

# Engineering Standard

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SAES-H-201

31 May 2005

General Specifications for Over-the-Ditch External  
and Internal FBE Coating of Field Girth Welds

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## Saudi Aramco DeskTop Standards

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## 1 Scope

This Standard covers minimum mandatory requirements governing the application and installation of over-the-ditch fusion bonded epoxy (FBE) coating for external and internal field girth welds of pipelines having diameters from 10" to 63".

In addition, Procedures for each specific job shall be prepared by Applicator incorporating all the mandatory requirements specified in this standard for CSD approval shall be obtained prior to work commencement.

## 2 Conflicts and Deviations

- 2.1 Any conflicts between this standard and other applicable Saudi Aramco Engineering Standards (SAESs), Materials System Specifications (SAMSSs), Standard Drawings (SASDs), or industry standards, codes, and forms shall be resolved in writing by the Company or Buyer Representative through the Manager, Consulting Services Department of Saudi Aramco, Dhahran.
- 2.2 Direct all requests to deviate from this standard in writing to the Company or Buyer Representative, who shall follow internal company procedure [SAEP-302](#) and forward such requests to the Manager, Consulting Services Department of Saudi Aramco, Dhahran.

## 3 References

All referenced Specifications, Standards, Codes, Forms, Drawings and similar material shall be of the latest issue (including all revisions, addenda and supplements) unless stated otherwise.

### 3.1 Saudi Aramco References

#### Saudi Aramco Engineering Procedure

[SAEP-302](#)

*Instructions for Obtaining a Waiver of Saudi Aramco Engineering Requirements*

#### Saudi Aramco Engineering Standards

[SAES-H-002](#)

*Internal and External Coatings for Steel Pipelines and Piping*

[SAES-H-100](#)

*Painting Requirements for Industrial Facilities*

[SAES-H-200](#)

*Storage, Handling, and Installation of Externally Coated Pipe*

### 3.2 Industry Codes and Standards

Society for Protective Coatings

*SSPC PA-2*

*Measuring Dry Film Thickness*

*SSPC SP-1*

*Solvent Cleaning*

## 4 Definition

**RSA:** The Responsible Standardization Agent for Coatings, is assigned by Engineering Services/CSD, the responsible agency, with the concurrence of Materials Standardization, to be the technical authority on issues related to Paints and Coatings

## 5 Material Storage and Handling

- 5.1 Coating material shall be stored and handled in accordance with the Manufacturer's recommendations. Improved storage, such as air conditioned buildings, shall be provided if and when the Consulting Services Department determines that it is necessary.
- 5.2 Powder shall be kept dry at all times and not exposed to direct sunlight or used within 15 m of any source of ignition. Adequate safety equipment shall be worn as a precaution against inhalation of the powder dust and to prevent contact with the eyes.
- 5.3 Powder and repair materials shall have the manufacturer's name, product identification number, batch number, date of manufacture, and the shelf life or the expiry date.

## 6 Design

- 6.1 The FBE powder shall meet the requirements of [SAES-H-002](#), APCS-104 for External and APCS-102 for Internal.
- 6.2 Minimum acceptable width of the strip area to be coated shall be: 280 mm centered on the weld.

## 7 Application and Installation

- 7.1 General
    - 7.1.1 General surface preparation and application requirements applicable to all over-the-ditch FBE shall be states in this standard for all line pipes with diameters vary between 10" up to 63". Consult with the RSA for other diameters that are outside the scope of this standard.
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- 7.1.2 Application of FBE coating shall be strictly in accordance with the application procedure prepared by the contractor (Applicator) and approved in writing by the CSD prior to commencement of any coating work. FBE materials and method of application and equipment to be used shall be specified in this procedure.
  - 7.1.3 For welds that require post weld heat treatment (PWHT), FBE coating over-the-ditch on both Internal and External welds shall be done after PWHT and welds accepted by responsible Inspector.
  - 7.1.4 The maximum length of the FBE field application is strictly limited by the total length of the cutback plus a reasonable overlap to tie in with the initial FBE coating. The maximum total length of the coating on the girth weld shall be 11 inch (280 mm). Consult with the RSA if the length is extended due to adjacent coating damage.
  - 7.1.5 Internal cleaning and FBE coating of line pipes with diameter from 10" to 20" shall be commenced by the fully remote controlled crawling machine fitted with 2 cameras to monitor the work.
  - 7.1.6 A test spool shall be used to verify the correct functioning of the crawling machine during the work implementation. The length and diameter of the test spool shall be decided and agreed by the contractor, CSD and Saudi Aramco inspector before the work commences.
- 7.2 Surface Preparation
- 7.2.1 Prior to blast cleaning, all hydrocarbon contaminants within a 500 mm wide band centered over the weld shall be removed from the pipe by solvent cleaning per SSPC SP-1. Kerosene, diesel, or similar degreasers that leave an oily film shall not be used. Acceptable degreasers are Saudi Aramco solvents SAP# 1000186759 and SAP# 01000198575.
  - 7.2.2 All weld joints including adjacent areas to be FBE coated either Internal or External shall be ground smooth and free from burrs, weld spatter, sharp edges. Weld toes shall be merged smoothly and rounded with no sharp undercuts. The weld cap or internal root protrusion shall not be more than 1.5 mm.
  - 7.2.3 The bare metal joint shall be abrasive blasted to near white metal cleanliness, Sa 2½. The surface profile shall be 40 to 75 micrometers.
  - 7.2.4 The gloss shall be removed from the shop-applied FBE pipe coating that will be overlapped by the field coating by light abrasive (sweep) blasting or sanding. Wire brushes shall not be used for this purpose.
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- 7.2.5 Blasting abrasives shall contain less than 100 ppm chlorides and sulfates. They shall be stored in a dry condition and maintained dry during use. Sand shall not be used as an abrasive. The Contractor shall furnish chemical analyses for all batches of abrasives used to demonstrate compliance with these requirements.

### 7.3 Application Procedures

- 7.3.1 Preheating shall be accomplished by using induction heating coils only.
- 7.3.2 As soon as surface preparation by blast cleaning operation is completed to specified standard & required profile is achieved and within a maximum period of 4 hours, before any rust blooming of the prepared metal surface occurs, the area to be coated shall be cleaned of any deleterious matter by brushing or by blowing with clean, dry, oil-free compressed air. Any blasted area showing evidence of flash rusting shall be re-blasted prior to coating.
  - 7.3.2.1 In subkhas and other areas where chloride contamination of the pipe surface is possible, the first girth weld area blasted on each shift shall be tested for chlorides using a test method that has been previously approved in writing by the RSA. Thereafter, test one out of each successive 40 girth weld areas. Residual chloride on the surface shall not exceed 40 mg/m<sup>2</sup>.
  - 7.3.2.2 Failure to meet the residual chloride limitation requires that the girth weld be sweet water washed and retested until the chloride limitation is met. Subsequent girth weld areas shall be similarly treated, with testing being conducted on one out of each successive 40 girth weld area. Alternatively, if 5 consecutive girth weld areas are tested and meet the chloride limitation without the use of water washing, then the procedure in paragraph 7.3.2.1 shall be applied.
- 7.3.3 The area to be coated shall then be immediately heated to a temperature in accordance with the Powder Manufacturer's recommendation using induction heating coil.

*Commentary Note:*

*Temperatures in excess of the Manufacturer's recommended maximum can damage the adjacent internal coating.*

- 7.3.4 Preheating temperatures shall be measured with contact pyrometers. Temperature crayons shall not be used.

- 7.3.5 As soon as the correct metal temperature has been reached, the induction coil shall be removed from the welded joint area and the powder application equipment placed in position. Powder application shall start immediately
  - 7.3.5.1 The machine shall apply powder to a uniform rate, to a correct width centered on the girth weld, to a minimum dry film thickness of 625 up to a maximum of 1000 microns for External and 325 microns minimum up to 625 microns maximum for Internal, in the least number of passes possible. Avoid overspray on the adjacent FBE coated areas.
  - 7.3.5.2 Care shall be taken to prevent the spray head, braces or hoses, etc., from dragging on the ground during application operations. Dirt or deleterious materials shall not contaminate the powder coated area during the application and curing stages.
- 7.3.6 During periods of bad weather (rain, high winds, etc.) cleaning and coating operations will only proceed if protective canopies are used to the satisfaction of the Saudi Aramco Inspector.

## **8 Inspection Methods and Acceptance Criteria**

### **8.1 General**

This section gives the mandatory inspection methods and acceptance criteria that shall be met before the FBE-coated welds can be put into service.

### **8.2 Visual Inspection**

8.2.1 The Inspector shall verify that the surface preparation requirements of paragraph 7.2 are met prior to the commencement of preheating.

8.2.2 Thickness checks shall be made on each coated weld joint using an approved, correctly calibrated dry film thickness gauge (e.g., Microtest, Elcometer or equivalent). The instrument shall be calibrated in accordance with SSPC PA-2.

A minimum number of 6 readings shall be taken on each field joint coating to verify compliance with the thickness requirement in paragraph 7.3.5.1. The readings shall include the weld seam.

8.2.3 On the first 5 joints of the job and twice each day thereafter, the quality of cure shall be checked by maintaining a MEK soaked pad in contact

with the coating surface for one minute and then rubbing vigorously for 15 seconds. There shall be no softening of the coating or substantial color removal from the coating.

8.2.4 The finished coating shall have a uniform, glossy appearance and be free of defects such as holidays, fish eyes, lumps, dry spray, sags and runs. Coating overlap shall be within the thickness specified in [SAES-H-200](#) and / or as per the applicator's procedure approved.

8.2.5 Internally coated pipeline with diameters from 10" to 20" shall be inspected by the cameras fitted on the crawling machine.

### 8.3 Holiday Detection

8.3.1 100% of the coated girth weld surface area shall be holiday detected, inspected, and repaired in accordance with the procedures and equipment specified in [SAES-H-200](#) for the mill-applied FBE coating on the pipe. Holiday detection shall not be conducted if the surface temperature of the coated girth weld area exceeds 88°C.

8.3.2 All holidays, imperfections, and damaged areas shall be carefully identified with a waterproof marker. All markings shall be sufficiently distant from the area to be repaired to allow surface preparation and patching to take place without being a detriment to the adhesion of the repair coating.

### 8.4 Destructive Testing

8.4.1 Using a sharp knife with a narrow width blade, make two, approximately 13-mm long incisions through to the metal substrate to form an X.

8.4.2 Starting at the intersection of the X, attempt to force the coating from the steel substrate with the knife point. Refusal of the coating to peel constitutes a pass. Partial or complete adhesion failure between the coating and the metal substrate constitutes a failure. Cohesive failure caused by voids in the coating leaving a honeycomb structure on the specimen surface also constitutes failure.

8.4.3 This shall be performed once every hour. When five consecutive tests are successful, the frequency shall be reduced to once every two hours.

8.4.4 If coating fails to meet the acceptance criteria in paragraph 8.4.2, the adjacent field girth weld areas shall also be tested until acceptable coatings are found on both sides of the defective coating. The defective coatings shall all be completely removed and the areas recoated. At least

one of the repaired areas shall be re-inspected, and the subsequent inspection frequency shall be as given in paragraph 8.4.3.

## 8.5 Repairs

### 8.5.1 General

Defects shall be repaired in accordance with the criteria and methods below. If the number of defects is more than 3 holidays on any girth weld, the coating shall be completely blasted off and the area recoated at no cost to Saudi Aramco.

### 8.5.2 Preparation of Surface

The pipe surface to be recoated shall be cleaned to remove all dirt and damaged or disbonded coating using abrasive blasting or other approved and suitable means. The edges of the original coatings shall be "feathered out" approximately 50 mm around the specific area to be coated, and all dust wiped off before applying the patch coating.

### 8.5.3 Patch-up Coating

The material for patch-up coating shall be supplied or approved by the manufacturer of the powder epoxy coating. The repair material shall be a part of the contractor's procedure to be approved by CSD.

The patch-up coating materials can be FBE powder, melt sticks, or liquid coating. The patch-up coating shall not be applied when the pipe surface temperature is less than 3°C above the dew point.

Freshly patched coated areas shall be allowed to cure according to Manufacturer's recommendations prior to handling.

### 8.5.4 Repair Inspection

Patch repair areas shall be 100% holiday tested in accordance with paragraph 8.3. No holidays shall be present on the girth weld after patching.

### 8.5.5 Contractor Responsibilities

The Contractor shall be responsible for all quality control processes including visual inspection, surface cleanliness and profile checking, thickness measurements, and holiday testing. The Contractor shall keep daily records of the work progress and results of all inspection activities



in a form suitable to the Saudi Aramco Inspector surveillance and approval.

31 May 2005

**Revision Summary**  
Major revision.