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	CLIENT: PETROBRAS	SHEET:	1 of 8
	JOB: RIGID OFFSHORE PIPELINES	CC	
	AREA:	PROJECT:	
ENG-SUB	TÍTLE: INTERNAL FBE FOR LINEPIPES	NP-1	
		MANAGER: EISE/EDR	

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INDEX OF REVISIONS

REV.	DESCRIPTION AND/OR REVISED SHEETS
0	ORIGINAL (THIS DOCUMENT SUPERSEDES THE DOCUMENT I-ET-0000.00-6500-217-PPR-020)

	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H
DATE	03/04/2020								
PROJECT	EISE/EDR								
EXECUTION	UPL2								
CHECK	C5FP								
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1. SCOPE OF DOCUMENT

This Technical Specification defines the minimum requirements related to the application of internal Fusion Bonded Epoxy anticorrosion coating on pipelines.

APPLICATOR shall fulfill all the requirements presented within this Technical Specification.

This document shall be read in conjunction with the following standards:

- API RP 5L7 – August 2010.
  Title: Recommended Practice for Unprimed Internal Fusion Bonded Epoxy Coating of Line Pipe.

- DNV-RP-F106 – May 2011
  Title: Factory Applied External Pipeline Coatings For Corrosion Control.

- DNV-OS-F101 – October 2013
  Title: Submarine Pipeline Systems.

In case that it is noted any sort of conflict between this Technical Specification and the aforementioned documents, the following precedence order shall be respected by APPLICATOR:

a) This Technical Specification;
b) API RP 5L7.

2. LINEPIPE COATING REQUIREMENTS

APPLICATOR shall fulfill the requirements of the following document for the coating manufacturing:

- API RP 5L7 – August 2010.
  Title: Recommended Practice for Unprimed Internal Fusion Bonded Epoxy Coating of Line Pipe.

There are some additional and modified requirements which shall be fulfilled by APPLICATOR. Additional and modified requirements to the aforementioned document within the item 2.1 will be duly highlighted in this Technical Specification considering the following expressions:

[ADDITION] - When new requirements shall be considered.

[MODIFICATION] - When a partial or full modification in the referred item is required.

[DELETION] - When the referred item shall be entirely disregarded.

3. ADDITIONAL AND MODIFIED REQUIREMENTS FOR LINEPIPE COATING APPLICATION RELATED TO API RP 5L7.

The items mentioned below are following the sequence already defined within the API RP 5L7. The paragraph number related to API RP 5L7 is given in brackets.

SECTION 1 – SCOPE

(Table 1.0) Addition: "9. ASTM D4541: Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers, latest edition."
(Table 1.0) Addition: "10. ISO 21809-2: Petroleum and natural gas industries – External coatings for buried or submerged pipelines used in pipeline transportation systems – Part 2: Fusion-bonded epoxy coatings."

(Table 1.0) Addition: "11. ISO 8501-1: Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings."

(Table 1.0) Addition: "12. ISO 8502-3: Preparation of steel substrates before application of paint and related products – Tests for the assessment of surface cleanliness – Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)."

(Table 1.0) Addition: "13. NACE No. 2/SSPC-SP 10: Near-White Metal Blast Cleaning."

(Table 1.0) Addition: "14. NACE No. 5/SSPC-SP 12: Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating."

SECTION 3 – LABORATORY COATING TESTING

(3) Modification: "Coating Pre-Qualification Trial."

(3.1) Addition: "For compliance with this RP, a project specific 'procedure qualification trial' (PQT) is mandatory since no PQT track record is available for the relevant coating system regarding to the specific conditions for the execution of a procedure qualification trial."

(3.1) Addition: "The PQT shall utilize the specific coating materials, equipment considering their relevant spares and procedures to be used during the ordinary production. The key personnel participating in a PQT process shall be responsible to ensure a proper training for all the employees which will be assigned to the other production shifts."

(3.1) Addition: "In case that a coating system has been already qualified by PETROBRAS, the specific conditions demanding the execution of a new PQT are as follows:

KEY VARIABLE	SPECIFIC CONDITIONS REQUIRING A NEW FULL PQT
Coating material	Change of any coating material composing the coating system.
Surface treatment	Alteration of surface treatment after blasting operation.
Equipment	Change of methodology for the coating application.
Pipe Inner Diameter (ID)	Any change on the pipe ID.
Key process parameters	Out of the tolerance previously qualified (e.g temperatures, application speed, etc.)

Beyond to the aforementioned conditions, the following items shall be considered:

- In case of existing PQT track records for projects having an equivalent methodology of installation, no further trial is necessary whether the aforementioned conditions are kept.
- A total amount of five pipes shall be coated in case of need for a new Procedure Qualification Trial.
- During the PQT process, five pipes shall be coated. Nevertheless it shall be taken into account a suitable amount of pipes in order to cover also the full scale testing protocol.
- The PQT schedule and the relevant Inspection and Test Plan as well as the Application Procedure Specification shall be sent for customer's review at least 45 days prior to the beginning of trial."

(3.1) Addition: "Coating application procedures (including repairs) and equipment for coating shall be qualified prior to production through the execution of a PQT. The PQT shall be scheduled taking into account the time needed to complete and report the testing."

(3.1) Modification: "This Section describes tests required to the PQT. It is responsibility of the APPLICATOR to qualify the coating material prior to production. The SUPPLIER shall certify to the APPLICATOR and/or PURCHASER the results of tests performed under Section 3 for each qualified material."

(3.2) Modification: "PQT shall be performed on actual project's pipes or pipes with same characteristics, e.g. ID. Surface preparation shall be in accordance with Section 4.5 of this Recommended Practice."

(3.3) Modification: "Coating of Pipes for PQT".

(3.3.2) Modification: "Thickness of coating on pipes shall be within the range of 350µm and 550µm, measured by a coating thickness gauge calibrated per Par. 5.3.2.4."

(3.4.1) Modification: "The following tests shall be performed on samples extracted from coated pipes which have been prepared and coated for the PQT. Tests shall be performed on duplicate samples. The application procedure shall be considered qualified when the results of both test samples meet the acceptance criterion for each test."

(3.4.2) Addition: "The following additional tests shall be performed during PQT: Degree of Cure in accordance with ISO 21809-2 Annex A.8 (acceptance criterion $-2 < \Delta Tg < +3$, test performed at one sample)."

(3.4.2) Modification: "Adhesion pull-off tests shall be performed in accordance with ASTM D4541. Acceptance criterion is 17.2MPa."

(3.4.2) Addition: "Full scale tests shall be performed during PQT in order to simulate installation and operational requirements. The following full scale tests are mandatory:

TEST
Full scale bending (only for reel-lay installation method)
Full scale pigging

- The additional testing protocol after full scale tests shall be agreed within the relevant test procedure;
- In case of existing successful full scale tests track records that were carried out in an equivalent condition being requested for a new project, the test data shall be shared with

PETROBRAS for reviewing.

- The aforementioned full scale test shall be carried out in compliance with a relevant test procedure agreed with PETROBRAS;
- APPLICATOR shall specify any additional test which is applicable according to its technical analysis."

SECTION 4 – APPLICATION PRACTICES

(4.2.3.1) Modification: "By agreement between PETROBRAS and APPLICATOR, a list of coating materials previously qualified by PETROBRAS 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..."

(4.5.2.1) Addition: "Prior to blast cleaning, the contamination by chlorides shall be verified in accordance with NACE no. 5/SSPC-SP 12, Table 2, condition SC-2. Maximum acceptable value is 2µg/cm^2 measured by ELCOMETER 130-SCM 400 or similar equipment. If chlorides contamination is found, suitable chemical pre-treatment or high pressure demineralized water shall be used to eliminate it."

(4.5.3.1) Modification: "The blast abrasive shall be a mix of steel shots (spherical) and steel grits (angular) in order to promote the anchor pattern profile. The pipe surface shall be blast cleaned to a near white in accordance with the latest edition of NACE no. 2/SSPC-SP 10 or equivalent (Sa 2½ in accordance with ISO 8501-1)."

(4.5.3.2) Addition: "Compressed air for blast cleaning and blow out shall be tested and be in accordance with requirements of ASTM D4285."

(4.5.4) Modification: "The resulting surface profile shall be within 60µm to 100µm and has an angular nature. Roughness shall be measured using replica tape ("Press-o-Film" or similar) or roughness tester and, in this case, the parameter R_{Zdin} and angular profile shall be considered. The surface profile is obtained from the average of three measures in each extremity of the pipe."

(4.5.5) Addition: "The residual dust contamination after blasting shall be determined by the adhesive tape method in accordance with ISO 8502-3. Acceptance criterion is maximum rate 2."

(4.6.2.2) Modification: "Pipe surface temperature shall not exceed 260°C. It should be recognized…"

(4.6.3) Modification: "The coating thickness shall be within 60µm to 100µm. Coating thickness shall be checked on every pipe with an approved gauge. The gauge is to be calibrated daily."

(4.7.2) Modification: "The usual methods for repairing applied internal coatings are (a) stripping and recoating, (b) overcoating. The method to be used shall be determined by agreement between PETROBRAS and APPLICATOR. Recommended practices and limitations for each method follow."

(4.7.2.2) Modification: "Pipe shall first be reblasted. Complete removal of the original coating is not required, but it shall be sufficiently roughened to ensure adhesion of the second coat. The pipe shall be recoated per this Recommended Practice. Coating thickness range remains as originally specified."

(4.7.2.3) Deletion of item.

SECTION 5 – PRODUCTION INSPECTION AND ACCEPTANCE

(5.3.2.1) Modification: “Surface preparation shall be monitored continually to assure compliance with Par. 4.5.3. At least once each shift, the surface profile on pipe shall be measured in accordance with Par. 4.5.4. The profile shall be within the limits of Par. 4.5.4.”

(5.3.2.5) Modification: “…The unit shall have both visual and audio alarms to indicate holidays. No holidays are permitted. Pipe lengths with coating…”

(5.3.3.2) Modification: “A cathodic disbondment test of 48 hour duration at 65°C shall be performed…”

(5.3.3.2) Modification: “…An average disbonded radius less than or equal to 8mm from the edge of the original holiday shall constitute a pass. Disbonded radii greater than 8mm from the edge of the original holiday constitute a fail. In this case all coating applied before and after the tested joint, up to the last and next passable ring tests are rejected.”

(5.3.3.3) Addition: “The following additional tests shall be performed during production: adhesion pull-off at (23 ± 2)°C in accordance with ASTM D4541 (acceptance criterion minimum 17.2MPa, test performed at one ring per shift), Degree of Cure in accordance with ISO 21809-2 Annex A.8 (acceptance criterion $-2 < \Delta Tg < +3$, test performed at one ring per shift).”