TECHNICAL SPECIFICATION

N° I-ET-3010.00-1200-956-P4X-003

CLIENT:

SHEET: 1 de 16

JOB: --

AREA:

DP&T-SUP

TITLE: THERMAL SPRAY COATING APPLICATION OF ALUMINUM

NP-1

ESUP

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0 ORIGINAL ISSUE

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FORM OWNED TO PETROBRAS N.381 REV. L

PRELIMINARY
1 INTRODUCTION

1.1 This Technical Specification establishes the minimum conditions required for thermally sprayed aluminum coating for corrosion control on offshore units to be executed according to SSPC-CS 23.00/AWS C2.23M/NACE No. 12.

1.2 The coating qualification of procedure, application and quality control shall meet SSPC requirements, in addition to the changes indicated in the paragraphs of this technical specification, as described below:

- Addition: continued paragraph of the parentheses in the SSPC-CS 23.00/AWS C2.23M/NACE No. 12;
- Modification: Replacement of part of the paragraph indicated in parentheses of SSPC-CS 23.00/AWS C2.23M/NACE No. 12;
- Substitution: Full replacement of the paragraph indicated in parentheses of the SSPC-CS 23.00/AWS C2.23M/NACE No. 12;
- New: Inserting a paragraph not found in the SSPC-CS 23.00/AWS C2.23M/NACE No. 12;
- Exclusion: removal of the paragraph indicated in parentheses from the SSPC-CS 23.00/AWS C2.23M/NACE No. 12.

2 NORMATIVE REFERENCES

All equipment shall comply with the requirements of this technical specification, data sheets, documents as stated below and with those referred to herein.

2.1 CODES AND STANDARDS

The following codes and standards include provisions which, through reference in this text, constitute provisions of this specification. The latest issue of the references shall be used unless otherwise agreed. Other recognized standards may be used, provided it can be shown that they meet or exceed the requirements of the standards referenced below.

- ASTM D4285 Standard Test Method for Indicating Oil or Water in Compressed Air.
- ISO 2063 Thermal spraying - Metallic and other inorganic coatings - Zinc, aluminum and their alloys.
- ISO 8502: Part 1 to 10 Preparation of steel substrates before application of paints and related products - Test for the assessment of surface cleanliness.
ISO 9712 Non-destructive testing - Qualification and certification of personnel
ISO 12944-3 Paints and varnishes - Corrosion protection of steel structures by protective paint systems. Part 3: Design considerations.
ISO 14917 Thermal spraying - Terminology, classification.
ISO 14918 Thermal spraying - Approval testing of thermal sprayers.
ISO 14919 Thermal spraying - Wires, rods and cords for flame and arc spraying - Classification - Technical supply conditions.
ISO 14922-Part 1-4: Thermal spraying.; quality requirements of thermally sprayed structures
NSF 61 Drinking water system components - Health effects.
SSPC-CS 23.00/AWS C2.23/NACE No. 12: Specification for the application of thermal spray coatings (metallizing) of aluminum, zinc, and their alloys and composites for the corrosion of steel.
SSPC-PA 2 Procedure for Determining Conformance to Dry Coating Thickness Requirements.
SSPC-SP 1 Solvent Cleaning.
SSPC-SP 5 White Metal Blast Cleaning.
SSPC-SP 10 Near White Blast Cleaning.
SSPC-VIS 1 Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning.
SSPC-TR 3 Dehumidification and Temperature Control During Surface Preparation, Application, and Curing for Coatings/Linings of Steel Tanks, Vessels, and Other Enclosed Areas.
SSPC-AB 1 Mineral and Slag Abrasives.
SSPC-AB 2 Cleanliness of Recycled Ferrous Metallic Abrasives
SSPC-AB 3 Ferrous Metallic Abrasive.

Governmental codes, regulations, ordinances or rules applicable to the equipment in Brazil shall prevail over the requirements of above specification, including reference codes and standards and/or these engineering specifications, only in those cases where they are more stringent.

3 DEFINITIONS AND ABBREVIATIONS

3.1 DEFINITIONS
In addition of ISO 14917 and ISO 14918 are valid. Others definitions are:

Spraying pass: The coat thickness deposited by the thermal spray coat process in one movement of the spray gun in one direction, without interrupting the movement.

Thermal spray coat layer: The coat thickness deposited by many overlapped spraying passes with no crossing pass.
Thermal spray coat thickness: The final thickness of thermal spray coating achieved by many designed layers of applied material over the surface.

3.2 ABBREVIATIONS:
TSC: Thermal spray coating;
JCR: Job control record;
QC: Quality control;
CS: Carbon steel;
CUI: Corrosion under insulation;
ESCC: External Stress Chloride Corrosion;
SS: Stainless steel;
HDG: Hot dip galvanizing;
NA: Not applicable;
WFT: Wet film thickness;
DFT: Dry film thickness;
VOC: Volatile organic compound;
MSDS: Material safety data sheet;
PDS: Product data sheet;
QCP: Quality control plan;
CTF: Coating Technical File.
SENAl: Serviço Nacional de Aprendizagem Industrial

4 NEW: THERMAL SPRAY COATING INSPECTOR

4.1 All thermal spray coating activities shall be supervised by coating inspector.

4.2 The examining body mentioned by ISO 14918 shall be an independent third party organization according ISO 9712.

4.3 The applicator of thermal spray coatings shall be qualified according to ISO 14918.

4.3.1 NACE International Coating Inspector Training and Certificate Program is considered acceptable for qualification of Thermal spray coating inspector inspectors.

4.3.2 FROSIO, The Norwegian Professional Council for Education and Certification of Inspectors for Surface Treatment, is considered acceptable for qualification of Thermal spray coating inspector inspectors.

4.3.3 The industrial painting inspectors qualifying program of ABRACO, The Brazilian Association of Corrosion, is considered acceptable for qualification of Thermal spray coating inspector inspectors.

4.3.4 The thermal spray anti-corrosive coatings inspector (Inspetor de Revestimento Anticorrosivo por Aspersão Térmica) qualifying program of SENAI, Serviço Nacional de Aprendizagem Industrial, is considered acceptable for qualification of Thermal spray coating inspector inspectors.
4.4 The inspector shall have knowledge and skill in the use of inspection equipment to measure and validate the coating applicator’s conformance to the contract. Specifically, the inspector shall be:

a) Skilled in measuring surface temperature, dew point, and ambient air temperature and in calculating the dew point. Specific skills include the use of a surface temperature gauge, sling psychrometer, psychrometric charts, and digital measuring equipment;

b) Skilled in the use of water break, UV light, solvent evaporation, and heat tests to detect grease and oil;

c) Skilled in the use of conductivity, commercially available kits, and titration kits for the measurement of soluble salts and skilled in the use of a Bresle kit for soluble salt measurement;

d) Knowledgeable about SSPC-AB 2 and ASTM D4940, for the detection of salt in abrasives;

e) Skilled in the detection of oil in abrasives;

f) Knowledgeable about ASTM D4285

g) Skilled in measuring blast air pressure and nozzle orifice condition;

h) Knowledgeable about SSPC surface preparation standards, specifically SSPC-SP 5 and SSPC-VIS 1;

i) Skilled in testing surface profile using ISO 8503;

j) Skilled in measuring coating thickness per SSPC-PA 2 using a Type 2 gauge, in accordance with ASTM D4138,
k) Skilled in performing adhesion tests, including the bend test, tensile adhesion test (ASTM D4541, using a self-aligning Type IV tester, described in Annex A4 of ASTM D4541), and GRID test.

5 SURFACE FINISH REQUIREMENTS

5.1 NEW: PRIOR ACTIVITIES

5.1.1 Accessibility: The requirements of ISO 12944: Part 3 item 5.1 shall considered before beginning the job.

5.1.2 JCR’s shall be elaborated before beginning the works. The JCR’s shall be available to the thermal sprayers and inspectors.

5.1.3 The preparation grades of welds, edges and other areas with surface imperfections shall be grade P3 of ISO 8501-3.

5.2 NEW: PRE-CLEANING

5.2.1 Immediately before spraying, the surface shall be dry and free from dust, grease, scale, rust and any contaminants.

5.2.2 The substrate shall be degreased according to SSPC-SP 1.

5.2.3 The inspection techniques to confirm the absence of oil or grease residues shall be according to Appendix D QCCP #1.
5.2.4 The substrate may be hydro blasted (5000 - 10000 psi) to remove soluble salts contaminants before beginning the surface preparation.

5.3 Modification of paragraph 5.2: Angular profile Depth:

5.3.1 The steel substrate shall have, at a minimum, an angular profile depth ≥ 75 µm with a sharp angular shape and a maximum of 120 µm.

5.4 Modification of paragraph 5.3.1. (3) - Abrasives:

5.4.1 Type: Use clean dry angular blasting abrasives. Unless otherwise specified, only aluminum oxide abrasives according to ISO 11126-7 shall be used.

5.4.2 Steel grit abrasives may be used but the following requirements shall be observed:

5.4.2.1 PETROBRAS prior approval is required;

5.4.2.2 Steel grit abrasives shall be selected and evaluated according to SSPC-AB 3;

5.4.2.3 The recycled ferrous metallic grit abrasives shall be evaluated according to SSPC-AB 2, prior its use;

5.4.2.4 Before each reuse, the recyclable steel grit abrasive shall be cleaned of millscale, rust, paint, and other contaminants by an abrasive reclaimer;

5.4.2.5 At every work shift during blast cleaning operations, the Manufacturer shall verify that the recycled steel grit abrasives meet the requirements of SSPC-AB 2;

5.4.2.6 The abrasive material shall not be reused more than 3 times.

5.4.3 Other mineral and slag abrasives may be used but the following requirements shall be observed:

5.4.3.1 PETROBRAS prior approval is required;

5.4.3.2 The mineral and slag abrasives shall be selected and evaluated according to SSPC-AB 1.

5.4.4 The absence of oil contamination shall be confirmed using the test for oil in the appropriate abrasive specification (no oil film or grease). When it is not specified, the abrasive shall be tested according to SSPC-CS 23.00, item APPENDIX D QCCP # 4.

5.4.5 The soluble salts contamination analysis shall be done according to the appropriate abrasive specification. When it is not specified, the abrasive shall be tested according to ASTM D4940 and the maximum soluble salts content shall not exceed 100 µS/cm.

5.4.6 Abrasive size range: The requirements of SSPC-CS 23.00, TABLE 2 shall be followed as a basis for selecting the proper abrasive size range.

5.5 New: Compressed Air:

5.5.1 All compressed air sources shall have oil and moisture separators, attached and functional, and properly designed and sized;

5.5.2 The compressed air sources shall deliver air to the blast nozzle, for blowing down the surfaces, or for conventional spray application that is free from oil and moisture and of sufficient pressure to accomplish the associated work efficiently and effectively;

5.5.3 The tanks on the air compressor and moisture separator shall be drained, at least, at the end of each work shift;
5.5.4 The compressed air source shall produce a minimum pressure of 90 psi at the nozzle during abrasive blast cleaning.

5.5.5 The compressed air shall be tested to verify the presence of oil and water according to SSPC-CS 23.00, item APPENDIX D QCCP # 3.

5.5.5.1 The test frequency shall be:
   a) Before the beginning of any work shift;
   b) 15 minutes after the beginning of the work shift;
   c) At least every four hours for each compressor system in operation.

5.6 New: Ambient Conditions:

5.6.1 No surface preparation shall be performed when the conditions are as follows:
   5.6.1.1 When the relative humidity is above 85%;
   5.6.1.2 When the substrate is damp or covered by frost or ice;
   5.6.1.3 When the surface temperature is less than 5ºC;
   5.6.1.4 When the surface temperature of the steel is less than five (5) degrees Celsius above the dew point temperature as determined by a surface temperature thermometer and electric or sling psychrometer.

5.7 New: Soluble salts and Dust test:

5.7.1 The maximum acceptable water-soluble salts on abrasive blasted surfaces after surface preparation is 5 µg/cm² for carbon steel and 3 µg/cm² for stainless steels; The test shall be executed according to ISO 8502-6 or ISO 8502-9.

5.7.2 Before thermal spray application, the surface shall be dust tested in accordance with ISO 8502-3. The maximum acceptable is quantity: rating 2 and dust size: 3 or over.

5.7.3 The minimum number of randomly taken measurements to be taken for verifying the dust or soluble salts on surfaces is given in TABLE 1. The number of measurements given is generally considered as being representative for inspection areas for the purposes of this standard. This number shall be increased for inspection areas having a difficult configuration with regard to paint application or measurement or limitations in accessibility (difficult areas).

<table>
<thead>
<tr>
<th>Sampling plan</th>
<th>Thermal spray coated area (m²)</th>
<th>Minimum number of measurements for soluble salts test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Up to 100</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Above 100 to 250</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Above 250</td>
<td>2 each 300 m²</td>
</tr>
</tbody>
</table>

6 TSC REQUIREMENTS

6.1 Substitution of paragraph 6.1.2.: The feedstock material shall be Al 99.5 according to ISO 14919.
6.1.1 Addition to paragraph 6.2: Thickness measurements:

6.1.1.1 Minimum Thickness: The average of the acceptable gage readings shall be no less than the specified minimum thickness (TABLE 3). No single gage reading shall be less than 88% of the minimum;

6.1.1.2 Maximum thickness: The average of the acceptable gage readings shall be no more than the specified maximum thickness (TABLE 3). No single gage reading shall be more than 110% of the maximum.

6.1.2 Modification to paragraph 6.2.2.1: If the TSC thickness is greater than 400 µm but lower than 450 µm, information shall be recorded in the JCR and one adhesion test (see item 4.3.3.2 of this technical specification) shall be done at every 1 m² of over thickness area. If the results of adhesion tests fail, all over thickness areas shall be reblasted and the TSC coating reapplied; if the results of adhesion tests pass, the inspector shall record the adhesion value.

6.1.3 New: The adhesion test can be replaced by the GRID test.

6.1.3.1 GRID TEST shall be performed according to ISO 2063, ANNEX A.1. This is a destructive test.

6.1.3.2 Acceptance criteria: No coat removal after the pull off the adhesive tape.

6.1.4 Modification to paragraph 6.3.4:

6.1.4.1 For TSC areas under 1 m²: one measure in line.

6.1.4.2 For TSC areas over 1 m² but under 10 m²: One measurement after the first square meter and others after each 2 m² of applied TSC.

6.1.4.3 For TSC areas over 10 m²: One measurement shall be taken every 10 m² of applied TSC for flat surfaces. For complex surfaces one measurement shall be taken every 5 m² of applied TSC. Each measurement shall be the average value of five readings”.

6.1.5 Substitution to paragraph 6.4.1: The TSC tensile bond shall be measured according to ASTM D4541 using a self-aligning adhesion tester, method D - Equipment Type IV and Method E - Equipment Type V- with automatic actuation.

6.1.6 Modification to paragraph 6.4.1.2: One portable tensile-bond measurement shall be made every 20 m². If the tensile bond is less than the contract specification, the degraded TSC shall be removed and reapplied.

6.1.7 Modification to paragraph 6.4.1.3: For nondestructive measurement: Tensile force shall be measured up to 10 MPa. The tensile force shall then be reduced and the tensile fixture removed without damaging the TSC.

6.1.8 Modification to paragraph 6.7.1: Changed to: “When required, metallographic examination evaluation shall be according to ISO 2063. No through TSC thickness cracks or voids are acceptable”.

7 TSC APPLICATION PROCEDURE

7.1 NEW: Application procedure

7.1.1 The thermally spray coating application procedure shall contain, at least, the following information:
a) Scope of the work;
b) Personnel certification and qualification requirements;
c) Thermal spray processes employed;
d) Pre-cleaning process (when necessary);
e) Surface preparation method;
f) Safety and environmental requirements;
g) Quality control points (in process, and hold points);
h) Inspection equipment;
i) List of all equipment;
j) Calibration procedures and reports.

7.2 NEW Thermal spray process:

7.2.1 The thermal spray process acceptable is ARC spraying processes. Flame spraying process requires previous approval by PETROBRAS.

7.3 NEW Thermal spray coating thickness:

7.3.1 For edges and corners: between 200 to 300 µm;
7.3.2 Other cases: between 200 to 400 µm.

7.4 Modifications to paragraph 7.3.2 Holding period:

7.4.1 Item 7.3.2.1: Time between the completion of the final surface preparation and the completion of the thermal spraying shall be no greater than six hours for steel substrates with the following exceptions: The time between the completion of the final surface preparation and the completion of the thermal spray coat flash coat shall be no greater than two hours for steel substrates.

7.4.2 Item 7.3.2.1 (2): For steel tanks, vessels and other enclosed spaces which have an environmental control according to SSPC-TR 3/NACE 6A192, it may be possible to retard the oxidation of the steel and hold the surface finish for more than six hours. The TSC applicator, with the previous approval of PETROBRAS, can establish a holding period greater than six hours by determining the acceptable temperature-humidity envelope for the work enclosure by spraying and analyzing bend coupons, tensile-bond specimens, or both. The following method shall be used for bend-test coupons: (a) establish, measure, and record the low-humidity environment; (b) prepare four bend-test coupons according to contract specifications; (c) place bend-test coupons in the low-humidity environment; (d) after target holding period duration, apply the contact specified thermal spray coating; (e) perform the bend test according to 6.5; (f) the low-humidity environment and holding period are satisfactory if the four bend coupons meet the requirement of 6.5.3(2);

7.4.3 Modification to paragraph 7.4.1.1. The flash coat do not extend the holding period over 6 hours.
8 TSC APPLICATION

8.1 Addition to paragraph 8.2.1. Thermal spraying

8.1.1 Spraying pass or layer shall have approximately the same width and shall overlap each other by 1/3 to ½ of the spraying pass width.

8.1.2 At least two crossing layers shall be applied for any TSC.

9 APPLICATION OF SEALERS AND TOPCOATS

9.1 New: The thermal sprayed steel shall be sealed and not be painted. No topcoat is required.

9.2 New: For ambient temperatures up to 120ºC, resins sealer shall be 2 component epoxy polyamide (maximum 20% of solids per volume). For higher temperatures, resin sealer shall be zinc pigmented free silicone.

9.3 New: For Fresh Water or Potable Water services sealants may not be used. If required, the sealant shall be certified according to NSF 61.

10 RECORDS

10.1 Modification to paragraph 10.1: The TSC applicator shall use a JCR to record the production and QC information and other information required by the purchasing contract. Additionally, the TSC applicator shall have its own Quality Assurance Program. The TSC applicator shall keep records for a time period consistent with the TSC applicator’s quality assurance and records program and as required for regulatory compliance and the purchasing contract. Records shall be stored for a minimum of five years.

11 DEBRIS CONTAINMENT AND CONTROL

Debris containment and control shall be according to SSPC-CS 23.00, Section 11.

12 WORK PROCEDURES AND SAFETY

Work procedures and safety shall be according to SSPC-CS 23.00, Section 12.

13 DOCUMENTATION

13.1 Substitution to paragraph 13.2: Job Reference Standard (JRS)

13.1.1 Any thermally spray coating procedure shall be qualified before starting the work.
13.1.2 Specimens to be tested shall be the same material specification as the equipment/piping to be coated.

13.1.3 The procedure shall cover only one process and its operation (manual, automatic or mechanized).

13.1.4 Qualifying tests coupons.

13.1.4.1 TABLE 2 - 2 summarizes the test coupons and test to be performed during JRS.

<table>
<thead>
<tr>
<th>Test coupon</th>
<th>Dimensions (mm)</th>
<th>Coated face</th>
<th>Tests</th>
<th>visual</th>
<th>roughness</th>
<th>thickness</th>
<th>adhesion</th>
<th>bending</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel</td>
<td>500 x 500 x 3</td>
<td>One face</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cantilever</td>
<td>FIGURE 1</td>
<td>One face</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel sheets</td>
<td>1.25 x 50 x 75</td>
<td>Width face</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>5 coupons</td>
</tr>
<tr>
<td>tubular</td>
<td>≤2&quot; x 500 x 5</td>
<td>externally</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

13.1.4.2 The thermal spray coating thickness shall be between 200 µm to 400 µm;

13.1.4.3 Tests coupons shall not be painted with sealer.

13.1.5 Visual test:

13.1.5.1 The visual inspection shall be carried out in adequate light conditions. As a recommendation, a magnifier with 8-fold magnification may be used if necessary. The visual inspection shall be executed in the as-sprayed condition or after machining.

13.1.5.2 The thermally sprayed coated surface shall be smooth and uniform, without blisters or bare patches, cracks, loose particles or exposed material; and free from non-adhering metal and defects which can be detrimental to the service life and expected use of the protective coating.

13.1.6 Roughness test

13.1.6.1 The roughness shall be ≥ 75 µm with a sharp angular shape and a maximum of 120 µm.

13.1.6.2 The roughness shall have an angular profile and shall be measured using replica tape (replica tape) according to ISO 8503-5 or using the "Stylus" method by ISO 8503-4, considering...
the parameter RZ DIN or Ry5. The total roughness shall be obtained by three random measurements on the surface.

13.1.7 Thickness measurements:

13.1.7.1 Use type 2 electronic gage equipment according to SSPC-PA 2; The coating thickness is given as an arithmetical mean of at least three and preferably five individual measurements; Discard any unusually high or low gage measurement that cannot be repeated consistently.

13.1.7.2 Number of measurements:

a) For Steel sheet test panel: measurements along imaginary lines, each 80 mm distant from the others (see FIGURE 2);

b) For Cantilever steel test panel: measurements along imaginary lines, each 80 mm distant from the others (see FIGURE 3);

c) For tubular steel test: four imaginary lines located at 90º from each other. (See FIGURE 4).

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**Figure 2 - Thickness measurements for steel sheet test panel.**

**Figure 3 - Thickness measurements for cantilever steel test panel.**
13.1.7.3 Acceptance criteria:

a) Minimum thickness: The average of the measurements shall be not less than the specified minimum thickness (TABLE 3). No single reading shall be less than 88% of the minimum.

b) Maximum thickness: The average of the measurements shall be not more than the specified maximum thickness (TABLE 3). No single reading shall be more than 110% of the maximum.

TABLE 3 - REQUIRED THICKNESS FOR THERMAL SPRAYED ALUMINUM COATINGS.

<table>
<thead>
<tr>
<th>Minimum Thickness</th>
<th>Maximum Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 µm</td>
<td>400 µm(1)</td>
</tr>
</tbody>
</table>

(1) Thickness higher than 400 µm but lower than 450 µm are considered acceptable if approved in the adhesion test.

13.1.8 Adhesion measurements:

13.1.8.1 Test equipment according to ASTM D 4541, using pneumatic adhesion tensile testing instrument with an automatic centered pulling force and self-alignment;

13.1.8.2 Adhesion test locations shall be according to FIGURES 4 and 5.

13.1.8.3 The average of the measurements shall be not less than 10 MPa. No single measurement shall be less than 7 MPa.
13.1.9 Bend test:
13.1.9.1 Bend test equipment shall have a mandrel with a diameter of 13 mm.
13.1.9.2 Bend test passes if on the bend radius there is no cracking or detachment or there is only minor cracking that cannot be lifted from the substrate with a knife blade.

13.2 Report of qualification tests:

13.2.1 The qualification test report shall contain, at least, the following information:
   a) Data of issue;
   b) Report number or code;
   c) Thermal spray coating procedure evaluated;
   d) Identification of the entity responsible for performing tests;
   e) Responsible for performing the tests;
   f) Thermal spray coating system information regarding surface preparation and application;
   g) Information about consumables (metallic material and abrasives) as: the name of the manufacturer, chemical composition, size (for abrasives only) and batch number;
   h) Test results;
   i) Conclusion;
   j) Standards used during tests.

14 CONTRACT PRE-AWARD VALIDATION

14.1 NEW: Documentation

14.1.1 The contract pre-award validation shall include the following documents:
a) Thermally spray coating application procedure according to item 13.1.1 of SSPC-CS 23.00 and the requirements of item 4.2 of this technical specification;

b) Procedures for inspection of thermal spray coating, including acceptance.

c) Reports of thermal spray coating inspection in accordance with (b);

d) Certificates of approval testing of thermal spray applicators according to ISO 14918;

e) Qualification certificates of coating inspectors;

f) Reports of the qualifying tests of thermally spray coating application procedure.

15 TSC APPLICATOR WARRANTY

15.1 NEW: QUALITY CONTROL

15.1.1 The manufacturer shall have a QUALITY CONTROL SYSTEM according to ISO 14922 - Part 1 and Part 4.

15.1.2 The Manufacturer shall have as many Job Control Records as necessary to do the Job. Those documents shall be available to thermal spray team at any time.

15.1.3 The Manufacturer shall have a Thermal spraying coordinator to work in the general supervision of thermal spray works. This thermal spraying coordinator may also be the thermal spray coating inspector.

15.1.4 The Manufacturer shall have a thermal spray coating inspector to perform the tests and elaborate the quality control inspections and reports.

15.1.5 Manufacturer QC inspections shall include, but not limited to the following:

a) Pre surface Preparation Inspection (Design conditions, presence of oil and grease);

b) Ambient conditions (prior to blasting, during blasting works, and during the thermal spray coating works);

c) Compressed air cleanliness (during blasting and thermal spray works);

d) TSC feedstock material quality;

e) Abrasive cleanliness and quality;

f) Surface preparation (presence of oil and grease, content of soluble salts, surface cleaning standard and surface profile);

g) Thermal spray coating application (Equipment setup, holding times, etc.);

h) Thermal spray coating quality (thickness, adhesion, appearance of the applied coating, etc.);

i) Sealer coating quality (dry film thickness).

15.1.6 After any thermal spray coating work a report shall be done. The report shall have, but not be limited to, information data about:

a) Manufacturer data (company name and contract number);

b) Issuing data;

c) Thermal spray process used;

d) Thermal spray procedure (codification number);
e) Substrate related: Codification of the equipment or component thermally sprayed; Surface areas coated; Surface profile; Presence of oil and grease; soluble salts content; Surface cleanliness according to SSPC-SP VIS 1.

f) Ambient conditions: Humidity; Surface temperature; Surface dew point temperature; Air temperature.

g) Compressed air: Presence of oil and water; Air pressure.

h) Abrasives: type; Cleanness; Size; Presence of oil and water.

i) Thermal spray coat: Thickness; Adhesion; Feedstock quality; Holding times.