



U.S. Department
of Transportation

Pipeline and
Hazardous Materials
Safety Administration

Construction & Pipeline Coatings

Greg Ochs

PHMSA Central Region



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Corrosion Found Less than One Year of Service





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Coating Reflects Quality

- Inspection and repair of coating on a new pipeline reflects the **quality** of the contractors workforces and training.
- The job is not difficult, nor glamorous, but requires knowledge, skill, and will to pay attention mile after mile, looking for large and many small defects.



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Preface

- Operators are responsible for construction to be in compliance with Code of Federal Regulations Part 192 or 195 and to follow the operator's procedures.
 - Not the contractor
 - Not the inspection service



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GET'ER Done

“GET'ER Done” any old way will cause

PROBLEMS

Construction Crew are ingenious problems solvers.

Guaranteed they will “get it done”

Great agility and skills used in procedures

Some inspectors have been found fearful of enforcing procedures.

These inconsistencies should be addressed. Listen to the contractor because the procedures may be flawed or impossible to apply.



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Recommendation

- Recommend having **operator** performed audits (even of the inspection contractor) on the construction practices and documentation.
- Review each spread's practices throughout the time of construction.
 - Especially when construction starts - people interpret procedures differently or use past experience rather than procedures for the current job.
- Not all spreads or even crews have the same quality.



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Written Construction Procedures Gas & Liquid

Gas

- § 192.605(a) Each operator shall prepare and follow ...a manual of written procedures for;
(2) Controlling corrosion in accordance with the...requirements of **subpart I**
- Coating Procedures need to List Approved Coating Materials (Manufacturer & Product #)
- Operator should be able to justify requirements of § 192.461(a)(1-5) and (b)

Liquid

- §195.402(a) Each operator shall prepare and follow ...a manual of written procedures for;
(c)(3) Operating, maintaining, and repairing the pipeline system in accordance with each of the requirements of this subpart and **subpart H** of this part
- Coating Procedures need to List Approved Coating Materials (Manufacturer & Product #)
- Operator should be able to justify requirements of § 195.559 (a) – (f)



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Written Construction Procedures Gas & Liquid

- The operator's procedures are to be made known to all the personnel responsible for those various tasks.
 - Beneficial: Conduct a training session for those individuals on these specific procedures.
- Operator Qualifications required for O&M construction and new 80% SMYS permit construction.



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Coating Criteria

Gas & Liquid

Gas

- § 192.461 External corrosion control: Protective coating
- (a) Each external protective coating, whether conductive or insulating, applied for the purpose of external corrosion control must—
- (2) Have sufficient adhesion to the metal surface to effectively resist underfilm migration of moisture;
- (3) Be sufficiently ductile to resist cracking;

Liquid

- **§195.559 What coating material may I use for external corrosion control?**
- Coating material for external corrosion control under Sec. 195.557 must--
- (b) Have sufficient adhesion to the metal surface to prevent under film migration of moisture;
- (c) Be sufficiently ductile to resist cracking;



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Coating Criteria Gas & Liquid

§ 192.461 Gas (cont.)

- (4) Have sufficient strength to resist damage due to handling and soil stress; and
- (5) Have properties compatible with any supplemental cathodic protection.
- (b) Each external protective coating which is an electrically insulating type must also have low moisture absorption and high electrical resistance.

§195.559 Liquid (cont.)

- (d) Have enough strength to resist damage due to handling and soil stress;
- (e) Support any supplemental cathodic protection; and
- (f) If the coating is an insulating type, have low moisture absorption and provide high electrical resistance.



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Gas Regulations Even Specify What Is Intuitive

- § 192.461 External corrosion control: Protective coating
 - (a) Each external protective coating, whether conductive or insulating, applied for the purpose of external corrosion control must—
 - (1) Be applied on a properly prepared surface;



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Surface Preparation

- Purpose of Surface Preparation
 - Clean Metal Surface
 - Abrade Metal Surface
 - Surface/Anchor Profile



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Surface Preparation

Coating Manufacturer will specify the type
of surface preparation required

Industry Standards

- Steel Structures Painting Council (SSPC)
- NACE International



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Surface Preparation

- **SSPC-SP 1 Solvent Cleaning**
 - Removes Grease/Oil and Debris
- **SSPC-SP 2 Hand Tool Cleaning**
 - Removes loose mill scale, rust, paint, and other detrimental foreign material with hand tools
- **SSPC-SP 3 Power Tool Cleaning**
 - Removes loose mill scale, rust, paint, and other detrimental foreign material with power tools,
 - Examples: white metal blast, near white metal and commercial blast cleaning
 - Near white - Typical Surface Prep. for Epoxies



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Coating Procedures

- Surface Preparation Requirements
 - Specify by Industry Standards (SSPC & NACE)
- Application Method
 - Spray, Brush or Roller?
- Application Conditions
 - Air & Surface Temperature
 - Caution use Infrared Temperature Guns that are calibrated to surface
 - Relative Humidity & Dew Point (Epoxies & Urethanes)

Protal 7200

Technical Data

PROPERTIES

Solids Content	100%
Base Component (Unmixed) @ 77°F (25°C)	
Specific Gravity	1.68
Viscosity	Soft Gel
Color	White
Hardener Component (Unmixed) @ 77°F (25°C)	
Specific Gravity	1.04
Viscosity	Liquid (400 cps)
Color	Forest Green
Mixed Material (Mixed) @ 77°F (25°C)	
Specific Gravity	1.53
Viscosity	Light Gel
Color	Forest Green
Mixing Ratio (A/B) by Volume	3 Parts Base:1 Part Hardener
Cure Times	
Pot Life @ 77°F (25°C)	6 Minutes
Handling Time @ 77°F (25°C)	60 Minutes
Theoretical Coverage	14 ft ² /30 mils/liter
Thickness	
Minimum	20 mils
Recommended	25 - 30 mils
Holiday Detection (Maximum)	2000 volts
Cathodic Disbondment Test (ASTM G95)	
28 Days @ 77°F (25°C)	3 mm
28 Days @ 150°F (65°C)	4 mm
28 Days @ 175°F (80°C)	7 mm
Hardness (Shore D)	85 +/-2
Impact Resistance	Excellent
Application and Service Temperature	-30°F (-34°C) to 185°F (85°C). <i>Note: If temperature falls below 50°F (10°C), surface must be preheated.</i>
Glass Transition	185°F (85°C)

STORAGE: Minimum 12 months when stored in original containers @ 41°F (5°C) to 100°F (36°C). On job site where temperatures are below 68°F (20°C) product must be kept warm to mix properly.

CLEANING: Clean equipment with solvent cleaner (Xylene 95%, Butanol 5%).

HEALTH AND SAFETY: Wear protective clothing and ensure adequate ventilation. Avoid contact with skin and eyes. See material safety data sheet for further information.

PACKAGING: 1.0 liter, 1.5 liter, 2.0 liter standard, (packaged separately: 8 base per carton, 16 hardeners per case). Special kit sizing also available. Repair cartridges available for FBE repair and clean up work.



DENSO NORTH AMERICA INC.

TORONTO: 90 Ironside Crescent, Unit 12, Toronto, Ontario, Canada M1X1M3 Tel: 416-291-3435 Fax: 416-291-0898	HOUSTON: 18211 Chisholm Trail, Houston, Texas, U.S.A. 77060 Tel: 281-821-3355 Fax: 281-821-0304
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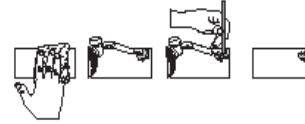
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Coating Procedures

- Thickness Requirements
 - Dry Fill Thickness (mils) per Coat for Liquid/Powder Coatings
- Overlap Requirements
 - Tape Coating & Shrink Sleeves
 - Minimum Overlap of Consecutive Wraps
 - Minimum Overlap of Existing Coatings
- Cure Time prior to Recoating or Burying

3M™ Scotchkote™ Hot Melt Patch Compounds - 226P

Instructions



Product Description

3M Scotchkote™ Hot Melt Patch Compounds, (H.M.P.C.) are heat bondable polymeric coatings in stick form designed for plant and field repair of Scotchkote Fusion Bonded Epoxy Coatings. Scotchkote Hot Melt Patch Compounds are ideal for repairing minor pinholes and abrasions. Scotchkote 226P H.M.P.C. is colormatched to Scotchkote 226W and 6233.

Scotchkote 226P H.M.P.C. can be used on holidays where no steel is visible. The following 3M two-part epoxies should be used for bare steel areas larger than pinholes, depending on the functional and application properties required:

Scotchkote 323 Scotchkote 323i

Scotchkote 352 Scotchkote 327

Features

- Easy to apply
- Usable in all weather conditions
- Quick setting for immediate installation and handling
- No solvents
- No mixing, metering, or pot life problems
- Flexible
- Color matched to Scotchkote fusion bonded epoxy coatings
- Maximum operating temperature 122°F/50°C
- Patch sticks are recommended to repair pin holes, however they can be used to repair other coating defects at the discretion of the end user.

3M and Scotchkote are trademarks of 3M Company.

Important Notice

All statements, technical information, and recommendations related to 3M's products are based on information believed to be reliable, but the accuracy or completeness is not guaranteed. Before using this product, you must evaluate it and determine if it is suitable for your intended application. You assume all risks and liability associated with such use. Any statements related to the product which are not contained in 3M's current publications, or any contrary statements contained on your purchase order shall have no force or effect unless expressly agreed upon, in writing, by an authorized officer of 3M.

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This product will be free from defects in material and manufacture for a period of 24 months from the date of purchase. 3M MAKES NO OTHER WARRANTIES INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. If this product is defective within the warranty period stated above, your exclusive remedy shall be, at 3M's option, to replace or repair the 3M product or refund the purchase price of the 3M product. Except where prohibited by law, 3M will not be liable for any loss or damage arising from this 3M product, whether indirect, special, incidental or consequential regardless of the legal theory asserted.



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80-6111-8325-4 Rev F



General Application Steps

1. Roughen the surface of the parent FBE coating using 80-mesh to 120-mesh sandpaper. Clean the surface and wipe away the sanding residue with a non-contaminating cloth.
2. Preheat the parent-coating surface using a non-contaminating heat source, such as portable hand-held butane torch. Heat should be applied in a manner that avoids burning or charring of the epoxy coating. Slight browning of the parent coating is acceptable, but charring or blistering is not. Avoid heat application directly to the patchstick while prewarming the coating surface.
3. While continuing to heat the FBE surface, occasionally draw the patchstick across the repair area until it leaves a residue. Then rub the stick in a circular motion and utilize the torch to help melt it and maintain the pipecoating temperature. Continue until the patch is smooth and has a thickness of at least 15 mils (380 microns) greater than the parent coating.
4. Allow the patch to cool before handling.

Ordering Information/Customer Service

For ordering information, technical information, product information or to request a copy of the Material Safety Data Sheet:

Phone: 800/722-6721 or 512/984-9385

Fax: 877/601-1306 or 512/984-6296

Handling and Safety Precautions

Read all Health Hazard, Precautionary, and First Aid statements found in the Material Safety Data Sheet, and/or product label of chemicals prior to handling or use.

Product Description

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Scotchkote 226P H.M.P.C. can be used on holidays where no steel is visible. The following 3M two-part epoxies should be used for bare steel areas larger than pinholes, depending on the functional and application properties required:

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Scotchkote 352 Scotchkote 327

Features

- Easy to apply
- Usable in all weather conditions

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Poor Patch Stick Application Lack of Adhesion



Excessively Large Patch Stick Application

Use for Pinholes Only on 42" Pipe



Inappropriate Bundling of Patch Sticks

Use One Only-Small Areas





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Inspection of Coatings Gas & Liquid

- **§ 192.307 Inspection of materials**
- Each length of pipe and each other component must be visually inspected at the site of installation to ensure that it has not sustained any **visually determinable damage** that could impair its serviceability.
- **§195.206 Material inspection**
- No pipe or other component may be installed in a pipeline system unless it has been **visually inspected at the site of installation to ensure that it is not damaged** in a manner that could impair its strength or reduce its serviceability



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Inspection of Coatings Gas & Liquid

- **§ 192.461 External corrosion control: Protective coating**
 - (c) Each external protective coating must be inspected just prior to lowering the pipe into the ditch and backfilling, and any damage detrimental to effective corrosion control must be repaired.
- **195.561 When must I inspect pipe coating used for external corrosion control?**
 - (a) You must inspect all external pipe coating required by Sec. 195.557 just prior to lowering the pipe into the ditch or submerging the pipe.
 - (b) You must repair any coating damage discovered.



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Coating Inspection

- Visual
 - Runs, Drips, Blisters, Foreign Inclusions
 - Wrinkles and Insufficient Overlap in Tape & Shrink Sleeves
- Thickness Measurement
 - Critical for Liquid Applied Coatings
- Holiday Testing (jeeping)
 - Electrical Test for Small Defects



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Holiday Detection (Jeeping)

- **Holiday:** A discontinuity in a protective coating that exposes unprotected surface to the environment.*
- **Holiday detector:** A device for locating discontinuities in a coating.*

(*NACE SP0490-2007)



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Voltage Settings for Holiday Detectors

- Operators O&M Manual: §192.605 (a)(2) §195.402(a)
 - **Requirements should be in Operators Written Procedures or Project Specifications**
- NACE RP0274-2004: High-Voltage Electrical Inspection of Pipeline Coatings
- NACE SP0490-2007: Holiday Detection of Fusion-Bonded Epoxy External Pipeline Coatings Coating
- Manufacturer's Published Instructions

Recommended Testing Voltages (non-FBE)

(*NACE RP0274-2004)

Coating Thicknesses		Testing Voltage
(mm)	(mils)	(volts)
0.51	20	6,000
0.79	31	7,000
1.6	62	10,000
2.4	94	12,000
3.2	125	14,000
4.0	156	16,000
4.8	188	17,000
13	500	28,000
16	625	31,000
19	750	34,000

Recommended Testing Voltages for FBE

(*NACE SP0490-2007)

Coating Thickness	Test Voltage
(mils)	(volts)
10	1,650
11	1,750
12	1,800
13	1,900
14	1,950
15	2,050
16	2,100
20	2,350
25	2,650
30	2,900

Thin Field Joint Coating



Joint Coating Applied over Dirt/Debris





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Coating Damage Cause by Welding Band (Jeeper did not indicate holiday)





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Tape on Pipe

Preventing proper Holiday Detection





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Coating to be Protected During Installation Gas & Liquid

- **§ 192.319 Installation of pipe in a ditch**
- (a) ... each transmission line ... must be installed so that the pipe fits the ditch so as to minimize stresses and protect the pipe coating from damage.
- (b) .. must be backfilled in a manner that:
 - (1) Provides firm support under the pipe; and
 - (2) Prevents damage to the pipe and pipe coating from equipment or from the backfill material.
- **§195.252 Backfilling**
- When a ditch for a pipeline is backfilled, it must be backfilled in a manner that:
 - (a) Provides firm support under the pipe; and
 - (b) Prevents damage to the pipe and pipe coating from equipment or from the backfill material.



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Coating to be Protected During Installation Gas & Liquid

- **§195.246 Installation of pipe in a ditch**
- (a) All pipe installed in a ditch must be installed in a manner that minimized the introduction of secondary stresses and the possibility of damage to the pipe.



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Lowering

Sidebooms Spaced Per API 1104, Appendix A, ECA Stress

Analysis





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Bored Crossing – Failed Hydro Test





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Rocks against pipe (No screening for over 1 mile)





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Pipe laid directly on solid rock





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Existing Pipelines Coatings Must Be Inspected

- **§ 192.459 External corrosion control: Examination of buried pipeline when exposed**

Whenever an operator has knowledge that any portion of a buried pipeline is exposed, the exposed portion must be examined for evidence of external corrosion if the pipe is bare, or if the coating is deteriorated. If external corrosion requiring remedial action under §§192.483 through 192.489 is found,

- **Operator qualified individual**

- **§195.569 Do I have to examine exposed portions of buried pipelines?**

- You must investigate circumferentially and longitudinally beyond the exposed portion (by visual examination, indirect method, or both) to determine whether additional corrosion requiring remedial action exists in the vicinity of the exposed portion.

- **Operator qualified individual**



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PHMSA New Construction Coating Issues

- Failing to visually inspect pipe
- Electronic Holiday Detection (Jeeps)
 - Failing to follow written instructions
 - Low voltage setting
 - Using bent defective springs
 - High resistance in electrical circuit (grounding)
 - Jeeping over duct tape and fiberboard
 - Jeeping only at skid locations upon lowering-in
 - Traveling too fast and with Holiday Detector not working



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PHMSA New Construction Coating Issues

- Two Part Epoxy
 - Failing to follow Written instructions
 - Failing to properly prepare surface and use solvent wipe (some manufacturers require solvent wipe)
 - Applying coating repair after epoxy starts to set (pot life)
 - Applying coating below or above manufactures recommended temperature or not heating pipe before application



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PHMSA New Construction Coating Issues

- Fusion Bond Epoxy issues
 - Failing to follow written instructions
 - Improper application temperature
 - Heating pipe containing water (water prevents obtaining proper temperature)
 - Coating over mud or rust
 - Poor preparation during sand blasting (no sweeping over factory coating)



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PHMSA New Construction Coating Issues

- **FBE Patch Stick Issues:**
 - Failing to follow written instructions
 - Not heating pipe during application
 - Using the patch stick on bare metal - for pinhole or abrasion repair only
 - Failing to prepare surface by sanding as required by manufacturer
 - Repairing two part epoxy with patch stick



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PHMSA New Construction Excavation Issues

- Insufficient burial depth
- No One Call Notifications
- Inadequate use of rock shield, padding machines, or selective backfill
- Dents caused by placing pipe on rocks
- Construction crews damaging pipe and coating during installation in ditch and backfill and when installing river weights



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Construction Damage

Section of Pipe was Replaced

(found by DCVG Survey-Line was in Service)





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Gouge in Pipe

(found by DCVG Survey-Line was in Service)





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Quality?

- Good inspection and repair of pipeline coating is an indication of High Quality Construction Practices.
- Thanks for your attention.