

# Recommended Practice for Unprimed Internal Fusion Bonded Epoxy Coating of Line Pipe

API RECOMMENDED PRACTICE 5L7  
SECOND EDITION, JUNE 1988

REAFFIRMED, MAY 2015



AMERICAN PETROLEUM INSTITUTE



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## Upstream Segment

API RECOMMENDED PRACTICE 5L7  
FOURTH EDITION, JUNE 1988

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## FOREWORD

- (a) This Recommended Practice was prepared by a Formulating Committee which included representatives of pipeline operators and line pipe manufacturers and advisors from coating manufacturers and coating applicators as well as other interested individuals.
- (b) The purpose of this Recommended Practice is to present methods for qualifying coating materials, production application of such materials, and final acceptance tests of coated pipe for internally corrosive conditions.
- (c) While the coating system described in this document is intended to provide a high degree of corrosion protection, the user is cautioned that operating conditions as well as the chemical nature of the product to be transported can affect the performance of the coating, and additional anti-corrosion methods, such as inhibitors, may also be warranted.
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## SECTION 1 SCOPE

### 1.0 SCOPE

This Recommended Practice provides for UN-PRIMED INTERNAL FUSION BONDED EPOXY COATING OF LINE PIPE for use in transportation pipelines in the petroleum industry. The recommendation provided herein covers:

- a. Section 1 Scope
- Section 2 Coating Material Specification
- Section 3 Laboratory Coating Testing
- Section 4 Application Practices
- Section 5 Production Inspection and Acceptance Procedures

Within this Recommended Practice:

- 1) "Shall" is used to indicate that a provision is mandatory.
- 2) "Should" is used to indicate that a provision is not mandatory, but recommended as good practice.
- 3) "May" is used to indicate that a provision is optional.
- b. The Recommended Practice is limited to the application of internal coatings on unused pipe prior to installation. It should be recognized that there may exist differences in the surface condition of pipe produced by the various pipemaking processes permitted under the latest editions of API standards. Surface conditions may preclude the coating of such pipe.
- c. It is intended that the Applicator be responsible for assuring compliance with all of the provisions of this practice; however, the Purchaser may make any investigation necessary to satisfy himself of compliance by the Applicator.

### 1.1 DEFINITIONS

#### 1.1.1 Applicator

The "Applicator" is the organization responsible to the Purchaser for the application of the coating.

#### 1.1.2 Batch

A "Batch" is defined as the quantity of material produced during a continuous production run of not more than 8 hours.

#### 1.1.3 Coating

"Coating" indicates the film of coating as applied to the substrate.

#### 1.1.4 Coating Material

"Coating Material" indicates the material prior to application to the substrate.

#### 1.1.5 Holiday

A "Holiday" is a discontinuity in a protective coating which exhibits electrical conductivity when exposed to a specific voltage.

#### 1.1.6 Inspector

The authorized agent of the purchaser.

#### 1.1.7 Purchaser

The "Purchaser" is the owner company or the authorized agency that buys the coated pipe.

#### 1.1.8 Supplier

The "Supplier" is the manufacturer and/or distributor of the coating material and its authorized technician.

### 1.2 GENERAL

#### 1.2.1 Coating Supplier Information

The coating material Supplier shall furnish to the Purchaser and/or Applicator the following information in written form upon request.

- a. Specifications of the basic material properties and laboratory test results of the coating material(s) and coating(s). The basic material properties shall be within the ranges permitted in Section 2 of this Recommendation. The laboratory test results of the coating shall be within the ranges permitted in Section 3.
- b. Directions for handling and storing of the coating materials.
- c. Certification of compliance to the requirements of Table 2.3.
- d. Infrared "analysis" of the coating material (See Appendix 1).

### 1.3 REFERENCED STANDARDS

#### 1.3.1 General

This specification includes by reference, either in total or in part, other API, industry and government standards listed in Table 1.0.

#### 1.3.2 Requirements

Requirements of other standards included by reference in this specification are essential to the safety and interchangeability of the equipment produced.

#### 1.3.3 Equivalent Standards

Other nationally or internationally recognized standards shall be submitted to and approved by API for inclusion in this specification prior to their use as equivalent standards.

**TABLE 1.0**  
**REFERENCED STANDARDS**

|                        |                                                                                                                                  |                |                   |                                                                                                      |                |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------|----------------|-------------------|------------------------------------------------------------------------------------------------------|----------------|
| 1. NACE TM-01-75:      | <i>Nace Visual Standard</i>                                                                                                      | Latest Edition | 5. ASTM D1002:    | <i>Test Method for Strength Properties of Adhesives in Shear by Tension Loading (Metal to Metal)</i> | Latest Edition |
| 2. SSPC-Vis 1-82T SP5: | <i>Pictorial Surface Preparation Standards for Painting Steel Surfaces</i>                                                       | Latest Edition | 6. ASTM G17:      | <i>Test Method for Penetration Resistance of Pipeline Coatings (Blunt Rod)</i>                       | Latest Edition |
| 3. SIS 05-59-00 SA3:   | <i>Pictorial Surface Preparation Standards for Painting Steel Surfaces</i>                                                       | Latest Edition | 7. ASTM B117:     | <i>Method of Salt Spray (Fog) Testing</i>                                                            | Latest Edition |
| 4. DIN 55928-Part 4:   | <i>Corrosion Protection of Steel Structures by Organic, Inorganic and Metallic Coatings; Preparation and Testing of Surfaces</i> | Latest Edition | 8. NACE TM 01-70: |                                                                                                      | Latest Edition |

## SECTION 2

### COATING MATERIAL SPECIFICATION

#### 2.1 PURPOSE

This Section describes material properties of coating materials to be applied under the intent of this Recommended Practice. It is the Supplier's responsibility to perform the tests referenced in this Section. The Purchaser or Applicator may also perform any or all of the referenced tests as part of a quality assurance program.

#### 2.2 COATING MATERIAL

The coating material shall consist of a one-component, powdered, fusion-blended material consisting of epoxy resin(s), curing agent(s), pigment(s), filler(s), catalyst(s), and flow control agent(s) which, when applied to the preheated substrate, will melt, flow, and subsequently cure to produce a coating complying with the requirements of this Recommended Practice.

#### 2.3 COATING MATERIAL PROPERTIES

| Property                     | Value/Limits                                                         | Test Method |
|------------------------------|----------------------------------------------------------------------|-------------|
| Specific Gravity             | (1) $\pm 0.05$ g/cc                                                  | Appendix 2  |
| Particle size                | 0.1% max. retained on 60 mesh (250 micron)                           |             |
| Shelf Life                   | (1, 2)                                                               | Appendix 3  |
| Gel Time                     | (1) $\pm 20\%$                                                       | Appendix 4  |
| Cure Cycle                   | Capable of cure at temperature below 500 F [260 C] (3) for Time: (1) | (1)         |
| Glass Transition temperature | (1)                                                                  | Appendix 5  |
| Potential Reaction Energy    | (1)                                                                  | Appendix 5  |
| Moisture Content (4)         | 0.50% maximum                                                        | Appendix 6  |
| Total Volatile Content (4)   | 0.6% maximum                                                         | Appendix 7  |

- (1) per supplier's specification
- (2) per supplier's recommended storage conditions
- (3) limitation imposed by regulations on heating of cold expanded pipe
- (4) either Moisture or Total Volatile Content may be determined at supplier's discretion.

## SECTION 3 LABORATORY COATING TESTING

### 3.1 PURPOSE

This Section describes laboratory tests required to qualify coating materials. It is the responsibility of the Purchaser and/or coating Applicator to qualify the coating material prior to production. Once qualification is established, further qualification testing is not required unless the coating material or formulation changes. The Supplier shall certify to the Applicator and/or Purchaser the results of tests performed under Section 3 for each qualified material.

### 3.2 PERFORMANCE TESTING STEEL PANELS

Test panels shall be mild steel. Panel dimensions for each test are given in the referenced test method. Unless otherwise agreed upon between the Supplier and the Purchaser and/or Applicator, the surface shall be blast cleaned using steel grit (G40, HRC 50-55) to any of the following standards:

- a. NACE No. 1 white metal finish in accordance with NACE Visual Standard TM-01-75.
- b. Steel Structures Painting Council SSPC-Vis 1-82T SP5.
- c. Swedish Pictorial Standard SIS 05-59-00 SA3
- d. DIN 55928 PART 4.

The surface profile shall be 1.5 to 4.0 mils [38 to 100 microns], measured from peak to trough.

### 3.3 COATING OF TEST PANELS

**3.3.1** Coating application and curing shall be in accordance with the Supplier's recommendations.

**3.3.2** Thickness of coating on the completed test panel shall be  $14 \pm 2$  mils [ $356 \pm 51$  microns], measured by a coating thickness gauge calibrated per Par. 5.3.2.4.

### 3.4 PERFORMANCE OF LABORATORY COATED STEEL PANELS

#### 3.4.1 Testing

The following tests shall be performed on test panels which have been prepared and coated in accordance with the above procedure. Tests shall be performed on duplicate panels. A coating shall be considered qualified when the results of both test panels meet the acceptance criterion for each test.

#### 3.4.2 Additional Tests

At the option of the Purchaser or Applicator, additional qualification tests may be specified.

| Test                  | Value/Limits                                                                                                                  | Test Method               |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Abrasion              | 20 mg max.                                                                                                                    | Appendix 8                |
| Adhesion              | 5000 psi [34.5 MPa] min. or 2500 psi [17.2 MPa] min. (The 2500 psi minimum applies only when Appendix 9 Test Method is used.) | ASTM D1002 or Appendix 9. |
| Autoclave             | Free of blisters, cracks, delaminations, or other defects exposing the steel substrate to corrosive media.                    | Appendix 10               |
| Cathodic Disbondment* | 0.31 in. [8 mm] maximum average radius                                                                                        | Appendix 11               |
| Chemical Resistance   | 90 days at $73 \pm 5$ F [ $23 \pm 3$ C] without blistering                                                                    | Appendix 12               |
| Flexibility           | 3.75°/PD bend at 0 F [-18 C]                                                                                                  | Appendix 13               |
| Hot Water Soak        | Maximum: Rating 3                                                                                                             | Appendix 16               |
| Impact                | 15 in.-lb [1.70J], minimum                                                                                                    | Appendix 14               |
| Penetration           | Less than 10%                                                                                                                 | ASTM G17 at 200 F         |
| Salt Fog              | No blistering; no loss of adhesion                                                                                            | ASTM B117 for 1000 hr     |

\*This is included as an adhesion test, not a service simulation.

## SECTION 4 APPLICATION PRACTICES

### 4.1 PURPOSE

This Section prescribes equipment and practices used in the surface preparation of line pipe for internal fusion bonded epoxy coating and the application of this coating on the prepared surface.

### 4.2 GENERAL

#### 4.2.1 Applicator

The Applicator is responsible for the quality control production tests outlined in Section 5 to ensure conformance with this Recommended Practice.

#### 4.2.2 Plant Access

The Inspector shall have free access at all times to all parts of the application site which concern the internal coating of the pipe, while work on the contract of the Purchaser is being performed.

#### 4.2.3 Coating Material

##### 4.2.3.1 Selection

By agreement between the Purchaser and Applicator, a list of coating materials previously qualified by either the Purchaser or Applicator under Sections 2 and 3 shall be prepared. The Applicator and/or Purchaser shall then choose the coating material to be applied from this list subject to bidding restrictions. Approval or selection of the coating materials shall be done far enough in advance (preferably not less than 30 days) to provide material at the scheduled start of the work. Selection of alternate coating materials from the approved list may be made at any time by agreement between the Purchaser and the Applicator.

##### 4.2.3.2 Batch Samples

It shall be the right of the Purchaser or Applicator to procure a coating material batch sample prior to or during the job for the purpose of verification of conformance to coating material specifications.

### 4.3 HANDLING OF PIPE

Pipe shall be handled in a manner to prevent damage to pipe walls, beveled ends, and coating. Pipe that is damaged by the coating and handling operations shall be repaired in compliance with the latest editions of applicable API standards, or replaced, at the Applicator's expense.

### 4.4 HANDLING OF COATING MATERIALS

4.4.1 Coating material batches shall be identified by a batch coding system devised by the

Supplier. Coating materials shall be shipped and stored under cover and in such a manner that contamination or adverse effects on application or performance are avoided. Epoxy powder shall be stored in a cool, dry area; the storage temperature shall not exceed that recommended by the Supplier.

#### 4.4.2 Shelf Life

Storage time should not exceed the maximum shelf life as recommended by the Supplier. Any batch of coating material which has exceeded the recommended shelf life shall be subject to coating material verification tests (Par. 5.3.1) prior to usage.

### 4.5 SURFACE PREPARATION

#### 4.5.1 General

The cleaning must be of sufficient quality to ensure a surface that will permit firm adhesion of the coating to the pipe.

#### 4.5.2 Degree of Cleaning

##### 4.5.2.1 Contamination

Pipe shall be supplied to the Applicator essentially free of oil and grease.

All surfaces to be coated shall be free of oil, grease, etc., which, if present on the surface, shall be removed with a suitable solvent. All components of the cleaning machine that enter the pipe must be free of dirt, grease or other material which could contaminate the surface to be coated.

##### 4.5.2.2 Pre-Heat

Pipes shall be pre-heated prior to blast cleaning to remove moisture from the steel. The pre-heat shall be sufficient to ensure that the internal pipe surface temperature is at least 5 F [3 C] above the dew point temperature during blast cleaning inspection, but shall not exceed the maximum pipe temperature described in Par. 4.6.2.2.

#### 4.5.3 Blast Cleaning

##### 4.5.3.1 Method and Degree of Cleanliness

The blast abrasive such as slag, sand, flint, or grit shall be agreed upon by applicator and purchaser. The pipe surface shall be blast cleaned to a near white no. 2 finish in accordance with the latest editions of NACE TM 01-70 or equivalent (Sa 2½ per SIS 05-59-00 or SP 10 per SSPC-Vis 1-82T), unless otherwise agreed upon between Purchaser and Applicator.