

L-C-530C
February 17, 1987
SUPERSEDING
L-C-530B
June 4, 1970

FEDERAL SPECIFICATION

COATING, PIPE, THERMOPLASTIC RESIN

This specification was approved by the Assistant Administrator, Office of Federal Supply and Services, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers the materials and methods of application of a coating system for steel pipe and tubing.

1.2 Classification. The coating system covered by this specification shall be of one type.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

Federal Standard:

FED-STD-141 - Paint, Varnish, Lacquer, and Related Materials; Methods of Inspection, Sampling, and Testing

(Activities outside the Federal Government may obtain copies of Federal specifications, standards, and commercial item descriptions as outlined under General Information in the Index of Federal Specifications, Standards, and Commercial Item Descriptions. The Index, which includes cumulative bimonthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

(Single copies of this specification and other Federal specifications and commercial item descriptions required by activities outside the Federal Government for bidding purposes are available without charge from General Services Administration Business Service Centers in Boston, MA; New York, NY; Philadelphia, PA; Washington, DC; Atlanta, GA; Chicago, IL; Kansas City, MO; Fort Worth, TX; Denver, CO; San Francisco, CA; Los Angeles, CA; and Seattle, WA.

AMSC N/A

FSC 8030

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Military Standards:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by
Attributes

MIL-STD-130 - Identification Marking of U. S. Military Property

(Copies of military specifications and standards required by contractors in connection with specific acquisition functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials (ASTM):

- D5 - Penetration of Bituminous Materials
- D149 Dielectric Breakdown Voltage and Dielectric Strength of
Electrical Insulating Materials at Commercial Power Frequencies
- D256 - Impact Resistance of Plastics and Electrical Insulating
Materials
- D257 - D-C Resistance or Conductance of Insulating Materials
- D562 - Consistency of Paints Using the Stormer Viscosimeter
- D570 - Water Absorption of Plastics
- D618 - Conditioning Plastics and Electrical Insulating Materials for
Testing
- D638 - Tensile Properties of Plastics
- D647 - Molds for Test Specimens of Plastic Molding Material
- D696 - Coefficient of Linear Thermal Expansion of Plastics
- D792 - Specific Gravity and Density of Plastics by Displacement
- D1130 - Injection Molding of Specimens of Thermoplastic Materials
- D1238 - Flow Rates of Thermoplastics by Extrusion Plastometer
- D1525 - Vicat Softening Point of Plastics
- D1693 - Environmental Stress-Cracking of Type I Ethylene Plastics
- D2240 - Indentation Hardness of Rubber and Plastics by Means of a
Durometer
- E28 - Softening Point by Ring-And-Ball Apparatus
- G23 - Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type)
for Exposure of Nonmetallic Materials

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

Steel Structures Painting Council (SSPC):

SP 6 - Commercial Blast Cleaning

(Application for copies should be addressed to the Steel Structures Painting Council, 5500 Fifth Avenue, Pittsburgh, PA 15213.)

(Non-Government standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specifications sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Materials. Materials shall be as specified herein and in applicable specifications and standards, and other referenced documents. Materials not specified shall be selected by the contractor and shall be subject to all provisions of this specification. Materials shall be free of defects which adversely affect performance or serviceability of the finished product.

3.2 Description. The coating system covered in this specification is divided into three parts; (1) A hot adhesive applied directly to the exterior surface of a length of pipe; (2) a plastic coating applied to the adhesive; and (3) the complete coating system.

3.3 Adhesive. The adhesive shall consist of a blend of rubber, asphalt, and high molecular weight resins. The adhesive shall adhere to the steel pipe and plastic coating. The adhesive shall have the properties specified in table I.

3.4 Plastic resin. The resin shall be prime virgin, high-density polyethylene, modified polyethylene or a copolymer of ethylene and propylene. A yellow or other light-colored pigment shall be dispersed in the resin. The resin shall be as specified in table II.

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TABLE I. Properties of adhesive.

Property	Requirements		Test paragraph
	Maximum	Minimum	
Softening point (Deg F)	176	140	4.5.1.1
Penetration in mm. (at 77 deg F, 100g., 5 sec.)	12.0	8.0	4.5.1.2
Impact resistance at 0 deg F	-	No Cracks in 75 per- cent of tests	4.5.1.3
Flow in 1 hr. at 73.4 deg F (in)	0.19	-	4.5.1.4
Flow in 1 hr. at 160 deg F (in)	2.00	-	4.5.1.4
Viscosity at 300 deg F (sec. for 100 rev.)	80	55	4.5.1.5

TABLE II. Properties of plastic resin.

Property	Requirements		Test paragraph
	Maximum	Minimum	
Specific gravity at 23 C:			
Polyethylene	0.965	0.941	4.5.2.1
Copolymer ethylene and propylene	0.920	0.895	4.5.2.1
Flow rate (g./10 min)			
Polyethylene	0.75	-	4.5.2.2
Copolymer ethylene and propylene	1.00	-	4.5.2.2
Artificial Weathering		No cracks after 288 hrs.	4.5.2.3
Water absorption (percent by wt.)	0.01	-	4.5.2.4
Tensile yield strength (p.s.i.)	-	3,000	4.5.2.5
Tensile strength (at break) (p.s.i.)	-	2,200	4.5.2.5

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TABLE II. Properties of plastic resin - con't.

Property		Requirements	Test paragraph
Tensile elongation (at break) (percent)	-	100	4.5.2.5
Impact (Izod type) resistance ft. lb/in. of notch	-	2.0	4.5.2.6
Indentation hardness- durometer, type D	-	55	4.5.2.7
Dielectric strength (volts/mil)	-	1,000	4.5.2.8
Volume resistivity (ohm-cm.)	-	10**6	4.5.2.9
Vicat softening pt. (deg F)	-	245	4.5.2.10
Coef. of linear ther- mal expansion (in./in. per F)	0.0001	-	4.5.2.11

3.5 The complete coating system.

3.5.1 Application. The exterior surface of the pipe to receive the coating shall be blast cleaned in accordance with SSPC-SP6. The adhesive shall be applied uniformly to the pipe at 30 degrees Fahrenheit (deg F) plus or minus 10 deg F to a minimum thickness of 8 mils. The plastic shall be applied over the adhesive by an extrusion process so as to provide a smooth outer sheath uniform in thickness and free from pinholes, bubbles, blisters, wrinkles, cracks, underfilm voids, or mechanical damage. The thickness of the plastic sheath applied to various pipe sizes shall be as shown in table III. Unless otherwise specified (see 6.2), the coating shall end 4 inches plus one minus zero inches from each end of plain-end pipe and 2 inches plus one minus zero inches from the last thread on threaded pipe.

TABLE III. Thickness of plastic resin.

Outside diameter of pipe (inches)	Thickness in mils (minimum)
0.50 to 1.50	23
1.51 to 2.88	27
2.89 to 4.50	32
4.51 to 20.00	36 Or 54 as Specified (see 6.2)

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3.5.2 Electrical resistance. The coating system shall show no defects when subjected to the electrical flaw detection test specified in 4.5.3.1.

3.5.3 Fungus resistance. The coating system shall show no fungus growth when tested as specified in 4.5.3.2.

3.6 Identification marking. Each length of coated pipe shall be identified in accordance with MIL-STD-130, except that for pipe which is bundled, the identification marking may be permanently marked on a metal tag attached to each bundle.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements,

4.1.1 Responsibility for compliance. All items must meet all requirements of section 3. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 Material inspection. The contractor is responsible for insuring that supplies and materials are inspected for compliance with all the requirements specified herein and in applicable referenced documents.

4.2 Quality conformance inspection. The quality conformance inspection shall include the examination of 4.4 and the tests of 4.5. This inspection shall be performed on the samples selected in accordance with 4.3.

4.3 Sampling. Sampling and inspection procedures shall be in accordance with MIL-STD-105. The unit of product shall be one length of coated pipe. All coated pipe of the same outside diameter offered for delivery at one time shall be considered a lot for the purpose of inspection. If an inspection lot is rejected, the contractor may rework it to correct the defects, or screen out the defective units, and resubmit for a complete reinspection. Resubmitted lots shall be reinspected using tightened inspection. If the

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rejected lot was screened, reinspection shall be limited to the defect causing rejection. If the lot was reprocessed, reinspection shall be performed for all defects. Rejected lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

4.3.1 Sampling for examination. Examination shall be based on inspection level II and an Acceptable Quality Level (AQL) of 1.5 percent defective.

4.3.2 Sampling for tests.

4.3.2.1 Adhesive tests. Sampling for the adhesive tests (see 4.5.1) shall be by a 1-quart representative sample from each batch of adhesive compounded at one time.

4.3.2.2 Plastic resin tests. Sampling for the plastic resin tests (see 4.5.2) shall be by a 5-pound representative sample from each lot.

4.3.2.3 Electrical flow detection test. Each length of coated pipe shall be subjected to the test specified in 4.5.3.1.

4.3.2.4 Fungus resistance test. Sampling for the fungus resistance test specified in 4.5.3.2 shall be based on one length of coated pipe from each lot.

4.3.2.5 Thickness test. Sampling for the thickness test specified in 4.5.3.3 shall be based on inspection level II and an AQL of 1.5 percent defective.

4.4 Examination. Each length of coated pipe selected shall be examined for defects listed in table IV. Each attribute within each classification of multiple defects shall constitute one defect.

TABLE IV. Classification of defects.

Classification	Defects	Requirement paragraph
101	Coating has blisters, cracks, bubbles, under-film voids, or mechanical damage.	3.5.1
102	Coating does not cover the pipe to within 2 or 4 inches of the end of the pipe, as applicable.	3.5.1
103	Identification marking not as specified.	3.6

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4.5 Tests.

4.5.1 Tests for adhesive. The adhesive shall be subjected to the following tests. Any test not meeting the requirements of table I shall constitute failure of the test. Failure of any test shall be cause for rejection of the lot to adhesive represented by the sample.

4.5.1.1 Softening point of adhesive. The softening point of the adhesive shall be determined in accordance with ASTM E28 using the procedure for materials having softening points above 176 deg F except that (1) a low softening point thermometer shall be used and (2) the immersion liquid shall be stirred at a speed of 500 to 700 revolutions per minute with a motor-driven stirrer with shaft rotation to move the liquid upward.

4.5.1.2 Penetration of adhesive. The penetration of the adhesive shall be determined in accordance with ASTM D5 except that the penetration units shall be expressed in millimeters.

4.5.1.3 Impact resistance of adhesive. Four specimens from each sample of adhesive shall be prepared and tested. The impact tester shall consist of a heavy, rigid metal anvil centered under a 1,000-gram steel plunger arranged to slide freely in a vertical sleeve. The lower end of the plunger shall be spherical in shape with a radius of 1/2 inch. A metal hammer weighing 2,000 grams shall be arranged to fall freely 5-1/8 inches between guides onto the top of the plunger. Melt the adhesive at the lowest possible temperature and pour into a split amalgamated brass mold which will furnish a disk-shaped sample 1-3/4 inches in diameter and 3.8 inch thick. Cool at room temperature for 24 hours and remove adhesive specimens from molds. Maintain the specimens in a refrigerator at 0 deg F plus or minus 3.6 deg F for at least 24 hours. In an elapsed time of not more than 8 seconds, remove the specimens from the refrigerator, center with the plunger resting on the sample, and trip the raised hammer. Examine test specimens after impact for cracking. If cracking cannot be determined by simple visual observation, remove specimen from apparatus and subject to a bending stress.

4.5.1.4 Flow of adhesive at 73.4 deg F and at 160 deg F. Melt adhesive at lowest possible temperature and pour into amalgamated brass split molds which will give cylindrical specimens 3/8 inch in diameter and 3/4 inch high. Cool at room temperature for 1 hour and remove from molds. Place a specimen in a trough of corrugated 4- by 8-inch brass plate made of stock 0.03 inch in thickness. The corrugations shall run lengthwise and shall be 3/16 inch deep and 3/8 inch from crest to crest. The corrugated plate shall be supported in such a manner that the long axes of the corrugations are at an angle of 45 deg from horizontal. The bottom of the specimens shall coincide with a line scribed across the brass plate 2 inches from its upper end. Place one test setup in an oven maintained at 160 deg F plus or minus 3.6 deg F for 24 hours. The other test setup shall be left at 73.4 deg F plus or minus 3.6 deg F for 24 hours. Measure distance of flow of each specimen at the end of the last hour of the 24 hour period.

4.5.1.5 Viscosity of adhesive at 300 deg F. Place a wraparound heater around a standard 1/2-pint friction-type can and heat can at a low constant heat. Fill can with adhesive, using a hot curved spatula, to a level exactly 3/4 inch below the uppermost edge of the can. Increase heat slowly as needed to bring adhesive to 300 deg F in not less than 1/2 hour. Place sample can on the platform of the Stormer viscosimeter so that the paddle and shaft are centered laterally in the can and immersed in the sample just to the scribe mark on the shaft. (The Stormer viscosimeter paddle rotor shall have the dimensions shown in ASTM D562 except that the distance from the center of the shaft to the top of each paddle blade shall be 9.16 inch.) With the sample at 300 deg F, stir sample vigorously and then using 100 grams total load, start the rotor. At the end of the fifth revolution, measure, by stopwatch, the time required for 100 revolutions.

4.5.2 Tests for plastic resin. Inability of the plastic resin to meet the requirements of table II shall constitute failure of the test. Failure of any test shall be cause for rejection of the lot represented by the samples.

4.5.2.1 Specific gravity. The specific gravity of the plastic resin shall be determined in accordance with ASTM D792, method A-1.

4.5.2.2 Flow rates. The flow rates of the plastic resin shall be determined in accordance with ASTM D1238, procedure A - Manual Operation. Condition E, table I, of the test method shall apply for polyethylene and modified polyethylene and procedure A - Manual Operation, condition L, table I, of the test method shall apply for copolymer of ethylene and propylene.

4.5.2.3 Artificial weathering. Unless otherwise specified (see 6.2), artificial weathering tests shall be conducted. The test specimen shall be a strip of a suitable size and shape for mounting and shall be cut from a 6- by 6- by 0.125-inch sheet molded in accordance with ASTM D1693. Artificial weathering shall be conducted in accordance with ASTM G23 using type EH apparatus and employing an exposure condition of continuous lighting with intermittent water spray. Failure to comply with requirement of Table II shall constitute failure.

4.5.2.4 Water absorption. The test specimen for moisture absorption shall be in the form of a strip, with dimensions (in inches) of 3(L) by 1(W) by 0.125 plus or minus 0.008(T), die cut from a 6- by 6- by 0.125-inch sheet molded in accordance with ASTM D1693. Specimens shall be tested in accordance with ASTM D570; time of test shall be 24 hours, temperature of test shall be 73.4 deg F plus or minus 3.6 deg F.

4.5.2.5 Tensile yield strength, tensile strength (at break), and tensile elongation (at break). Tensile tests shall be conducted in accordance with ASTM D638 on type I flat strip specimens 0.125-inch thick as shown on figure 1 of D638. Speed of testing shall be 2.0 inches per minute. Tensile yield strength shall be computed from the yield point as defined in the appendix to ASTM D638. Test specimens shall be injected molded in accordance with ASTM D1130.

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4.5.2.6 Impact (Izod type) resistance. Impact resistance test specimens shall be made from injection molded bars 5 inches long by 0.250-inch thick by 0.500-inch wide; molds shall conform to ASTM D647. Cut bars into half lengths and proceed in accordance with ASTM D256. Test specimens shall be conditioned in accordance with ASTM, D618, procedure A, and tested under the same conditions.

4.5.2.7 Indentation hardness-durometer (type D). Indentation hardness specimens shall be 0.125 inch thick. Specimens shall be cut from a 6- by 6- by 0.125-inch sheet (compression molded in accordance with ASTM D1693 and tests shall be conducted in accordance with ASTM D2240). The time that the specimen is under pressure from the pressure foot shall be 15 seconds. Test specimens shall be conditioned in accordance with ASTM D618, procedure A, and tested under the same conditions.

4.5.2.8 Dielectric strength. Dielectric specimens shall be 0.040- inch thick and shall be die cut from 6- by 6- by 0.040-inch sheet compression molded in accordance with ASTM D1693. Test shall be conducted in accordance with ASTM D149. The application of voltage shall be "short-time". The electrodes shall be 1/4-inch diameter copper rods with edges rounded in 1/32-inch radius. The rate of rise of the voltage shall be 1,000 volts per second. The specimens shall be conditioned in accordance with ASTM D618, procedure A, and tests shall be conducted under the same conditions.

4.5.2.9 Volume resistivity. Volume resistivity test specimens shall be die cut from a 6- by 6,- by 0.125-inch sheet compression molded in accordance with ASTM D1693. Tests shall be conducted in accordance with ASTM D257. The applied voltage shall be 500 volts and the time of electrification shall be 1 minute. The specimens shall be conditioned in accordance with ASTM D618, procedure A, and tests shall be conducted under the same conditions.

4.5.2.10 Vicat softening point. The Vicat test specimens shall be cut from a 6- by 6- by 0.125-inch sheet compression molded in accordance with ASTM D1693. Test shall be conducted in accordance with ASTM D1525.

4.5.2.11 Coefficient of linear thermal expansion. The coefficient of expansion test specimens shall be die cut from a 6- by 6- by 0.125-inch sheet compression molded in accordance with ASTM D1693. Tests shall be conducted in accordance with ASTM D696. The apparatus used shall be of the Dilatometer type. The temperatures at which the coefficient of linear expansion shall be determined (in order to derive an average) are minus 22 deg F and plus 86 deg F (minus 30 deg Celsius (C) and plus 30 deg C).

4.5.3 Test for the coating system.

4.5.3.1 Electrical flaw detection test. Each coated pipe section shall be tested throughout its length for flaws in the coating system by means of a high-potential flaw detector which impresses 8,000 volts across the coating. One electrode of the tester shall maintain complete circumferential contact

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with the coating while transversing the entire length of the coating system, and the other electrode shall be the underlying metal pipe. An electrical discharge through the coating, detected visually, aurally, or by instrument, shall constitute failure of this test.

4.5.3.2 Fungus resistance. The fungus resistance shall be determined in accordance with FED-STD-141, method 6271, except that (1) *Aureobasidium pullulans*, ATCC No. 9348 or QM 3090 shall be used as the test organism, (2) test specimens shall be leached before inoculation, and (3) the sterile distilled water used in the preparation of the inoculum shall contain approximately 0.005 percent of a nontoxic wetting agent. Test specimens for the system coating shall consist of portions of the complete coating system sheath, 1-1/2 inches square, removed from a pipe by means of a sharp blade. Nonconformance of 3.5.3 shall constitute failure of this test.

4.5.3.3 Thickness. Thickness of the plastic sheath may be determined by any suitable method capable of providing an accuracy of plus or minus 5 percent. Thickness not within the limits specified in table III shall constitute failure of this test.

5. PREPARATION FOR DELIVERY

This section is not applicable to this specification.

6. NOTES

6.1 Intended use. The coating specified herein is primarily intended for the corrosion protection of steel pipe subject to underground exposure or underwater exposure.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

- a. Title, number, and date of this specification.
- b. When coating shall cover pipe in a manner other than that specified (see 3.5.1).
- c. Whether coating shall be 36 or 54 mils (see table III).
- d. When artificial weathering test is not required (see 4.5.2.3).

6.3 Pipe. The reference to "pipe" throughout this specification means steel pipe or steel tubing. Pipe or tubing would be purchased under another specification.

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6.4 Organism cultures. Cultures of the organism used in the fungus resistance test, specified in 4,5.3.2, may be obtained from the American Type Culture Collection, 12301 Parklawn Drive, Rockville, Maryland 20852, or, for service use from the Mycology Group, Pioneering Research Laboratory, U.S. Army Natick Laboratories, Natick, Massachusetts 01760.

6.5 Data requirements. When this specification is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL) and invokes the provisions of DOD Federal Acquisition Regulations (FAR) Supplement 27.410-6, the data requirements will be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL (DD Form 1423) incorporated into the contract. When the provisions of DOD FAR 27.410-6 are not invoked, the data shall be delivered in accordance with the contract requirements.

6.6 Cross-reference of classifications. The following coatings were previously classified as indicated:

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Type I	Covered
Type II	Not designated

MILITARY INTEREST:

Custodians

Army - ME
Navy - YD
Air Force - 99

Review Activities

Army - MR
Air Force - 84

User Activity

Army - CE

CIVIL AGENCIES INTEREST:

HHS
GSA - FSS

PREPARING ACTIVITY:

Navy - YD

DOD project 9330-B147