pg. 341) 12-2-16; remove “randomly selected” from 1<sup>st</sup> sentence of the 8<sup>th</sup> paragraph as follows:

“Take cores on the test strip at ten locations as designated by the Engineer.”

**Subsection 407.15 A. 3. c.** (pg. 337-338) 5-15-17; update 10,000 square yards to 1,000 tons:

“c. Projects containing less than 1,000 tons or bituminous pavement.”

**Subsection 407.15 A. and B.** (pg. 337-342) 10-8-18;A. Add Roller Requirements by Mix Type, modify 1., 2., and 4., B. Modify Tables to condense into Table 407.15 – 1 Density Requirements for Bituminous Pavements, modify 1<sup>st</sup> sentence of the 1<sup>st</sup> paragraph below Table 407.15:

**407.15 Compaction**

**A. General**

After spreading and striking-off the bituminous mixture and adjusting surface irregularities, thoroughly compact the mixture using methods approved by the Engineer and that are capable of achieving the specified density while the material is in a workable condition. When no density requirements are specified, use a system of compaction for roadway pavements that has previously produced the required bituminous pavement densities. The Engineer may require a control strip and random density samples to evaluate the system.

In general, accomplish compaction using a combination of the equipment specified in **407.07**. As a minimum, meet the following roller requirements, but increase the number of rollers if the required results are not being obtained.

Table 407.15 - Roller Requirements by Mix Type

Mix Type	Roller Requirements
307-A, 307-B, 307-BM-2, 307-C, 307-CW (except surface)	3 Rollers (Intermediate Roller shall be Pneumatic)
307-AS, 307-ACRL, 411-D, 411-E, 307-CW (surface), 313-Asphalt Treated Permeable Base	3 Rollers (unspecified)
411-TL, 411-TLD, 411-TLE, 307-CS (when paved as a continuous layer)	2 Rollers (unspecified)
411-OGFC	2 rollers (both rollers shall be static steel double drum, 10 Ton minimum)
Any mix used for scratch paving	2 rollers (breakdown shall be pneumatic)

1. If the compaction effort is detrimental to the quality of the mat, immediately stop and re-evaluate rolling patterns and equipment. To modify the roller train from that which is specified for the mix, submit to the engineer a written request of the rollers to be substituted

- and a narrative explanation of how the specified equipment has been detrimental to the quality of the pavement.
2. The Department will only consider requests for substitution of equipment when it is shown that best practices are being followed and that the problem is not due to improper operation or poor maintenance of the equipment. If this request is approved by the Engineer, a new test strip and roller pattern shall be established.
  3. With the Engineer's approval, the Contractor may reduce the minimum number of rollers listed above to one roller of either the steel-wheel or vibratory type on the following types of construction and projects:
    - a. Shoulder construction,
    - b. Incidental construction such as bridge approaches and driveways, and
    - c. Projects containing less than 10,000 square yards of bituminous pavement.
  4. Compaction of 411-OGFC mixtures shall consist of a minimum of two passes before the material temperature has fallen below 185 °F. Unless otherwise directed by the Engineer, begin rolling at the low side and proceed longitudinally parallel to the road centerline. When paving in echelon, or abutting a previously placed lane, roll the longitudinal joint first, followed by the regular rolling procedure. When paving in echelon, rollers shall not compact within 6 inches of an edge where an adjacent lane is to be placed. Operate rollers at a slow uniform speed with the drive wheels nearer the paver, and keep the rollers as nearly as possible in continuous operation. Continue rolling until all roller marks are eliminated. Do not park rollers on the bituminous pavement.

To prevent adhesion of the mixture to the rollers, keep the wheels properly moistened with water or water mixed with very small quantities of detergent or other approved material. Limit excess use of liquid.

Do not refuel rollers on bituminous pavements.

Along forms, curbs, headers, walls and other places not accessible to the rollers, compact the mixture thoroughly using hot hand tampers, smoothing irons, or with mechanical tampers. On depressed areas, the Contractor may use a trench roller to compact the mix.

## **B. Density Requirements**

Meet the applicable density requirements specified in Tables 407.15-1.



Table 407.15-1: Density Requirements for Bituminous Pavement

Mix Type	% of Maximum Theoretical Density (Lot Average)	No Single Test Less Than, % (Sub Lot)
Travel Lanes ADT < 1,000 A, B, BM, BM2, C, CW, D, E	90.0	87.0
Travel Lanes 1,000 < ADT < 3,000 A, B, BM, BM-2, C, CW, D, E	91.0	89.0
Travel Lanes ADT > 3,000 A, B, BM, BM-2, C, CW, D, E	92.0	90.0
Travel Lanes and Shoulders Any ADT CS, TL, TLD, TLE, OGFC	NA	NA
Shoulders B, BM, BM-2, D, E	88.0	85.0

Correct sublots that test below the minimum density so that the density of the area is equal to or above the minimum, at which point it can be used to determine the average density of the lot. Do not place any successive layers until the area has been corrected. As necessary to determine the classification of open graded or dense graded mixes and to measure segregation, use AASHTO T 269 or ASTM D3203.

Repair or replace defective mixture to the satisfaction of the Engineer and at no cost to the Department.

The Department will perform density testing in accordance with **407.20.B.5**.

**Subsection 407.20 A.** (pg. 345), 11-6-17; Revise the second paragraph as follows:

“The Department will pay for liquid anti-strip additive and hydrated lime anti-strip additive based on certified documentation of material costs not to exceed \$15 per gallon and \$90 per ton, respectively.”

**Subsection 407.20** (pg. 346) 5-18-15; Basis of Payment; B. Acceptance of Mixture; Modify the last paragraph to revise 500 tons to 1000 tons:

“When the total plan quantity of any mix is less than 1000 tons, the Department will accept the mix on the basis of visual inspection and Contractor Quality Control certification. The Department may run extraction, gradation analysis, or other tests deemed necessary for acceptance purposes.”

**Subsection 407.20 B.1** (pg. 346), 5-13-19; **Acceptance of the Mixture, General**; Revise 2<sup>nd</sup> & 3<sup>rd</sup> paragraph:

The Engineer will accept bituminous mixture at the plant with respect to gradation and asphalt content, on a lot basis. A standard size lot at the asphalt plant will consist of a continuous shift's production that does not start over at Midnight. The number of sublots in a lot will vary from n=1 to n=4 according to Table 407.20-1.

When the total plan quantity of any mix is less than 1000 tons, the Department will accept the mix on the basis of visual inspection and Contractor Quality Control certification. If the daily production of any mix is less than 100 tons, no tests will be required for that quantity of mix. The Department may run extraction, gradation analysis, or other tests deemed necessary for acceptance purposes.

**Subsection 407.20 B.3** (pg. 347-348), 12-30-19; **Acceptance of the Mixture**; Revise 3<sup>rd</sup> paragraph:

~~At least once per week~~Monthly, per mixture ~~during production~~, the Engineer shall check-determine the correction factor for the ignition oven used for acceptance of the mixture per AASHTO T 308 correction factors with a sample of the aggregate mixture proportions, blended at the optimum asphalt content and adjust the Asphalt Cement content for acceptance of the mixture accordingly. Adjust the correction factor accordingly.—Keep records of all correction factors for all mixtures. Adjusted payment for asphalt content and gradation will be based on the ignition furnace results as specified in Table 407.20-2. Use of this alternative equipment shall be at no additional cost to the Department.

**Subsection 407.20** (pg. 348) 10-8-18; Table 407.20-2, add OGFC information to table:

**Table 407.20-2: Acceptance Schedule of Payment  
(Asphalt Plant Mix Characteristics)**

Characteristics	Pay Factor	Average Arithmetic Deviation of the Lot Acceptance Test from the JMF	
		1 Test	2 Tests or more
All mixes except 411-OGFC	1.00	0.00-0.30	0.00-0.25
Asphalt Cement Content <sup>(1)</sup>	0.95	0.31-0.35	0.26-0.30
(Extraction or ignition oven)	0.90	0.36-0.40	0.31-0.35
	0.80 <sup>(2)</sup>	over 0.40	over 0.35
411-OGFC only	1.00	0.00-0.30	0.00-0.25
Asphalt Cement Content	0.90	0.31-0.35	0.26-0.30
(Extraction or ignition oven)	0.80	0.36-0.40	0.31-0.35
	0.60 <sup>(2)</sup>	over 0.40	over 0.35
Gradation	1.00	0.00-6.50	0.00-5.70
3/8 inch sieve and larger	0.95	6.51-7.08	5.71-6.20
	0.90	7.09-7.66	6.21-6.69
	0.80 <sup>(2)</sup>	over 7.66	over 6.69
Gradation	1.00	0.00-4.62	0.00-4.00
No. 4 sieve <sup>(3)</sup>	0.95	4.63-5.20	4.01-4.50
	0.90	5.21-5.77	4.51-5.00
	0.80 <sup>(2)</sup>	over 5.77	over 5.00
Gradation	1.00	0.00-3.80	0.00-3.30
No. 8, 16, 30 & 50 sieves <sup>(3)</sup>	0.95	3.81-4.46	3.31-3.91
	0.90	4.47-5.12	3.92-4.52
	0.80 <sup>(2)</sup>	over 5.12	over 4.52
Gradation	1.00	0.00-1.80	0.00-1.60
No. 100 & 200 sieves <sup>(3)</sup>	0.95	1.81-2.00	1.61-1.75
	0.90	2.01-2.20	1.76-1.90
	0.80 <sup>(2)</sup>	over 2.20	over 1.90

<sup>(1)</sup> Does not apply to 307 Grading A, AS, or ACRL mixes.

<sup>(2)</sup> If approved by the Engineer, the Contractor may accept the indicated partial pay. The Department may require removal and replacement at no cost. The Contractor may remove and replace at no cost to the Department at any time.

<sup>(3)</sup> When there is more than one reduced payment relating to gradation in 1 lot of material, only the greatest reduction in payment will be applied. Reductions applicable for any other reason will be cumulative.

Characteristics	Pay Factor	Average Arithmetic Deviation of the Lot Acceptance Test from the JMF	
		1 Test	2 Tests or more

**Subsection 407.20** (pg. 348) 11-16-15; Table 407.20 – 2, make the following changes:

**Table 407.20-2: Acceptance Schedule of Payment  
(Asphalt Plant Mix Characteristics)**

Characteristics	Pay Factor	Average Arithmetic Deviation of the Lot Acceptance Test from the JMF	
		1 Test	2 Tests or more
Asphalt Cement Content <sup>(1)</sup>	1.00	0.00-0.30	0.00-0.25
(Extraction or ignition oven)	0.95	0.31-0.35	0.26-0.30
	0.90	0.36-0.40	0.31-0.35
	0.80 <sup>(2)</sup>	over 0.40	over 0.35
Gradation	1.00	0.00-6.50	0.00-5.70
3/8 inch sieve and larger	0.95	6.51-7.08	5.71-6.20
	0.90	7.09-7.66	6.21-6.69
	0.80 <sup>(2)</sup>	over 7.66	over 6.69
Gradation	1.00	0.00-4.62	0.00-4.00
No. 4 sieve <sup>(3)</sup>	0.95	4.63-5.20	4.01-4.50
	0.90	5.21-5.77	4.51-5.00
	0.80 <sup>(2)</sup>	over 5.77	over 5.00

**Subsection 407.20** (pg. 349) 10-8-18; B.5, Add the sentence as the next to last sentences of the 1<sup>st</sup> paragraph:

**“Acceptance for Mix Density on the Roadway.** The Department will apply a deduction in payment, not as a penalty but as liquidated damages, for failure to meet the density requirements specified in **407.15**. As soon as practicable after the final rolling is completed on each lot, the Department will perform 5 density tests at locations determined by the Engineer, and will compute an average of all such tests. Deductions for failure to meet density requirements will be computed to the nearest 0.1% as a percentage of the total payment otherwise due for each lot. The percent of total payment to be deducted will be 5 times the percent the average in-place density for each lot that fails to meet **407.15**. The Department will make deductions in monies due the Contractor for failure to meet the density requirements under the item for Density Deduction. The Department will conduct acceptance testing for density in accordance with ASTM D2950 unless otherwise specified. For projects with total project tonnage per mix type less than 2,000 tons (not including small quantity jobs as defined in 407.20.B.1) the department may alternatively calculate in place density by cores (AASHTO T-166), in this case no cores will be taken for gauge correlation on the test strip. The Department inspector will be a certified Asphalt Roadway Technician.”

**Subsection 407.20** (pg. 350) 10-7-19; B.5. Acceptance for Mix Density on the Roadway, Revise the last sentence in the 1<sup>st</sup> paragraph:

“**Acceptance for Mix Density on the Roadway.** The Department will apply a deduction in payment, not as a penalty but as liquidated damages, for failure to meet the density requirements specified in **407.15**. As soon as practicable after the final rolling is completed on each lot, the Department will perform 5 density tests at locations determined by the Engineer, and will compute an average of all such tests. Deductions for failure to meet density requirements will be computed to the nearest 0.1% as a percentage of the total payment otherwise due for each lot. The percent of total payment to be deducted will be 5 times the percent the average in-place density for each lot that fails to meet **407.15**. The Department will make deductions in monies due the Contractor for failure to meet the density requirements under the item for Density Deduction. The Department will conduct acceptance testing for density in accordance with ASTM D2950 unless otherwise specified. The Department inspector conducting the density tests shall be a certified Nuclear Gauge Field Technician.”

**Subsection 407.20** (pg. 350) 11-16-15; B. 5. Acceptance for Mix Density on the Roadway, Replace the entire 2<sup>nd</sup> paragraph with the following:

“For density testing purposes, the Department will divide the pavement into lots of 1,000 tons. Five density tests will be performed in each lot and the average results compared with the requirements specified in Tables 407.15-1 to 407.15-4. At the beginning of a project or at any time it is deemed advisable, the Department may consider smaller lots to evaluate compaction methods or for other reasons as approved or directed by the Engineer.”

**Subsection 411.03** (pg. 357) 10-8-18; B. Proportioning, modify table 411.03-1 to add TLE requirements:

**“Table 411.03-1: Proportions of Total Mixture, Percent by Weight**

Surface Course	Effective Combined Mineral Aggregate	Asphalt Cement
Grading D	93.0 - 94.3	5.7 - 7.0 <sup>(1)</sup>
Grading E <sup>(2)</sup>	93.0 - 94.3	5.7 - 7.0 <sup>(1)</sup>
Grading E (shoulders)	92.0 - 94.7	6.0 - 6.5 <sup>(1)</sup>
Grading TL	92.5 - 94.3	5.7 - 7.5 <sup>(1)</sup>
Grading TLD	93.0 - 94.3	5.7 - 7.0 <sup>(1)</sup>
Grading TLE	93.0 - 94.3	5.7 - 7.0 <sup>(1)</sup>
Grading OGFC	92.0 - 94.0	6.0 - 8.0 <sup>(1)</sup>

<sup>(1)</sup> If the effective combined specific gravity of the aggregate exceeds 2.80, the above proportions may be adjusted as directed by the Engineer. The upper limit for flow values shall not apply to mixes with modified asphalt liquids.

<sup>(2)</sup> The minimum allowable asphalt cement content for 411E low volume mixtures is 5.3%.

**Subsection 411.03** (pg. 358-359) 10-8-18; B. Proportioning: 2. Grading E, modify subsection and Table 411.03-3 to add TLE requirements, remove riding surface phrase:

2. **Grading E and TLE.** In addition to the other requirements of these Specifications, the composition of the mineral aggregate shall be such that, when combined with the required amount of bitumen, the resultant mixture will meet Table 411.03-3.

**Table 411.03-3: Mixture Properties (High vs. Low Volume Roads)**

Mix	Traffic Volume	Stability Minimum lb-ft <sup>(1, 3)</sup>	Flow 0.01 inch <sup>(2)</sup>	Design Void Content % <sup>(1)</sup>	Production Void Content % <sup>(1)</sup>	VMA, Min % <sup>(1)</sup>
411E 411TLE	High Volume (ADT > 1,000)	2,000	8 - 16	4.0 ± 0.2	3 - 5.5	14
411E 411TLE	Low Volume (ADT ≤ 1,000)	1,500	8 - 16	3.5 ± 0.5	2 - 5	n/a

- <sup>(1)</sup> Tested according to AASHTO T 245 with 75 blows of the hammer on each side of the test specimen, using a Marshall Mechanical Compactor.
- <sup>(2)</sup> Flow will only be required when using a non-modified binder (PG 64-22 or 67-22)
- <sup>(3)</sup> Minimum stability for shoulder mixes will be 1,500 lb-ft and optimum asphalt cement content for shoulder mixes shall be as directed by the Regional Materials Supervisor.

**Subsection 411.03** (pg. 358-359) 10-8-18; C. Recycled Asphalt Pavement and Recycled Asphalt Shingles: modify Table 411.03-6 to add TLE requirements:

**Table 411.03-6: Use of Recycled Asphalt Pavement**

Mix Type	% RAP (Non-processed) <sup>(1)</sup>	Maximum % RAP (Processed) <sup>(2)</sup>	Maximum % RAP Processed and Fractionated <sup>(3)</sup>	Maximum Particle Size (inch)
411D (PG64-22, PG67-22)	0	15	20	1/2
411D (PG70-22, PG76-22, PG82-22)	0	10	15	1/2
411E & 411TLE(Roadway)	0	15	20	1/2
411E &	15	30	35	1/2

Mix Type	% RAP (Non-processed) (1)	Maximum % RAP (Processed) (2)	Maximum % RAP Processed and Fractionated (3)	Maximum Particle Size (inch)
411TLE (Shoulder)				
411TL (PG64-22, PG67-22)	0	15	15	5/16
411TL (PG70-22, PG76-22, PG82-22)	0	10	10	5/16
411TLD (PG64-22, PG67-22)	0	15	15	5/16
411TLD (PG70-22, PG76-22, PG82-22)	0	10	10	5/16

(1) “Non-processed” refers to RAP that has not been crushed and screened or otherwise sized such that the maximum recycled material particle size is less than that listed above prior to entering the dryer drum.

(2) “Processed” refers to RAP that has been crushed and screened or otherwise sized such that the maximum recycled material particle size is less than that above prior to entering the dryer drum.

(3) “Fractionated” refers to RAP that has been processed over more than one screen, producing sources of various maximum particle sizes (e.g., 3/4 to 1/2 inch, 1/2 inch to #4, etc.). The Contractor may use the larger percentages of fractionated RAP specified only if individual fractions of two different maximum particle size are introduced into the plant as separate material sources for increased control.

**Subsection 411.03** (pg. 363) 11-16-15; 2. Recycled Asphalt Shingles (RAS), change 5% to 3% in the 1<sup>st</sup> sentence of the 1<sup>st</sup> paragraph.

“Recycled Asphalt Shingles (RAS) may be included to a maximum of 3% of the total weight of mixture.”

**Subsection 411.03 B. Anti-strip Additive** (pg. 365) 6-27-16; revise the 2<sup>nd</sup> paragraph:

“Mix an approved anti-strip agent with the asphalt cement at the dosage as specified in **921.06.B.**”

**Subsection 411.09** (pg. 367), 5-13-19; **Method of Measurement**; Revise Table 411.09-1:

**Table 411.09-1: Asphalt Cement Content**

Mix Type	Asphalt Content, %
411-D	5.9
411-E Roadway	6.3
411-E Shoulder	6.3
411-TL	6.3
411-TLD	5.9
411-TLE Roadway	5.9
411-TLE Shoulder	5.9
411-OGFC	6.0

**Subsection 414.02** (pg. 369) 11-16-15; Materials, add the following paragraph to the end of the subsection:

“Ensure that no deleterious material is introduced into aggregate stockpiled at project site.”

**Subsection 414.02** (pg. 369) 11-6-17; Revise the last sentence:

“For a slurry seal, use a Type CQS-1h emulsified asphalt. For micro-surfacing use a type CQS-1hp or CSS-1hp emulsified asphalt.”

**Subsection 414.02** (pg. 369), 12-30-19; **Materials**; Revise 2<sup>nd</sup> paragraph:

For a slurry seal, use a Type CQS-1h emulsified asphalt. For micro-surfacing, use a type CQS-1hp ~~or CSS-1hp~~ emulsified asphalt.

**Subsection 414.06** (pg. 379-382) 5-14-18; Remove B. 3. a., update b. to a. and revise as follows:

“B. Quality Control

**3. Documentation.** Maintain a lot sheet as follows:

**a. Lot Sheet.** Divide the Project into lots of each day’s production. For each lot, maintain a lot sheet, providing the following information:

- (1) Contract Number, Route,
- (2) Date, Air Temperature, Pavement Surface Temperature
- (3) Control Settings, Calibration Values, Unit Weight of Emulsion (pounds per gallon), Percent Residue in Emulsion
- (4) Beginning and Ending Log Miles



- (5) Computer display readings for material usage (Beginning, Ending, and Total)
- (6) Length, Width, Total Area (square yards) of the construction completed for the day
- (7) Aggregate used (dry ton) Asphalt Emulsion used (ton), additives (gallon), water (gallon), and/or Portland Cement (ton)
- (8) Application Rate of asphalt emulsion, Combined Application Rate (pounds per square yard)
- (9) Mix Design (Percent Portland cement, Percent Emulsion, Percent Asphalt Cement)
- (10) Calibration Forms
- (11) Contractor's Authorized Signature"

**Subsection 414.12** (pg. 384) 10-8-18, Basis of Payment, add the following as the last sentence of the paragraph:

“The Department will pay for accepted quantities, determined in accordance with 414.11, at the contract prices, complete in place, which payment shall be full compensation for all equipment, materials, labor and incidentals necessary to complete the work. A price adjustment for Loss on Ignition (LOI) shall be applied on a project basis per 407.20.C.3.”

**Subsection 414.12** (pg. 384), 12-30-19; **Basis of Payment**; Add subsection A & B:

**A. General**

The Department will pay for accepted quantities, determined in accordance with 414.11, at the contract prices, complete in place, which payment shall be full compensation for all equipment, materials, labor and incidentals necessary to complete the work.

**B. Adjustments**

- 1. Loss on Ignition (LOI).** A price adjustment for Loss on Ignition (LOI) shall be applied on a project basis per 407.20.C.3.
- 2. Specific Gravity.** In cases where the Bulk SSD specific gravity of the mineral aggregate exceeds 2.80, the Department will adjust the tonnage of mineral aggregate for payment by multiplying the tonnage of mineral aggregate used by a specific gravity of 2.80 and dividing by the higher specific gravity.