FOR ITEM NO. 1 - SOLAR PAVEMENT LEVELLED MARKER / STUD

097.13 DPWH
01.27.2022

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

JAN 27 2022

DEPARTMENT ORDER)
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NO. 08)
Series of 2022)
dl 1/27/2022

SUBJECT: Amendment to DPWH Standard Specification for Item 607(3) – Internally Illuminated (Solar) Pavement Levelled Markers/Studs Flush Type

In order to ensure uniformity in the application/ adoption of the Pay Items of Work to be used/adopted by those who are involved in the preparation of the Design Plans and Quantities, Program of Works (POW) and Approved Budget for the Contract (ABC) for Infrastructure Projects Nationwide, the attached amended DPWH Standard Specification for **Item 607(3) – Internally Illuminated (Solar) Pavement Levelled Markers/Studs Flush Type** is hereby prescribed for adoption in Government infrastructure projects that require the utilization of such in the Program of Works.

This Standard Specification shall form part of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II and is now included in the Project and Contract Management Application (PCMA).

This supersedes Memorandum 097.7_050719 *(Standard Specification for Item 607(3) – Internally Illuminated (Solar) Pavement Levelled Markers/Studs Flush Type for Inclusion in the DPWH Standard Specification for Item 607 – Reflective Pavement Studs)* issued on May 7, 2019 and shall take effect immediately.

ROGER G. MERCADO
Acting Secretary

14.1.2 MLL/RPF

Department of Public Works and Highways
Office of the Secretary
WIN2U01742

Amendment to DPWH Standard Specification for
ITEM 607(3) - INTERNALLY ILLUMINATED (SOLAR) PAVEMENT LEVELLED MARKERS/STUDS FLUSH TYPE

607(3).1 Description

This Item shall consist of furnishing and installing internally illuminated (solar) pavement levelled markers/studs on the surface of the pavement in accordance with this Specification and at the lines and locations shown on the Plans.

607(3).2 Material Requirements

607(3).2.1 Internally Illuminated (Solar) Pavement Levelled Markers/Studs

The internally illuminated (solar) pavement levelled markers/studs shall be either mono-directional or uni-directional, bi-directional or omni-directional.

The reinforced body case shall be made of aluminum die cast with adequate webbing to ensure a firm key to the road when installed. The protective upper cup or security ring shall be made of aluminum die cast with a minimum of five (5) stainless steel safety locks.

The internal circuit module shall be detachable from the reinforced body case for easy maintenance and shall be made of impact and abrasion resistant polycarbonate material which is tightly sealed with its body having an Ingress Protection (IP) 68 rating (dust and water resistant) based from IEC 60529, Degrees of protection provided by enclosures (IP Code).

The internally illuminated (solar) pavement levelled markers/studs shall conform to the applicable requirements of EN 55015, Limits and Methods of Measurement of Radio Disturbance Characteristics of Electrical Lighting and Similar Equipment, and EN 61547, Equipment for General Lighting Purposes - EMC Immunity Requirements. The certified true copy of the said test results shall be issued by the manufacturer to the Contractor reiterating the current date of certification and must be submitted to the Engineer before doing the installation work.

The solar cell and the rechargeable battery shall be of the latest technology and shall be able to last for at least 3 days of LED runtime with a 12 hour per day discharge criteria on one (1) full charge. The light-emitting diode (LED) shall have luminous intensity varying depending on the color (yellow, white, red, green, and blue). For yellow and white, the minimum luminous intensity values expressed in millicandela (mcd) is shown in Table 607(3).1. The LED shall have an output frequency of either steady or flashing.

Table 607(3).1 Luminous Intensity Properties

Luminance intensity (mcd)	Color	
	Yellow	White
Vertical angle 0.2° / Horizontal angle 0°	350	400
Vertical angle 0.3° / Horizontal angle +5°	200	200
Vertical angle 0.3° / Horizontal angle -5°	200	200
Vertical angle 1.0° / Horizontal angle +10°	100	100
Vertical angle 1.0° / Horizontal angle -10°	100	100

All LEDs should be covered with polycarbonate covers on the sides. Mono-directional or Uni-directional Internally Illuminated (Solar) pavement levelled markers/studs shall either have three (3) LED or a minimum of one (1) LED on one (1) tapering side. Bi-directional internally illuminated (solar) pavement leveled markers/studs shall have a minimum of two (2) LEDs on one (1) tapering side. Omni-directional internally illuminated (solar) pavement leveled markers/studs shall have a minimum of three (3) LEDS on one tapering side and a minimum of two (2) on two (2) opposite tapering sides.

Table 607(3).2 Specifications

Properties	Requirements
Housing/Body	Aluminum Die Cast
Diameter (Main Body), Min.	123 mm dia.
Height, Min.	39 mm
Weight, Min.	590 grams
Solar Panel, Min.	Mono (Single) Crystalline 2.5V, 120mA
Rechargeable Battery	Anti-heat Lithium Iron Phosphate ($LiFePO_4$) 3.2V, 1000-1500mAh
LED Chip, Min.	6mm
Gradient on LED Sides	30 degrees
Operating Temperature	-20°C to 65°C
Compression Test, Min.	30 Tons

607(3).2.2 Adhesive

Any approved two-part epoxy adhesive shall be used in the installation of the internally illuminated (solar) pavement levelled markers/studs.

607(3).3 Construction Requirements

The markers/studs shall be installed into the pavement in accordance with the manufacturer's instructions but shall also comply with the specified requirements.

Holes in the pavement shall be true to size of the marker/stud and shall be cleanly cut using appropriate coring equipment. Holes shall be clean and free from all dirt, dust, oil, grease, laitance, or any other materials, which would prevent bonding, prior to application of adhesive. No adhesive shall be applied when the weather is foggy or rainy.

Placing and positioning of the marker/stud shall be by means of rubber mallet until the top surface is flushed with the pavement and with the main directional LED light parallel to the centerline of the road. Excess adhesive displaced during the placing and positioning of the markers/studs shall be wiped clean and no adhesive shall be left exposed on the surface of the pavement.

Traffic shall be kept off the newly installed markers/studs for a period of at least 2 hours or until such time that the adhesive has sufficiently cured as determined by the Engineer.

607(3).3.1 Markings

Product marking (Manufacturer or applicable abbreviation and approval number) shall be clear and firm by way of not erasing easily and to be seen easily for road studs.

607(3).3.2 Warranty

The Contractor shall obtain from the manufacturer a one-year warranty for satisfactory field performance including stipulated luminous intensity of the LED and battery back-up capacity and submit the same to the Engineer.

607(3).4 Method of Measurement

The quantity of internally illuminated (solar) pavement levelled markers/studs to be paid for shall be the number of internally illuminated (solar) pavement levelled markers/studs of mono-directional or uni-directional type, bi-directional type and omni-directional type, whichever is called for in the Contract, installed complete and accepted.

607(3).5 Basis of Payment

The quantities measured as described in Section 607(3).4, Method of Measurement, shall be paid for at the Contract Unit Price of the Pay Items shown in the Bid Schedule, which payment shall constitute full compensation for furnishing and placing all materials, drilling of holes, preparation of surfaces, applying adhesive and for all labor, equipment, tools and incidentals necessary to complete the Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
607 (3)a.1	Internally Illuminated (Solar) Pavement Levelled Marker/Stud Flush Type (Mono-directional or Uni-directional), 123mm dia.	Each
607 (3)a.2	Internally Illuminated (Solar) Pavement Levelled Marker/Stud Flush Type (Mono-directional or Uni-directional), 143 mm dia.	Each
607 (3)b	Internally Illuminated (Solar) Pavement Levelled Marker/Stud Flush Type (Bi-directional)	Each
607 (3)c	Internally Illuminated (Solar) Pavement Levelled Marker/Std Flush Type (Omni-directional)	Each

References:

1. *International Electrotechnical Commission (TEC)*
   - *IEC 60529, Degrees of protection provided by enclosures (IP Code)*
2. *European Standard (EN)*
   - *EN 55015, Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment*
   - *EN 61547, Equipment for genera/ lighting purposes - EMC immunity requirements*
3. *DPWH Standard Specification for Highways, Bridges, and Airports*
4. *CTC Builder & Supplies Incorporated; Road Devices & Equipment Corporation (Exclusive Distributor in the Philippines) / Green & Innovation (GU) Tech Co. Ltd (Korean Counterpart/Manufacturer/Principal)*
5. *Crownmix Corporation (Exclusive Distributor in the Philippines) / Miracle Ind. Co. Ltd (Korean Counterpart/Manufacturer/Principal)*
6. *Technoshine Trading International*

FOR ITEM NO. 2 - REFLECTORIZED TRAFFIC PAINT WHITE

ITEM 709 – PAINTS

709.1 Description

This Item covers all paint materials including vehicles, pigments, pastes, driers, thinners and mixed paints for steel and wooden structures.

709.2 Material Requirements

709.2.1 General

Paint, except, aluminum paint, shall consist of pigments of the required fineness and composition ground to the desired consistency in linseed oil in a suitable grinding machine, to which shall be added additional oil, thinner and drier as required.

Aluminum paint shall consist of aluminum bronze powder or paste of the required fineness and composition to which shall be added the specified amount of vehicle.

The paint shall be furnished for use in ready mixed, paste or powder form.

All paint shall meet the following general requirements:

a. The paint shall show no excessive settling and shall easily be redispersed with a paddle to a smooth, homogenous state. The paint shall show no curdling, livering, caking or color separation and shall be free from lumps and skins.
b. The paint as received shall brush easily, possess good levelling properties and shall show no running or sagging when applied to a smooth vertical surface.
c. The paint shall dry to a smooth uniform finish free from roughness grit, uneveness and other imperfections.
d. The paint shall not skin within 48 hours in three quarters filled closed container.
e. The paint shall show no thickening, curdling, gelling or hard caking after six (6) months storage in full, tightly covered container at a temperature of 21^0C.

709.2.2 The paint shall conform to the requirements of the indicated specifications as follows:

Red Lead Ready-Mixed Paint	AASHTO M 72 Type I, II, III and IV
Aluminum Paint	AASHTO M 69 Type I and II
White & Tinted Ready-Mixed Paint	AASHTO M 70
Foliage Green Bridge Paint	AASHTO M 67
Black Paint for Bridges and Timber Structures	AASHTO M 68
Basic Lead Silicon Chromate, Ready-Mixed Primer	AASHTO M 229

709.2.3 The constituent parts of the paint shall meet the following specifications:

Red Lead (97% Pb_3O_4)	ASTM D 83
Iron Oxide (85% Fe_2O_3)	ASTM D 84
Aluminum Powder and Paste	ASTM D 962
Magnesium Silicate	ASTM D 605
Mica Pigment	ASTM D 607
Titanium Dioxide	ASTM D 476
Chrome Yellow	ASTM D 211
Calcium Carbonate	ASTM D 1199
Basic Lead-Silicon Chromate	ASTM D 1638
Basic Carbonate White Lead	ASTM D 81
Zinc Oxide	ASTM D 79
Chrome Oxide Green	ASTM D 263
Carbon Black	ASTM D 561
Lampblack	ASTM D 209
Prussian Blue	ASTM D 261
Boiled Linseed Oil	ASTM D 260
Raw Linseed Oil	ASTM D 234
Pale Heat Bodied Linseed Oil	Fed Spec. TT-0-367
Alkyd Resin	Fed. Spec. TT-R-266
Mineral Spirit	ASTM D 235
Driers	ASTM D 600
Turpentine	ASTM D 13

709.2.4 Drier

These specifications cover both straight oil drier (material free from resins and "gums"), and Japan drier (material containing varnish "gums"). The drier shall be composed of lead manganese or cobalt, or a mixture of any of these elements, combined with a suitable fatty oil, with or without resins of "gums" and mineral spirits of turpentine, or a mixture of these solvents. The drier shall conform to the following requirements:

a. Appearance – Free from sediment and suspended matter.
b. Flash Point – (Tag close cup) not less than 30^0C.
c. Elasticity – The drier when flowed on metal and baked for 2 hours at 100^0C shall have an elastic film.
d. Drying – It shall mix with pure raw linseed oil in the proportion of 1 volume of drier to 19 volumes of oil without curdling, and the resulting mixture when flowed on glass shall dry in not more than 18 hours.
d. Color – When mixed with pure, raw linseed oil in the proportion of 1 volume of drier to 8 volumes of oil, the resulting mixture shall be darker than a solution of 6 g of potassium dichromate in 13 cc of pure sulfuric acid (sp. gr. 1.84).

709.3 Proportion for Mixing

It is the intent of these Specifications to provide a paint of proper brushing consistency, which will not run, streak or sag and which will have satisfactory drying qualities.

709.3.1 Aluminum Paint, Field Coats on Structural Steel

The paint shall be mixed in the proportion of 0.242 kg of aluminum powder of paste per litre of vehicle of long oil spar varnish producing a paint containing 21 mass percent pigment and 79 percent vehicle. The weighed amount of powder or paste shall be placed in a suitable mixing container and the measured volume of vehicle then poured over it. The paste or powder shall be incorporated in the paint by vigorous stirring with a paddle. The powder or paste will readily disperse in the vehicle. Before removing any paint from the container, the paint shall be thoroughly stirred to insure a uniform mixture and the paint shall be suitably stirred during the use. The amount of paint enough for one day's use only shall be mixed at one time.

When two field coats of aluminum paint are specified, the first coat shall be tinted with lampblack paste or Prussian blue paste in the quantity of 0.024 kg/L or more of paints. The exact quantity used shall be sufficient to give a contrast in color which can be readily distinguished. When three field coats of aluminum paint are specified the second coat shall be tinted.

709.3.2 Aluminum Paint, Field Coats on Creosoted Timber

This paint shall be mixed as specified for Aluminum Paint for Structural Steel except that the proportions shall be 0.272 kg of aluminum powder or paste per litre of vehicle.

Other paint composition may be used when and as stipulated in the Special Provisions.

709.4 Containers and Markings

All paints shall be shipped in strong, substantial containers plainly marked with mass, color and volume in litres of the paint content, a true statement of the percentage composition of the pigment, the proportions of the pigment to vehicle, the name and address of the manufacturers and the stencil of the authorized inspecting agency. Any package or container not so marked will not be accepted for use under this Specification.

Designation: D 1615 – 60 (Reapproved 1995)ε1

Standard Test Methods for Glycerol, Ethylene Glycol, and Pentaerythritol in Alkyd Resins[1]

This standard is issued under the fixed designation D 1615; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε[1] NOTE—Keywords were added editorially and editorial changes made throughout in May 1995.

1. Scope

1.1 These test methods cover the determination of glycerol, ethylene glycol, and pentaerythritol in alkyd resins and resin solutions. Other polyhydric alcohols that can be oxidized by periodic acid to formaldehyde or formic acid, or both, will interfere with the determination of glycerol and ethylene glycol (see Test Methods D 2456 or D 2998). Urea, melamine, or phenolic resins interfere and render this procedure inapplicable.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 563 Test Method for Phthalic Anhydride Content of Alkyd Resins and Resin Solutions[2]

D 1193 Specification for Reagent Water[3]

D 1398 Test Method for Fatty Acid Content of Alkyd Resins and Alkyd Resin Solutions[2]

D 2456 Test Method for Identification of Polyhydric Alcohols in Alkyd Resins[2]

D 2998 Test Method for Polyhydric Alcohols in Alkyd Resins[2]

3. Purity of Reagents

3.1 Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.[4] Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

3.2 Unless otherwise indicated, references to water shall be understood to mean reagent water conforming to Specification D 1193.[3]

NOTE 1—The reagents and samples used in these methods may, under some conditions, be hazardous. Refer to the manufacturer's Material Safety Data Sheets for specific handling and safety precautions. Safe laboratory handling procedures and all applicable OSHA regulations are to be followed.

GLYCEROL AND ETHYLENE GLYCOL

4. Summary of Test Method

4.1 The primary hydroxyl groups of ethylene glycol and glycerol are oxidized to formaldehyde by periodic acid; the secondary hydroxyl group of glycerol is oxidized to formic acid. By acidimetric and iodometric titration, the proportions of formic acid and formaldehyde can be determined respectively, and calculated to glycerol and ethylene glycol by algebraic equations. The equations for the oxidation of the polyhydric alcohols are as follows:

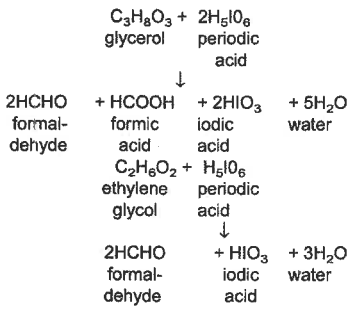
[1] These test methods are under the jurisdiction of ASTM Committee D-1 on Paint and Related Coatings, Materials, and Applications and are the direct responsibility of Subcommittee D01.33 on Polymers and Resins.

Current edition approved Sept. 19, 1960. Originally issued 1958. Replaces D 1615 – 58 T.

[2] *Annual Book of ASTM Standards*, Vol 06.03.

[3] *Annual Book of ASTM Standards*, Vol 11.01.

[4] *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmaceutical Convention, Inc. (USPC), Rockville, MD.



With pentaerythritol, there is no reaction.

5. Apparatus

5.1 *Burets*, 50 and 100-mL capacity.

5.2 *Pipets*, 20 and 50-mL capacity.

5.3 *Beakers*, two of 400-mL capacity.

5.4 *Erlenmeyer Flasks*, four of 1000-mL capacity, glass-stoppered.

5.5 *Volumetric Flasks*, two of 100-mL capacity.

5.6 *Graduated Cylinder*, 10-mL capacity.

5.7 *Filter Paper*, fast, qualitative grade.

5.8 *Watch Glass*.

6. Reagents

6.1 *Methyl Purple Indicator Solution.* [5]

6.2 *Periodic Acid* (11 g/L)—Dissolve 11 g of periodic acid (HIO_4) in water and dilute to 1 L. Prepare fresh daily and store in a brown bottle.

6.3 *Potassium Iodide Solution* (200 g/L)—Dissolve 200 g of potassium iodide (KI) in water and dilute to 1 L.

6.4 *Sodium Hydroxide, Standard Solution* (0.1 *N*)—Prepare and standardize a 0.1 *N* aqueous sodium hydroxide (NaOH) solution.

6.5 *Sodium Thiosulfate, Standard Solution* (0.2 *N*)—Prepare and standardize a 0.2 *N* aqueous sodium thiosulfate ($Na_2S_2O_3$) solution.

6.6 *Starch Indicator Solution*—Dissolve 5 g of soluble starch in water and dilute to 1 L. Preserve the solution with 1 g of salicyclic acid.

6.7 *Sulfuric Acid* (1+5)—Carefully mix 1 volume of concentrated sulfuric acid (H_2SO_4, sp gr 1.84) with 5 volumes of water.

7. Procedure

7.1 Determine the phthalic anhydride in accordance with Test Method D 563. Following this, extract the fatty acids in accordance with 5.6 through 7 of Test Method D 1398, except *do not* discard the aqueous phase.

7.2 Test the remaining water solution containing the polyalcohols for glycerol and ethylene glycol in the following manner:

7.2.1 Transfer the solution to a 400-mL beaker and evaporate to about 60-mL volume, using an electric hot plate as source of heat. Keep the beaker covered with a watch glass[6] during boiling.

7.2.2 Cool to room temperature, and filter through a rapid paper into a 100-mL volumetric flask. (Take the sample for pentaerythritol determination from this same volumetric flask.) Fill to the mark and agitate.

7.2.3 Pipet 20 mL (⅕ aliquot) (Note 2) into a 1-L Erlenmeyer, glass-stoppered flask. Add 2 drops of methyl purple indicator solution and neutralize with NaOH. Pipet into the 1-L flask also 50 mL of HIO_4 solution, stopper, and swirl to mix thoroughly.

NOTE 2—The aliquot should be so chosen, if possible, that 15 to 20 % of the periodic acid is consumed during the oxidation. Considerable excess of periodic acid is required to complete the oxidation, and in case more than 20 % is consumed the results should be disregarded and a smaller aliquot taken. On the other hand, too small an aliquot is not advisable, for in such a situation the difference between titration and blank is small and any titration errors are magnified.

7.3 Simultaneously prepare two blanks containing 20 mL of water. Allow to stand 50 to 70 min at room temperature.

7.4 To the aliquot of the sample (7.2.3) and the blank, add 100 mL of water and 3 drops of methyl purple indicator and titrate with 0.1 *N* NaOH solution to neutrality. Use the 50-mL buret and record the volume to the nearest 0.01 mL.

7.5 To the solution that has just been titrated, add 150 mL of water, 30 mL of KI solution, and 25 mL of H_2SO_4 (1+5). Titrate with 0.2 *N* $Na_2S_2O_3$ solution to faint iodine color, add 10 mL of starch indicator and titrate to the disappearance of the blue color.

NOTE 3—If the end point is not stable, as indicated by return of the blue color in the stoppered flask in 5 min, add water and titrate to a stable end point. Use the 100-mL buret and record the volume to the nearest estimated 0.05 mL.

8. Calculations

8.1 Calculate the percentage of glycerol, *G*, as follows:

$$G = [(A - B)N \times 0.09206/WF] \times 100$$

where:

A = millilitres of NaOH solution required for titration of the sample,
B = millilitres of NaOH solution required for titration of the blank,
N = normality of the NaOH solution,
0.09206 = grams of glycerol equivalent to 1 mL of 1 *N* NaOH solution (acidimetric),
W = grams of sample used, and
F = aliquot fraction = ⅕.

8.2 Calculate the percentage of glycerol and ethylene glycol, *T*, as a percentage of glycerol as follows:

$$(T = [(B' - A')N \times 0.023015)/WF] \times 100$$

where:

[5] Methyl purple indicator manufactured by the Fleisher Chemical Co., Benjamin Franklin Station, Washington 4, D.C., U.S. Patent No. 2,416,619, has been found satisfactory for this purpose.

[6] The Speedyvap watch glass has been found satisfactory for this purpose.

FOR ITEM NO. 3 - BITUMINOUS PLANT - MIX SURFACE COURSE, COLD LAID

texture or composition shall be corrected, including removal and replacement of unsatisfactory material at the Contractor's expense as directed by the Engineer.

307.4 Method of Measurement

The area to be paid for under this item shall be the number of square meters (m^2) of asphalt pavement placed, compacted and accepted based on the thickness and densities of the cores taken in accordance with subsection 307.3.10 (Acceptance, Sampling and Testing).

307.5 Basis of Payment

The accepted quantity, measured as prescribed in Section 307.4 will be paid for as provided in the respective items for the specified type of bituminous plant mix.

ITEM 308 – BITUMINOUS PLANT- MIX SURFACE COURSE, COLD-LAID

308.1 Description

This item shall consist of constructing a Bituminous Plant-Mix Surface Course composed of aggregates, mineral filler and bituminous material mixed in a central plant, constructed and laid cold on the prepared base in accordance with this Specification and in conformity with the lines, grades and typical cross-section shown on the Plans.

308.2 Material Requirements

308.2.1 Composition and Quality of Asphalt Cold Mix (Job-Mix Formula)

The asphalt cold mix shall be composed of coarse mineral aggregates, fine mineral aggregates, mineral fillers and chemically bonding bitumen.

At least three weeks prior to production, the Contractor shall submit in writing a job-mix formula for each mixture supported by laboratory test data along with samples and sources of the components and viscosity-temperature relationships information to the Engineer for testing and approval.

Each job-mix formula submitted shall propose definite single value for:

1. The percentage of coarse mineral aggregates passing each specified sieve size.

2. The percentage of fine mineral aggregates passing each specified sieve size.

3. The percentage of chemically bonding bitumen material to be added.
4. The temperature of the mixture delivered on the prepared base of the road.
5. The kind and percentage of chemical additive to be used.
6. The kind and percentage of mineral filler to be incorporated.

Stability Requirements:

The mixture shall conform to the following:

Test Property	Minimum	Maximum
Stability N at 22.2^{0}C	2224	-
Percent Stability Loss After Vacuum Saturation and Immersion	-	50
Aggregate Coating (Percent)	50	-

308.2.2 Bituminous Material

It shall be either Liquid Cut-back Asphalt or Emulsified Asphalt, whichever is called for in the Bill of Quantities. The type and grade of asphalt material will be specified by the Engineer and shall comply to the requirements of AASHTO M 82, M 140 or M 208 (ASTM D 2397).

308.2.3 Coarse Aggregates

Coarse Aggregates shall conform to the applicable requirements of Item 703 or AASHTO M 79.

308.2.4 Fine Aggregates

Fine Aggregates shall conform to the applicable requirements of Item 703, AASHTO M 29 or ASTM D 1073.

308.2.5 Mineral Fillers

It shall conform to the requirements of Item 703A, Mineral Filler or ASTM D 242.

308.2.6 Proportioning of Mixture

The proportioning of Bituminous Material on the basis of total dry aggregate shall be from 4.5 to 7.0 mass percent when cut back asphalt is used and from 6.0 to 10.0 mass percent when emulsified asphalt is used. The exact percentage to be used shall be fixed by the Engineer in accordance with the job-mix formula and the other quality control requirements.

308.3 Construction Requirements

308.3.1 Weather Limitations

Cold Asphalt Plant Mix shall be placed only when the specified density can be obtained. The mixture shall not be placed on any wet surface or when weather condition will prevent its proper handling or finishing. Asphalt surface mixture shall not be placed when the surface temperature of the base course is below 10^0C.

308.3.2 Preparing Area To Be Paved

1. The area to be paved shall be substantially true to line and grade. It shall have a firm and properly prepared surface before paving operations begin. All loose and foreign material shall be removed.

2. When the compacted subgrade on which the asphalt base is to be placed loosely bonded, it shall be primed with 0.5 to 1.40 litre/m^2 of the type and grade of asphalt priming material. The asphalt should be entirely absorbed by the base course and the prime should be fully set and cured before placing the surface.

3. Holes and depressions in existing surfaces shall be repaired by removing all loose and defective material to sound pavement and replacing with an approved asphalt-aggregate patching material. The patching mixture shall be compacted to produce a tight surface conforming to the adjacent pavement area.

4. Excess asphalt in patches and joints shall be removed only through methods approved by the engineer.

5. Immediately prior to application of the asphalt tack coat all loose and foreign material shall be removed by sweeping or by blowing, or both.

6. Surfaces of curbs, gutters, vertical faces of existing pavements, and all structures to be in actual contact with the asphalt-aggregate mixture shall be given a thin, even coating of asphalt material, type and grade. Care shall be taken to prevent spattering of the asphalt on surfaces that will not be in contact with the asphalt-aggregate mixture.

308.3.3 Preparing The Mixture

1. The asphalt shall be warmed, if necessary, at the paving plant to a temperature at which it can be applied uniformly to the aggregate.

2. When it is necessary to blend aggregates from one or more sources to produce the combined gradation, each source or size of aggregate shall stockpiled individually. Aggregate from the individual stockpiles shall fed through separate bins to cold elevator feeders. They shall not be blended in the stockpile.

3. Cold aggregates shall be fed carefully to the plant so that surpluses and shortages will not occur and cause breaks in the continuous operation.

4. Mixing time shall be the shortest time that will produce a satisfactory mixture.

308.3.4 Placing The Mix

The bituminous surface course mixture shall be placed with an asphalt paver to provide a nominal compacted thickness of the surface course. The minimum lift thickness shall be at least two times the maximum particle size. The maximum lift thickness shall be that which can be demonstrated to be laid in a single lift and compacted to a required uniform density and smoothness. Placing the mixture shall be a continuous operation. If any irregularities occur, they shall be corrected before final compaction of the mixture.

308.3.5 Compacting The Mixture

The mix shall be compacted immediately after placing. Initial rolling with a steel-wheeled tandem or three wheeled roller, vibratory roller, or a pneumatic-tired roller shall follow the paver as closely as possible. If needed, intermediate rolling with a pneumatic-tired roller shall be done immediately behind the initial rolling. An application of choke aggregate may be necessary to prevent mix pick-up by the pneumatic-tired roller. Final rolling shall eliminate marks from previous rolling. In areas too small for the roller, a vibrating plate compactor or a hand-tamper shall be used to achieve thorough compaction.

308.3.6 Acceptance Requirement

Divide asphalt mixture production into lots, each lot equal to the mix produced during one day. Determine the target density for each lot by measuring the average density of six laboratory prepared specimens representing two randomly chosen subsamples from trucks delivering mixture to the jobsite. The target density should be reported as dry density.

Determine the compacted density in the field from five randomly located positions in each lot of the compacted mixture. The density of freshly compacted material can be determined using a properly calibrated nuclear density device or other procedure. Density determinations made after a period of curing may be determined on samples obtained from compacted material by a suitable core drilling technique. All compacted densities should be converted to dry densities. It is recommended that the average of five field density determinations made in each lot be equal to or greater than 97 percent of the average density of the six laboratory prepared specimens, and that no individual determination be lower than 95 percent.

The compacted base and surface shall have an average thicknesses no less than those specified on the plans. Any deficiency in thickness shall be made up with surface mixture when the surface course is placed.

The surface of the completed pavement shall be checked longitudinally and transversely for smoothness with a 3 m straightedge. The surface shall not vary more than 5 m in a 3 m parallel to the centerline and not more than 8 mm in 3 m at right angles to the centerline.

308.4 Construction Equipment

308.4.1 Equipment

The equipment shall include:

1. Asphalt mixing plants designed to produce a uniform mix within the job-mix tolerances.

2. Self-powered pavers that are capable of spreading the mix to the thickness and width specified, true to the line, grade and crown shown on the Plans.

3. Enough smooth metal-bedded haul trucks, with covers when required to ensure orderly and continuous paving operations.

4. A pressure distributor that is capable of applying tack coat and prime material uniformly without atomization.

5. Steel-wheeled, pneumatic-tired, or vibratory rollers with capacity of attaining the required density and smoothness.
6. A power broom or a power blower or both.

7. Hand tools necessary to complete the job.

Other equipment can be used in addition to the specified equipment when approved by the Engineer.

308.5 Sampling

Sampling of asphalt materials shall be in accordance with the latest revision of AASHTO T 40 (ASTM D 140). Sampling of mineral aggregate shall be in accordance with the latest revision of AASHTO designation (ASTM D 75). Sampling of the asphalt mixture, as required by the Engineer, shall be in accordance with the latest revision of AASHTO 168 (ASTM D 979).

308.6 Testing

Methods of Testing shall be in accordance with the applicable AASHTO or ASTM Methods.

308.7 Method of Measurement

The bituminous mixture will be measured by square meter (m^2). The quantity to be paid for shall be the number of square meters of the mixture placed

and compacted in the accepted pavement. No deduction will be made for the weight of bituminous material in the mixture.

Batch weights will not be permitted as a method of measurement.

308.8 Basis of Payment

The accepted quantity, measured as prescribed in Section 308.7, shall be paid for at the contract unit price for Bituminous Plant-Mix Surface Course, Cold-Laid, which price and payment shall be full compensation for furnishing all materials, handling, placing, rolling, compacting, labor, equipment, tools and incidentals necessary to complete this Item.

Payment will be made under:

Pay item No.	Description	Unit of Measurement
308	Bituminous Plant-Mix Surface Course, Cold-Laid	Square Meter

ITEM 309 – BITUMINOUS PLANT-MIX (STOCKPILE MAINTENANCE MIXTURE)

309.1 Description

This Item shall consist of a bituminous stockpile maintenance mixture composed of aggregate, mineral filler, hydrated lime and bituminous material mixed in a central plant. The mixture is stockpiled for immediate or future maintenance needs.

309.2 Material Requirements

309.2.1 Composition and Quality of Bituminous Mixture

Same as Subsection 307.2.1

309.2.2 Bituminous Material

The type and grade of bituminous material shall be in accordance with the following guidelines:

Designation: D2397/D2397M – 13

Standard Specification for Cationic Emulsified Asphalt[1]

This standard is issued under the fixed designation D2397/D2397M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (′) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This specification covers seven grades of cationic emulsified asphalt for use in pavement construction in the manner designated.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D5 Test Method for Penetration of Bituminous Materials
D113 Test Method for Ductility of Bituminous Materials
D140 Practice for Sampling Bituminous Materials
D244 Test Methods and Practices for Emulsified Asphalts
D2042 Test Method for Solubility of Asphalt Materials in Trichloroethylene
D3910 Practices for Design, Testing, and Construction of Slurry Seal
D6930 Test Method for Settlement and Storage Stability of Emulsified Asphalts
D6933 Test Method for Oversized Particles in Emulsified Asphalts (Sieve Test)
D6935 Test Method for Determining Cement Mixing of Emulsified Asphalt
D6936 Test Method for Determining Demulsibility of Emulsified Asphalt
D6997 Test Method for Distillation of Emulsified Asphalt
D7226 Test Method for Determining the Viscosity of Emulsified Asphalts Using a Rotational Paddle Viscometer
D7402 Practice for Identifying Cationic Emulsified Asphalts
D7496 Test Method for Viscosity of Emulsified Asphalt by Saybolt Furol Viscometer
D7553 Test Method for Solubility of Asphalt Materials in N-Propyl Bromide

3. Requirements

3.1 The emulsified asphalt shall be tested within 14 days of delivery. The emulsified asphalt shall be homogeneous after thorough mixing provided separation has not been caused by freezing. Emulsions separated by freezing shall not be tested.

3.2 Emulsified asphalt shall conform to the requirements prescribed in Table 1 or Table 2. If no table is specified, the default is Table 1.

4. Sampling

4.1 Samples of emulsified asphalt shall be taken in accordance with Practice D140.

4.2 Samples shall be stored in clean, airtight sealed containers at a temperature of not less than 4°C [39.2°F] until tested.

5. Test Methods

5.1 The properties of the emulsified asphalts given in Table 1 or Table 2 shall be determined in accordance with the following ASTM test methods:

5.1.1 *Viscosity*—Test Method D7496 for Table 1 or Test Method D7226 for Table 2.

5.1.2 *Storage Stability*—Test Method D6930.

5.1.3 *Demulsibility*—Test Method D6936.

5.1.4 *Coating Ability and Water Resistance*—Test Methods D244.

5.1.5 *Particle Charge*—Test Method D7402.

5.1.6 *Sieve Test*—Test Method D6933, except use distilled water in all wetting and washing operations in place of the nonionic surfactant solution (1 %).

5.1.7 *Cement Mixing*—Test Method D6935.

5.1.8 *Distillation*—Test Method D6997.

5.1.9 *Tests on Residue from Distillation*—Test Methods D5, D113, D2042, and D7553.

[1] This specification is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.41 on Emulsified Asphalt Specifications.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

TABLE 1 Requirements for Cationic Emulsified Asphalt

Type	Rapid-Setting				Medium-Setting				Slow-Setting				Quick Setting	
Grade	CRS-1		CRS-2		CMS-2		CMS-2h		CSS-1		CSS-1h		CQS-1h[A]	
	min	max	min	max	min	max	min	max	min	max	min	max	min	max
Test on emulsions:														
Viscosity, Saybolt Furol at 25°C [77°F] SFS									20	100	20	100	20	100
Viscosity, Saybolt Furol at 50°C [122°F] SFS	20	100	100	400	50	450	50	450						
Storage stability test, 24-h, %[B]		1		1		1		1		1		1		
Demulsibility, 35 mL, 0.8 % dioctyl sodium sulfosuccinate, %	40	...	40	...										
Coating ability and water resistance:														
Coating, dry aggregate					good		good							
Coating, after spraying					fair		fair							
Coating, wet aggregate					fair		fair							
Coating, after spraying					fair		fair							
Particle charge test	positive		positive		positive		positive		positive		positive		positive	
Sieve test, %[B]		0.10		0.10		0.10		0.10		0.10		0.10		0.10
Cement mixing test, %										2.0		2.0		N/A
Distillation:														
Oil distillate, by volume of emulsion, %		3		3		12		12						
Residue, %	60		65		65		65		57		57		57	
Tests on residue from distillation test:														
Penetration, 25°C [77°F], 100 g, 5 s	100	250	100	250	100	250	40	90	100	250	40	90	40	90
Ductility, 25°C [77°F], 5 cm/min, cm	40		40		40		40		40		40		40	
Solubility in trichloroethylene, or N-Propyl Bromide %	97.5		97.5		97.5		97.5		97.5		97.5		97.5	

[A]CQS-1h is used for Quick Set Slurry Seal systems. CQS-1h emulsified asphalts shall meet the requirements outlined in Practices D3910.
[B]This test requirement on representative samples is waived if successful application of the material has been achieved in the field.

TABLE 2 Requirements for Cationic Emulsified Asphalt

Type	Rapid-Setting				Medium-Setting				Slow-Setting				Quick Setting	
Grade	CRS-1		CRS-2		CMS-2		CMS-2h		CSS-1		CSS-1h		CQS-1h[A]	
	min	max	min	max	min	max	min	max	min	max	min	max	min	max
Test on emulsions:														
Viscosity, Rotational Paddle Viscometer at 25°C [77°F] mPa s									45	220	45	220	45	220
Viscosity, Rotational Paddle Viscometer at 50°C [122°F] mPa s	45	220	220	880	110	990	110	990						
Storage stability test, 24-h, %[B]		1		1		1		1		1		1		
Demulsibility, 35 mL, 0.8 % dioctyl sodium sulfosuccinate, %	40	...	40	...										
Coating ability and water resistance:														
Coating, dry aggregate					good		good							
Coating, after spraying					fair		fair							
Coating, wet aggregate					fair		fair							
Coating, after spraying					fair		fair							
Particle charge test	positive		positive		positive		positive		positive		positive		positive	
Sieve test, %[B]		0.10		0.10		0.10		0.10		0.10		0.10		0.10
Cement mixing test, %										2.0		2.0		N/A
Distillation:														
Oil distillate, by volume of emulsion, %		3		3		12		12						
Residue, %	60		65		65		65		57		57		57	
Tests on residue from distillation test:														
Penetration, 25°C [77°F], 100 g, 5 s	100	250	100	250	100	250	40	90	100	250	40	90	40	90
Ductility, 25°C [77°F], 5 cm/min, cm	40		40		40		40		40		40		40	
Solubility in trichloroethylene, or N-Propyl Bromide %	97.5		97.5		97.5		97.5		97.5		97.5		97.5	

[A]CQS-1h is used for Quick Set Slurry Seal systems. CQS-1h emulsified asphalts shall meet the requirements outlined in Practices D3910.
[B]This test requirement on representative samples is waived if successful application of the material has been achieved in the field.

6. Keywords

6.1 cationic; emulsified asphalt; emulsion; medium setting; rapid setting; slow setting