Designation: A1117 – 23

Standard Practice for Application of Thermal Spray Aluminum (TSA) Coating to Carbon Steel Pipe[1]

This standard is issued under the fixed designation A1117; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice defines the minimum requirements for the application of Thermal Spray Aluminum (TSA) coatings to carbon steel pipe for the purpose of preventing atmospheric corrosion or corrosion under insulation. This practice is intended to be effective for TSA coatings applied at pipe manufacturing facilities or at on-site assembly locations.

1.2 This practice is for the application of TSA to the external surfaces of piping to prevent atmospheric corrosion of insulated and non-insulated surfaces.

NOTE 1—TSA has been found useful for temperatures up to 1000°F (540°C) for uninsulated surfaces and for preventing corrosion under insulation for pipes operating in the range of 25°F to 300°F (–4°C to 150°C) surface temperature.

1.3 This practice includes requirements for surface preparation, materials, application and quality control of TSA applied to carbon steel piping at the pipe manufacturing facility or at an on-site-assembly location.

1.4 This practice is expressed in both inch-pound and SI units. However, unless the order specifies the use of metric values, inch-pound units shall be used.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys

C633 Test Method for Adhesion or Cohesion Strength of Thermal Spray Coatings

D4417 Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel

D7091 Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals

2.2 *Other Standards:*

AWS C2.18 Guide for the Protection of Steel with Thermal Sprayed Coatings of Aluminum and Zinc and their Alloys[3]

AWS C2.25/C2.25M Specification for Thermal Spray Feedstock-Wire and Rods

NACE No. 2/SSPC-SP 10 Near-White Metal Blast Cleaning[4]

NACE No. 12/AWS C2.23M/SSPC-CS 23.00 Specification for the Application of Thermal Spray Coatings (Metallizing) of Aluminum, Zinc, and Their Alloys and Composites for the Corrosion Protection of Steel

NACE SP0198 The Control of Corrosion Under Thermal Insulation and Fireproofing Materials–A Systems Approach

3. Terminology

3.1 Terms used in multiple A01 standards are defined in Terminology A941.

3.2 *Definitions of Terms Specific to This Standard:*

[1] This practice is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.09 on Carbon Steel Tubular Products.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American Welding Society (AWS), 8669 NW 36 St., #130, Miami, FL 33166-6672, http://www.aws.org.

[4] Available from Association for Materials Protection and Performance (AMPP), 15835 Park Ten Place, Houston, TX 77084, https://www.ampp.org.

3.2.1 *electric arc spraying, n*—a thermal spray coating process, in which consumable metal wire is melted by heating with an electric arc and then propelled onto a substrate.

3.2.2 *flame spraying, n*—a thermal spray coating process that uses heat from the combustion of a fuel gas with oxygen to melt a spray coating material which is propelled onto a substrate.

3.2.3 *thermal spraying, n*—either electric arc spraying or flame spraying.

4. Summary of Practice

4.1 This procedure involves the following steps:

4.1.1 Cleaning and removing burrs from the pipe assemblies to be TSA coated,

4.1.2 Protecting components that should not be coated,

4.1.3 Sealing all openings to the interior of the pipe assemblies to prevent accidental application of TSA to the interior,

4.1.4 Abrasive-blasting the pipe assemblies to be TSA coated,

4.1.5 Applying the TSA coating,

4.1.6 Inspection of the coated product,

4.1.7 Repair, if necessary, and

4.1.8 Reporting.

5. Significance and Use

5.1 The quality and effectiveness of TSA coatings is dependent on a variety of factors including surface preparation, coating materials, environmental conditions and control of the applications process. This practice addresses the fundamental variables and concerns relative to proper TSA application.

5.2 TSA has been proven to offer resistance to the atmospheric corrosion of carbon steel pipe and to corrosion under insulation (CUI). The publication NACE No. 12/AWS C2.23M/SSPC-CS 23.00, AWS C2.18 and NACE SP0198 provide additional information regarding the performance of TSA coatings.

6. Procedure

6.1 Piping surfaces to be TSA coated shall be accessible for grit blasting and TSA coating application.

6.2 Prior to blasting sharp corners and edges on surfaces requiring TSA shall be dressed by blend grinding. Minimum corner radius shall be 0.063 in. (1.6 mm). Weld spatter, flux or slag, oil and grease shall be removed. Oxides and heat affected zones produced by thermal cutting shall be removed by grinding.

6.3 The following components shall be shielded during surface preparation and TSA application:

6.3.1 Pressure gauges, level and flow indicator glass, thermowells, Coriolis and magnetic flow meters;

6.3.2 Safety valves, control valves and block valves including packing glands and valve stems, pump seals, threaded connections, flange faces, field weld bevels, thin wall bellows, PTFE coated and stainless steel bolting; and

6.3.3 Non-ferrous components, non-metallic components, galvanized components and components requiring concrete or gunite fire-proofing.

6.4 All openings to the interior of the pipe or spool piece shall be sealed to prevent accidental application of TSA to the interior.

6.5 The blasting abrasive shall be dry, clean and free from contaminants such as oil and grease. Sharp, angular garnet, aluminum oxide or aluminum silicate shall be used. Other blasting media shall be used only with approval of the purchaser.

6.6 Surfaces to be TSA coated shall be blasted to near white surface finish per NACE No. 2/ SSPC-SP 10 as a minimum.

6.7 The anchor profile shall be 3 mils (75 microns) to 6 mils (150 microns). The anchor profile shall be measured in accordance with Test Method D4417, Method B or C.

6.8 The surfaces to be coated shall be clean and free of abrasive residue and dust prior to TSA application. Maximum salt concentration on the surface shall be 2.8 mg/ft^2 (30 mg/m^2).

6.9 If the blasted surface develops rust bloom or becomes wet prior to TSA application, it shall be dried and blasted again.

6.10 Aluminum wire grade 1100 shall be used. The chemical composition of the wire is given in Table 1. Only aluminum wire designated by the wire manufacturer for thermal spraying shall be used.

6.11 The aluminum wire shall be dry and free of scale, oils or coatings.

6.12 The surface to be coated shall be at least 5°F (3°C) above the dew point and the relative humidity shall be below 90 % during spraying.

6.13 Unless the purchaser has specified a different value, the TSA thickness shall be not less than 10 mils (250 microns) and not more than 20 mils (500 microns). If the purchaser has specified the coating thickness, the specified coating thickness shall be considered the minimum thickness and the maximum thickness shall be the specified thickness plus 10 mils (250 microns).

6.14 Unless the purchaser has specified a different value, the TSA surface roughness shall not exceed 3500 µin (90 µm) R_Z as measured per Test Method D4417.

TABLE 1 Chemical Composition of Aluminum Wire 1100[A] (Mass Percents)

NOTE 1—Single values shown are maximum percentages unless minimum is specified.

Al	99.00 min
Cu	0.05-0.20
Fe	0.95
Mn	0.05
Si	0.95
Zn	0.10
Other Elements	[B,C]

[A] Values are the same as those in AWS C2.25/C2.25M.
[B] 0.0008 Be maximum.
[C] Other elements: 0.05 maximum each; 0.15 maximum total.