Material Specification 583—Coal Tar-Epoxy Paint

1. Scope

This specification covers the quality of a coal tar polyamide epoxy paint suitable for use on structural steel or concrete. Paint supplied meeting Paint Specification No. 16, Type 1, Class II, of the Steel Structures Painting Council will meet the requirements of this specification.

2. Composition and processing

***Composition*—**The paint shall be a two-component system that has the pitch, filler, and catalyst in one component and the resin in another. Each component of this paint based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles. The components shall contain the followings types and proportions of ingredients:

Ingredient	Component A percent by weight min.	max.	Component A and B typical composition percent by weight
Coal tar pitch	33.0	36.0	28.2
Polyamide	11.0	12.0	9.5
Magnesium silicate	30.0	33.0	25.8
Xylene	18.0	21.0	15.4
Gelling agent and activator	2.5	2.6	2.0
Catalyst (accelerator)	1.2	1.3	1.1
Subtotal			82.0
	Component B		
Epoxy resin (100% nonvolatile)	100	---	18.0
Total			100.0

***Processing*—**Magnesium silicate and gelling agent shall be thoroughly dispersed in component A by means of grinding equipment capable of developing substantial shear values. Gellant shall be mixed with an equal weight of magnesium silicate and then dampened by stirring-in all of the alcohol; the resultant mixture shall be added to and thoroughly dispersed into component A. (The viscosity of component A is markedly influenced by the degree of dispersion of gellant and magnesium silicate.)

***Quality of ingredients*—**Ingredient material shall exhibit the following properties:

Coal tar pitch. Coal tar pitch is a product obtained from the distillation of high temperature crude coke oven tar, which in itself is a product obtained during the destructive distillation of coal in slot ovens operated at a temperature above 700 degrees Celsius. Coal tar pitch shall have the following characteristics:

	Min.	Max.
Softening point, in water, °C (ASTM D 36)	70	75
Ash, percent by weight (ASTM D 2415)	--	0.5
Insolubles in carbon disulfide, percent by weight (ASTM D 4)	--	20
Volatiles, percent by weight		
Under 250 °C	--	0.0
Under 300 °C	--	5.0

Gellant. The gellant or thixotropic-producing additive shall be an organic derivative of magnesium montmorillonite or hydrogenated castor oil. It shall be a creamy white powder having a bulking value of 15 ± 0.2 pounds per gallon and water content of 3 percent maximum.

Activator. The activator, if used, shall be methanol, ethanol, or propylene carbonate.

Catalyst. The catalyst (accelerator) shall be 2,4,6-tri (dimethylamino methyl) phenol.

Epoxy resin. Epoxy resin shall be a di-epoxide condensation product of bisphenol-A and epichlorohydrin with terminal epoxide group. It shall be clear, tree of turbidity, crystals, and particulate matter with the following properties:

Property	Requirements min.	max.
Nonvolatile content (1 to 2 grams after 1 hour at 105 ± 2 °C), % by weight	99	--
Epoxide equivalent (ASTM D 1652)	180	200
Color, Gardner (ASTM D 1544)	--	5.0
Specific gravity (ASTM D 1475)	1.15	1.18
Viscosity, Brookfield, poises at 25 °C	100	160

Polyamide resin. Polyamide resin shall be a condensation product of a dimerized fatty acid in polyamides. It shall be clear, free of turbidity and particulate matter, with the following characteristics:

Characteristics	Requirements min.	max.
Amine value 1/	330	360
Color, Gardner (ASTM D 1544)	--	9
Specific gravity (ASTM D 1475)	0.96	0.98
Viscosity, Brookfield, poises at 25 °C	7	9
Nonvolatile content (1-2 grams after 1 hr at 105 ± 2 °C), % by weight	97	--

1/ The amine value is defined as the milligrams of potassium hydroxide equivalent to the amine alkalinity potentiometric titration with standard perchloric acid according to the following method:

a. Weigh the approximate amount of well mixed resin to give a titration in the range of 12 to 18 milliliters (mL) into a tared 200 mL berzelius tall form beaker on an analytical balance. Cover the beaker with aluminum foil to minimize contact with air.
b. From a graduated cylinder, carefully add 90 mL of solvent (suitable solvents are nitrobenzene, propylene carbonate, or acetonitrile), insert a stirring bar, cover the beaker with aluminum foil, and stir on a magnetic stirrer to dissolve the sample. Add the solvent immediately after weighing the sample. A fume hood should be used for all operations.
c. From a graduated cylinder, add 20 mL of glacial acetic acid to the sample solution and stir for several minutes.
d. Immerse the electrodes into the sample solution, stir for 2 minutes, and titrate potentiometrically with 0.1 N perchloric acid using the millivolt scale. Record the millivolt reading every 0.1 mL. Plot a graph showing the millivolts against the titration. The endpoint is the midpoint of the inflection on the titration curve.
e. Conduct a blank determination on 90 mL of the solvent and 20 mL of acetic acid. The blank need only be determined once for each lot of solvent used. On the majority of lots used, the blank has been found to be zero.
f. Calculate the amine value using the following formula:

Amine value = (sample titration-solvent blank) x normality x 56.1 weight of sample

Magnesium silicate. Magnesium silicate shall conform to ASTM Standard D 605 "Magnesium Silicate Pigment (Talc)." When a dark red coating is specified, a dark red coating shall be furnished in 50 percent or more (by volume) of the magnesium silicate is replaced by synthetic red iron conforming to ASTM Standard D 3721. The red coating shall meet all of the test requirements prescribed for the black coating except that the nonvolatile content of component A shall be an amount reflecting the greater specific gravity of the iron oxide pigment.

3. Physical requirements

When tested by the methods described in section 4, component A shall exhibit the following properties:

- Viscosity, Brookfield, at 25 degrees Celsius poises 160 maximum
- Nonvolatile residue, percent by weight 77 minimum

The mixed paint shall exhibit the following properties:

- Sag, 14 mil wet film—None
- Pot life at 24 to 27 °C, hours—4 minimum

The cured film shall exhibit the following properties:

- Penetration, 200 grams, 5 seconds, 25 °C, hundredth centimeter units—3 maximum
- Odor after 48 hours curing—Pass test
- Flexibility on 0.5-inch mandrel—Pass test
- Adhesion—No delamination

4. Test methods

Viscosity of component A—Fill a container having a minimum diameter of 3 inches, a minimum height of 3.75 inches, and a minimum depth of 3 inches with a representative sample of component A. Set up a Model RVT or RVF-100 Brookfield Synochro-Electric Viscometer with a No. 7 spindle and with guard removed. Bring the sample to (and thereafter maintain) a temperature of 25 degrees Celsius and stir vigorously for 2 minutes with a stiff spatula. Immediately after stirring, lower the viscometer, immersing the spindle until half of the neck mark on the spindle is covered. Run the viscometer at 100 rpm for 1 minute and record the pointer position on the dial. If the dial reading is 40 or less, the viscosity shall be considered to be 160 poises or less. If the reading is over 40, immediately start the motor and take additional readings at 1-minute intervals. If one or more readings of 40 or less are obtained out of 10 readings, taken at 1-minute intervals, the viscosity of the material shall be considered to be within specification limits.

Nonvolatile content of component A—Place a stirrer (e.g., short length of stiff wire, such as a partly-straightened paper clip) into a small disposable aluminum dish of about 2 inches in diameter and weigh to the nearest 0.1 milligram. As rapidly as possible, place between 2 and 3 grams of component A into the dish and weigh immediately to the nearest 0.1 milligram. After weighing, spread the material over the bottom of the dish. Heat the dish, wire, and contents in a well-ventilated, convection-type oven maintained at 105 degrees Celsius plus or minus 2 degrees Celsius for 3 hours. After the material has been in the oven for a few minutes, and periodically thereafter, stir the material. Cool in a desiccator, weigh to the nearest 0.1 milligram, and calculate the percentage of nonvolatile on a weight basis.

Sag test of coal tar-epoxy paint—Prepare about 500 mL of the material by thoroughly mixing 100 mL of component B into 400 mL of component A. Determine its viscosity immediately after mixing using the same procedure as those for component A, but employing a No. 5 spindle. If all of five readings recorded at 1-minute intervals are above 50, reduce the viscosity by adding xylene in small increments until a reading not greater than 50 is obtained. Press a strip of 1-inch masking tape across the full width of a solvent-cleaned 3-inch by 6-inch cold-rolled steel panel. The tape should be parallel to and centered on the shorter axis of the panel. Within 5 minutes after making the final check of viscosity, apply the material to the panel to a wet film thickness at least 14 mils as determined by an Interchemical wet film doctor blade having a gap of about 25 mils, or by brush. Immediately after applying the material, carefully remove the masking tape and stand the panel in a vertical position (with the bare strip horizontal) in a draft-free, 24 to 27 degree Celsius location. Examine the panel after 4 hours. Sagging or running of the coating into the bare area shall constitute failure of the material to pass the sag test.

Pot life test of coal tar-epoxy paint—Mix 100 mL of compound B into 400 mL of component A with both components having a temperature of 24 to 27 degrees Celsius before mixing. Pour the material at once into a pint metal can, seal tightly, and maintain at 24 to 27 degrees Celsius. Examine the material 4 hours after it was mixed. For its pot life to be considered satisfactory, the mixed material must remain in a fluid condition and, when thinned with no more than 100 mL of xylene, shall be lump-free and brushable.

Penetration test on coal tar-epoxy film—Select and solvent spray-clean two 3-inch by 6-inch cold-rolled steel panels in accordance with ASTM D 609. Draw down in accordance with a

coat of the paint prepared as described in section 4 for the sag test. Allow the film to dry 18 to 24 hours in a horizontal position at 24 to 27 degrees Celsius and at a relative humidity of not over 60 percent. Apply a second coat over and at right angles to the first coat, using freshly mixed paint prepared identically to that used for the first coat. The draw down applicator(s) shall be such as to provide a total dry-film thickness for the two coats of 20 to 25 mils, and the coats shall be of approximately equal thickness. Allow the second coat to dry in a horizontal position for 120 hours at 24 to 27 degrees Celsius. After 120 hours of curing, and daily thereafter, clamp the panel into the table of a penetrometer (ASTM D 5) so that the needle is over an area that is within the prescribed thickness range (as measured by ASTM D 1186). Determine the penetration using a total load of 200 grams applied for 5 seconds at 25 degrees Celsius. The average of the three lowest out of five penetration readings, all taken within a 1 centimeter square, shall not exceed 0.03 of a centimeter after 120 hours of curing.

Odor of dried coal tar-epoxy film—Examine the paint film on one of the flexibility panels for odor after it has cured for 48 hours. The film shall be free of any odor except for a faint odor of xylene.

Flexibility of coal tar-epoxy film—Sand blast three steel panels (similar to those used in the penetration test) at low pressure with a clean, 30 to 50 mesh, nonmetallic abrasive until a uniform, gray-white surface with well developed anchor pattern, is achieved. (Note: It may be necessary to blast both sides of panel, in stages, to avoid warping.) Blow off any dust with a clean air blast. Apply two coats of paint as described in section 4 for the penetration test. Allow the film to cure in the period equal to that required to reach a penetration of 0.03 centimeter on the penetration test panel, whichever occurs first. With the film side up, and in a time interval of about 1 second, bend each of the flexibility panels double over a 0.5-inch diameter mandrel. Cracks in any of the panels visible to the naked eye shall constitute failure except that edge cracks extending no further than 0.5 inch or small local fissures emanating from air bubbles, craters, and similar imperfections shall be disregarded.

Adhesion of coal tar-epoxy film—Test the adhesion of the coating on an unbroken area of the flexibility panel with a sharp knife after the coating has cured for 120 hours. It shall strongly resist being removed from the metal. Also use a knife to test the intercoat adhesion of the film on a penetration panel after 120 hours curing. Any delamination of the two coats shall constitute failure.