Specification for Thermal Spraying Zinc Anodes on Steel Reinforced Concrete

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An American National Standard
Key Words—Zinc, concrete, zinc anode, thermal spraying, arc spraying, process instruction, surface preparation, quality control, adhesion measurement

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An American National Standard

Approved by
American National Standards Institute
December 16, 2002

Specification for
Thermal Spraying Zinc Anodes
on Steel Reinforced Concrete

Prepared by
AWS C2 Committee on Thermal Spraying

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This AWS standard is a specification for thermal spraying zinc anodes on steel reinforced concrete. This standard is formatted as an industrial process instruction. The scope includes: job description, safety, pass/fail job reference standards, feedstock materials, equipment, a step-by-step process instruction for surface preparation, thermal spraying, and quality control. There are two annexes: job control record and portable adhesion testing.
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Cathodic protection (CP) is a proven technique for corrosion protection of chloride contaminated concrete structures. Zinc thermal spray coatings are used as sacrificial anodes for passive CP and for distributed anodes in active impressed current CP systems. The California Department of Transportation pioneered zinc thermal spray coatings for a distributed anode in an impressed current CP system on the Richmond-San Rafael Bridge in 1983. Florida Department of Transportation pioneered the use of zinc thermal spray coating sacrificial anodes for concrete bridge substructures in water and tidal areas with full-scale application (=120,000 ft² area [11,000 m²]) on the Howard Franklin Bridge. Oregon Department of Transportation was first to specify and install zinc thermal spray coatings as the distributed anode for an impressed current CP system in the repair of reinforced concrete bridge substructures of the Cape Creek and Yaquina Highway 101 bridges in 1990–1991 and 1994. Industry and government agencies are now using zinc thermal spray coatings to provide impressed current and sacrificial CP systems for reinforced concrete structures.

This AWS process standard covers the application of zinc thermal spray coatings to concrete using arc and flame spray equipment. This standard is formatted as an industrial process instruction (see flow chart) and the scope includes: job description, safety, pass/fail job reference standards, feedstock materials, equipment, and a step-by-step process instruction for surface preparation, thermal spraying, and quality control.

There are two Annexes: (a) safety information for thermal spraying and (b) job control record. This standard does not cover the design standards or recommended practices for CP systems. The design of a CP system for reinforced concrete structures should be undertaken by an experienced and qualified Corrosion Engineer. The guidelines offered in this standard can be modified by the Corrosion Engineer as required for the specific project conditions. Further information on guidelines for CP of reinforced concrete is available in NACE Standard RP0290-90.

Comments and suggestions for the improvement of this standard are welcomed. They should be sent to the Secretary, AWS C2 Committee on Thermal Spraying, American Welding Society, 550 N.W. LeJeune Road, Miami FL 33126.

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Used in this Publication

Abbreviations

A
ANSI
ASTM
AWS
CP
ICCP
m
MAPP
MSDS
NACE
NFPA
QC
Rebar
SSPC
TS
TSC
µm
V
VIS

ampere
American National Standards Institute
American Society for Testing and Materials
American Welding Society
cathodic protection
impressed current cathodic protection
meter = 39.4 inches
methylacetylene-propadiene
Material Safety Data Sheet
National Association of Corrosion Engineers
National Fire Protection Association
quality control
reinforcing (steel) bar
Society for Protective Coatings
thermal spray
thermal spray coating
micron or micrometer = $10^{-6}$ meter
volts
visual

Conversion Factors

Length

<table>
<thead>
<tr>
<th>U.S. Customary</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>in.</td>
<td>in. Fraction</td>
</tr>
<tr>
<td>0.001</td>
<td>—</td>
</tr>
<tr>
<td>0.0625</td>
<td>1/16</td>
</tr>
<tr>
<td>0.09375</td>
<td>3/32</td>
</tr>
<tr>
<td>0.125</td>
<td>1/8</td>
</tr>
<tr>
<td>0.1562</td>
<td>5/32</td>
</tr>
<tr>
<td>0.1875</td>
<td>3/16</td>
</tr>
<tr>
<td>1.00</td>
<td>—</td>
</tr>
</tbody>
</table>
### Pressure

<table>
<thead>
<tr>
<th>U.S. Customary</th>
<th>Metric</th>
<th>Metric Nominal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 lb/in.²</td>
<td>6.9 kPa</td>
<td>7 kPa</td>
</tr>
<tr>
<td>100 lb/in.²</td>
<td>0.69 MPa</td>
<td>0.7 MPa</td>
</tr>
<tr>
<td>145 lb/in.²</td>
<td>1 MPa</td>
<td>—</td>
</tr>
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</table>

### Thermal Spraying

<table>
<thead>
<tr>
<th>Parameter Spray Rate</th>
<th>To Convert From</th>
<th>To</th>
<th>Multiply By</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lb/hr</td>
<td>kg/hr</td>
<td>0.454</td>
</tr>
<tr>
<td></td>
<td>kg/hr</td>
<td>lb/hr</td>
<td>2.20</td>
</tr>
<tr>
<td></td>
<td>lb/ft²/0.001 in.</td>
<td>kg/m²/m</td>
<td>0.195</td>
</tr>
<tr>
<td></td>
<td>kg/m²/m</td>
<td>lb/ft²/0.001 in.</td>
<td>0.947</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Area Coverage</th>
<th>ft²/hr/0.001 in.</th>
<th>m²/hr/µm</th>
<th>Multiply By</th>
</tr>
</thead>
<tbody>
<tr>
<td>unit area</td>
<td></td>
<td></td>
<td>2.32</td>
</tr>
<tr>
<td>m²/hr/µm</td>
<td></td>
<td></td>
<td>0.431</td>
</tr>
</tbody>
</table>
Specification for Thermal Spraying Zinc Anodes on Steel Reinforced Concrete

1. Scope

This standard covers the application of zinc thermal spray coatings to concrete using arc and flame spray equipment. This standard is formatted as an industrial process instruction: job description, safety, Pass/Fail Job Reference Standard, feedstock materials, equipment, a step-by-step process instruction for surface preparation, thermal spraying, quality control (QC), and a Job Control Record.

This standard is based on the literature, equipment, process developments, and industrial practices known at the time of publication. This standard does not cover the design standards or recommended practices for cathodic protection (CP) systems.

Figure 1 is the process chart summarizing the application process and quality control checkpoints. Table 1 summarizes the inspections and test methods that shall be employed.

Annex A summarizes the safety information for thermal spraying. The basic precautions for thermal spraying are essentially the same as for welding and cutting. Consult Safety Chapter in AWS Thermal Spraying: Practice, Theory, and Application; ANSI Z49.1, Safety in Welding, Cutting, and Allied Processes; and NFPA 58, Standard for the Storage and Handling of Liquefied Petroleum Gases. Read and follow safety precautions in the manufacturer’s equipment technical instructions and manuals and the feedstock Material Safety Data Sheet (MSDS).

This specification makes use of both U.S. Customary Units and the International System of Units (SI). The measurements are not exact equivalents; therefore each system must be used independently of the other without combining in any way. The specification with the designation C2.20 uses U.S. Customary Units. The specification C2.20M uses SI Units. The latter are shown in appropriate columns in tables or within parentheses ( ) when used in the text. Suitable conversions encompassing standard sizes of both can be made, however, if appropriate tolerances are applied in each case.

For the purposes of determining conformance with this specification, an observed or calculated value shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the limiting values in accordance with the rounding-off method given in ASTM E 29, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications.

2. Referenced Standards and Practices

The following standards contain provisions which, through reference in this text, constitute provisions of this AWS Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this AWS Standard are encouraged to investigate the possibility of applying the most recent editions of the documents shown below. For undated references, the latest edition of the standard referred to applies.

(1) ANSI Z49.1, Safety in Welding, Cutting, and Allied Processes.¹

(2) AWS Thermal Spraying: Practice, Theory, and Application.¹


¹ AWS and ANSI standards can be obtained from Global Engineering, 15 Inverness Way East, Englewood, CO 80112-5776. Telephones: (800) 854-7179, (303) 397-2740; fax (303) 397-2740; Internet: www.global.ihs.com.


(8) ASTM E 29, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications.2


2. ASTM standards can be obtained from American Society of Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.


(13) ASTM D 4258, Standard Practice for Surface Cleaning Concrete for Coating.

(14) ASTM D 4259, Standard Practice for Abrading Concrete.


(16) ASTM D 4417, Test Methods for Field Measurement of Surface Profile of Blasted Steel.


(18) CGA G-1.1, Commodity Specification for Acetylene.

(19) CGA G-4.3, Commodity Specification for Oxygen.

3. CGA standards can be obtained from The Compressed Gas Association, Inc., Crystal Gateway 1, Suite 501, 1235 Jefferson Davis Highway, Arlington, VA 22202.

Figure 1—Process Flow Chart for the Application of Zinc Thermal Spray Coatings on Reinforced Concrete
### Table 1
**Inspection and Acceptance Tests**

<table>
<thead>
<tr>
<th>Job Element</th>
<th>Criteria</th>
<th>Schedule</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surface Preparation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blasting Air</td>
<td>Clean dry air</td>
<td>At daily startup or as otherwise required</td>
<td>ASTM D 4285</td>
</tr>
<tr>
<td>Blasting Media</td>
<td>Clean blasting media per the test for oil in the appropriate abrasive specification. No oil film or fines</td>
<td>Each Section &gt;30 min. prior to thermal spraying</td>
<td>ASTM D 4940</td>
</tr>
<tr>
<td>Concrete Surface Finish</td>
<td>Clean with no visible oil, grease, dirt, moisture</td>
<td>Each Section &gt;30 min. prior to thermal spraying</td>
<td>Visual and 10x magnification</td>
</tr>
<tr>
<td>Exposed Rebar</td>
<td>Surface Finish Clean with no visible oil, grease, dirt, moisture</td>
<td>Each Section &gt;30 min. prior to thermal spraying</td>
<td>Visual and 10x magnification</td>
</tr>
<tr>
<td>Anchor-Tooth Profile</td>
<td>As mutually agreed by Purchaser and Contractor. The profile depth shall be that which is created when blasting to meet the concrete surface-finish requirement</td>
<td>As specified by the contract</td>
<td>ASTM D 4417, Method C or NACE RP0287</td>
</tr>
<tr>
<td><strong>Zinc Thermal Spraying</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSC Thickness</td>
<td>On Concrete 0.010–0.020 in. (250–500 mm) or as specified by the contract</td>
<td>As specified by the contract</td>
<td>ASTM D 1400 or ultrasonic gage calibrated for concrete</td>
</tr>
<tr>
<td></td>
<td>On Rebar</td>
<td></td>
<td>SSPC-PA 2</td>
</tr>
<tr>
<td>TSC Tensile Bond on Concrete</td>
<td>150 psi (1.0 MPa) or as specified by the contract</td>
<td>As specified by the contract</td>
<td>ASTM D 4541 using portable adhesion tester specified in the contract</td>
</tr>
<tr>
<td>TSC Surface Texture and Porosity</td>
<td>Texture Comparable to Job Reference Standard</td>
<td>As specified by the contract</td>
<td>Texture: Visual Porosity: Metallographic examination of companion coupon</td>
</tr>
</tbody>
</table>

(20) NACE RP0287, *Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Using a Replica Tape*.

(21) NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases*.

(22) SSPC 2300 (I), *Specification for the Application of Thermal Spray Coatings (Metallizing) of Aluminum, Zinc, and Their Alloys and Composites for the Corrosion Protection of Steel*.

(23) SSPC-PA 2, *Measurement of Dry Coating Thickness with Magnetic Gages*.


(25) SSPC-Vis 1, *Visual Standard for Abrasive Blast Cleaning Steel*.

**Federal Specifications**


(2) BB-O-925, *Oxygen, Technical, Gas and Liquid*.

3. Definitions

The following definitions are used in this publication.

**anode.** The electrode of an electrochemical cell at which oxidation occurs. Electrons flow away from the anode in the external circuit. Corrosion usually occurs and metal ions enter the solution at the anode.

**cathode.** The electrode of an electrochemical cell at which reduction is the principal reaction. Electrons flow toward the cathode in the external circuit.

**cathodic protection.** A technique to reduce the corrosion of a metal surface by making that surface the cathode of an electrochemical cell.

**electrolyte.** A chemical substance containing ions that migrate in an electric field.

**feathering.** Reducing the thickness of an edge of a coating, e.g., by masking or simultaneously increasing traverse speed and standoff distance of the thermal spray gun.

**flash coat.** A thin metallic coating usually less than 0.002 in. (0.05 mm) in thickness.

**galvanic anode.** A metal that provides sacrificial protection to another metal that is more noble when electrically coupled through an electrolyte. This type of anode is the current source in one type of cathodic protection.

**galvanic corrosion.** Accelerated corrosion of a metal because of an electrical contact with a more noble metal or nonmetallic conductor in a corrosive electrolyte.

**holding period.** Is that time between the start of final blasting for surface preparation and completion of thermal spraying.

**impressed current.** An electric current supplied by a device employing a power source that is external to the electrode system. (An example is direct current for cathodic protection.)

**near-white blast cleaning.** When viewed without magnification surface shall be free of visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter. Refer to SSPC-PC 10/NACE 2 for the complete definition.

**nobel metal.** A metal with good resistance to chemical reaction, oxidation and to solution by inorganic acids. The term is used synonymously with precious metal.

**overspray.** Is the excess spray material that is not being deposited on the part or area designated to be sprayed.

**sacrificial protection.** Reduction or corrosion of a metal in an electrolyte by galvanically coupling it to a more anodic metal, a form of sacrificial protection.

**sacrificial cathodic protection.** Reduction of corrosion of a metal in an electrolyte by galvanically coupling it to a more anodic metal.

4. Job and Contract Specification

4.1 Requirements

4.1.1 Summary of Requirements. Briefly summarize the background and requirements for this thermal spray job, i.e., zinc thermal spray coating on reinforced concrete for (1) a distributed anode for an impressed current CP system or (2) a sacrificial anode for galvanic CP system:

1. In an **impressed current CP system**, the rebar is protected by a **counter corrosion current** applied by a power source through the thermal spray zinc anode. The zinc thermal spray anode must be electrically isolated from the rebar. When installing a thermally sprayed zinc anode for use in an impressed current CP system, a viable method to avoid any short circuits between the anode and the rebar should be specified.

2. In a sacrificial CP system, the zinc anode and the rebar are connected to each other and the protective counter corrosion current is powered by the voltage differential between the zinc anode and the rebar. The more active zinc corrodes in preference to the steel rebar.

Table 1 summarizes the major job elements of a contract specification for the installation of zinc thermal spray anodes for the protection of reinforced concrete. The criteria, sampling schedule, and test methods are given for the major job elements. The zinc thermal spray coating thickness and adhesion strength should be related to the required service. Additionally, the contract should specify job-site access, job permits, industrial safety and environmental compliance requirements as appropriate.

4.1.2 Specific Requirements

1. Zinc feedstock shall meet the alloy composition requirements of ASTM B 833 or AWS C2.25.

2. The minimum inspection and acceptance criteria for the zinc thermal spray coating includes:

   a. Surface-preparation and thermal spray process qualification to include materials, equipment, and method.

   b. Production area and components to include specific inspection and measurement procedures, locations, and frequency.

3. Thermal spray coating work requirements including industrial process, which areas are to be sprayed (and
not sprayed), thermal spray coating thickness, quality control (QC) steps, and the Job Control Record per 4.4.

(4) Pass/Fail Job Reference Standard for surface preparation finish (of the concrete or the concrete with exposed rebar, or both) and for the zinc thermal spray coatings.

(5) Thermal spray coating inspector qualification, designation, and authority on behalf of the purchaser.

(6) Thermal spray operator qualification and validation of operator qualification record.

(7) Schedule (thermal spray job start, duration, key events, and completion).

(8) Concurrent work that may or will be on-going during the thermal spray work on the job site that may cause (mutual) interference. Cite the procedural and remedial actions to be taken should interference occur. File Delay and Disruption reports as required.

(9) Job site work permits; access permits; work regulations and procedures; safety requirements, equipment, and procedures; and Job Control Record.

(10) Containment and disposal of waste and debris generated by paint removal and surface preparation.

(11) Applicable federal, state, county, city, and union regulations.

(12) Other information and requirements that is necessary for the planning and the completion of the thermal spray job or contract.

Table 1 summarizes the inspections and test methods that shall be employed during shop and field application of thermal spray coatings. Table 2 lists the laboratory tests that may be used to further examine and qualify the surface preparation, feedstock material, and thermal spray process parameters. The purchaser shall specify the required tests and their pass and fail values. The preparation and analysis of thermal-spray-coating metallographic test specimens should be performed by a qualified laboratory using qualified thermal-spray procedures.

Page 1 of the Job Control Record (Annex I) summarizes the job requirements. Pages 2 and 3 summarize the eight QC checkpoints. Contractor’s quality assurance program, Job Control Record, and QC check points equivalent to this standard may be used if agreed to by the purchaser and contractor.

4.2 Job Reference Standard. The Job Reference Standard is a job site pass/fail reference standard made from concrete and rebar representative of the whole job (or job section) and range of environmental conditions, with or without enclosure, as appropriate. The actual field equipment and process parameters and procedures (surface preparation, thermal spraying, and quality control) for the contract work shall be used for making the Job Reference Standards. The preparation and the use of the Job Reference Standard for quality control should be agreed upon by the purchaser and contractor. Table 1 summarizes the major elements, acceptance criteria, and sampling schedule for the installation of zinc anodes by thermal spraying. Job Reference Standards shall be prepared, as required, for:

(1) Concrete surface finish (without exposed rebar).

(2) Concrete with exposed rebar surface finish and rebar profile.

(3) Zinc thermal spray coating on concrete without exposed rebar.

(4) Zinc thermal spray coating on concrete with exposed rebar.

(5) Bond strength of zinc anode to concrete substrate including the time period after spraying when to make the measurement.

The Job Reference Standards may be temporarily preserved by applying a 0.003–0.005 in. (75–125 m) clear polyurethane coating or equivalent material and thickness to protect the Job Reference Standard during the contract period.

4.3 Thermal Spray Boundary. The contract should specify the area, structure, or work piece to be thermal sprayed and the thermal spray boundary between the sprayed and non-sprayed areas.

4.4 Job Control Record. Annex I presents a Job Control Record that covers the essential job information and eight QC check points: Page 1 of the Job Control Record lists information on the contractor, the purchaser, zinc thermal spray coating requirements, safety precautions,
surface preparation and abrasive blasting media requirements, flame- and arc-spray equipment and parameters, and the thermal spray operator qualification. Pages 2 and 3 of the Job Control Record list the eight production QC checkpoints.

4.5 Thermal Spray Coating Inspector. The thermal-spray-coating inspector is a person who is knowledgeable in the concepts and principles of, and skilled in observing and measuring conformance to this standard.


4.7 Pre-Contract Award Validation. If required by the purchaser, the contractor shall submit for review and approval:

1. Surface Preparation
   (a) Equipment, material, and process information on the abrasive blasting media and the surface-preparation process, and the QC method to be used.
   (b) Demonstration of the surface preparation and QC method with the equipment and personnel proposed for performing the entire project.
   (c) Job Control Record.
   (d) Other information and demonstrations required by the purchasing contract.

2. Thermal Spraying
   (a) Equipment, material, and process information on the zinc wire feedstock, arc-spray equipment, and thermal spraying, and the QC processes to be used.
   (b) Demonstration of the surface preparation and zinc thermal spray coating application and QC method with the equipment and personnel proposed for performing the entire project.
   (c) Job Control Record.
   (d) Other information and demonstrations required by the purchasing contract.

5. Materials

The contractor shall indicate the consumable materials to be used for the job unless already specified by the purchaser or the purchasing contract; see 4.7(1) and 4.7(2).

5.1 Zinc Thermal Spray Wire. The zinc thermal spray wire shall meet the requirements of ASTM B 833 or AWS C2.25.

5.2 Tensile Bond Strength Test Specimens. Use the tensile-bond test specimen for the contract-specified ASTM D 4541 portable adhesion tester.

5.3 Bend Test Requirements. The bend test (180° bend on a mandrel) is used as a qualitative test for proper surface preparation, equipment setup, and spray parameters. The bend test puts the TSC in tension. The mandrel diameter for the threshold of cracking depends on substrate thickness, and coating thickness.

5.3.1 Mandrel Diameter. Table 3 summarizes a very limited bend-test cracking threshold for arc-sprayed zinc TSC thickness on steel coupons 0.05 in. (1.3 mm) thick versus mandrel diameter.

5.3.2 Bend-Test Procedure for TSC Thickness Range 175 to 350 µm (7 to 12 mils)

1. Five corrosion-control bend coupons shall be sprayed and shall pass the following bend test:
   (a) Carbon steel coupons of approximate dimensions 2 × 4 to 8 × 0.050 in. (50 × 100 to 200 × 1.3 mm) shall be used.
   (b) Surface shall be prepared according to contract specification.
   (c) The TSC shall be sprayed 7 to 12 mils (175 to 300 µm) thick. The TSC should be sprayed in crossing passes laying down approximately 3 to 4 mils (75 to 100 µm) in each pass.
   (d) Coupons shall be bent 180° around a 0.50 in. (13 mm) diameter mandrel.

2. Bend test passes if, on the bend radius, there is
   (a) no cracking or spalling, or

---

**Table 3**

<table>
<thead>
<tr>
<th>TSC Thickness, mils (µm)</th>
<th>Mandrel Diameter, in. (mm)</th>
<th>Cracking Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.50 (1.3)</td>
<td>0.50 (1.3)</td>
<td>≥10 (250)</td>
</tr>
<tr>
<td>0.63 (16)</td>
<td>0.63 (16)</td>
<td>≥15 (380)</td>
</tr>
<tr>
<td>&lt;1.0 (25)(1)</td>
<td>&lt;1.0 (25)(1)</td>
<td>≥25 (640)</td>
</tr>
</tbody>
</table>

Note:
(1) Confirm diameter with Job Reference Standard.
(b) only minor cracking that cannot be lifted from the substrate with a knife blade.
(c) See Figure 2.
(3) Bend test fails if the coating cracks with lifting from the substrate.

5.4 Gases


5.4.2 Acetylene. Use acetylene per Federal Specification BB-A-106, Acetylene, Technical, Dissolved, or CGA G-1.1, Commodity Specification for Acetylene for flame spraying. Other fuel gases as specified by the thermal spray equipment manufacturer (e.g., methylacetylene-propadiene stabilized [MAPP]) or propane may also be used.

5.5 Abrasive Blasting Media and Air. The contractor shall use abrasive blasting media and air quality specified by the purchaser.

6. Equipment for Thermal Spraying

6.1 Thermal Spray Equipment. Thermal spray equipment shall meet the requirements of AWS C2.21 or as specified by the purchaser.

6.2 Air Compressors. An air compressor with sufficient volume and pressure is necessary to operate the abrasive blasting equipment and thermal spray equipment. See 8.1.1(2) for the ASTM D 4258 and D 4259 surface preparation guidance. About 150 ft³/min (4.3 m³/min) at 80–100 psi (0.55–0.70 MPa) is required.

6.3 Air Dryers. An air dryer with sufficient capacity to support the blasting and thermal spraying air quality and air volume rate. ASTM D 4285, Method for Indicating Oil or Water in Compressed Air, gives the method for measuring the air quality.

7. Inspection and Quality Control Equipment

7.1 Surface Preparation. The QC equipment for surface preparation should include the following:
(1) For Blasting Media Contamination:
(a) Small glass or plastic container (4–6 oz vol. [120–180 ml]) with tops for qualitative oil-contamination test of the blasting media and the abrasive blasting system.
(b) Clean white cloth squares to collect and qualitatively detect moisture and contamination in the compressed air.

(2) For Concrete Surface Finish and Exposed Aggregate (in impressed current CP systems):

---

Figure 2—TSC Bend Test Pass and Fail Samples
(a) The concrete surface shall be free of oil, grease, dirt, moisture, and loose material with minimum areas of coarse aggregate exposed.

(b) Establish a job specific Pass/Fail Job Reference Standard for concrete-cleanness agreed to by the purchaser and contractor. Use the approved blasting media and blasting equipment and blasting parameters for making the Pass/Fail Job Reference Standard. This Job Reference Standard must meet the contract specifications and should be established on a concrete surface of the job or representative of the job. Record the pertinent technical parameters to include the enclosure temperature and humidity and the blasting media, equipment and blasting parameters. The Job Reference Standard must be representative of the allowable variations of the environmental, surface preparation, and thermal spraying conditions.

(3) For Rebar Surface Finish and Profile (in sacrificial CP systems):

(a) The rebar shall have a minimum near-white metal finish (refer to SSPC SP 10/NACE 2-2000) and an angular profile. Use SSPC-VIS 1 to evaluate the near-white SSPC SP 10 finish.

(b) The angular profile depth shall be that which is created when blasting to meet the concrete surface preparation requirement. IMPORTANT NOTE: Do not blast to profile the steel rebar as this will remove “good” concrete.

(c) Establish a job specific Pass/Fail Job Reference Standard for rebar cleanliness and profile agreed to by the purchaser and contractor. Use approved blasting media, equipment, and blasting parameters. This reference standard must meet the contract specifications and should be established on a concrete rebar of the job or representative of the job. Record the pertinent technical parameters to include the enclosure temperature and humidity and the blasting media, equipment, and blasting parameters. The Job Reference Standard must be representative of the allowable variations of the environmental, surface preparation, and thermal spraying conditions.

(d) Measure the profile depth according to NACE Standard RP0287 or ASTM D 4417, Method C (replica tape, x-coarse, 1.5–4.5 mils (38–113 m), or Method B (profile depth gauge), or both.

7.2 Zinc Thermal Spray Coating on Concrete. The QC equipment for thermal spraying should include the following:

(1) Substrate Temperature. Contact thermometer or infrared pyrometer to measure substrate temperature.

(2) Air Temperature, Dew Point, and Relative Humidity. Psychrometer or equivalent digital humidity measurement instrument to measure air temperature, dew point, and relative humidity.

(3) Zinc Thermal Spray Coating Thickness on Concrete. The thickness may be measured:

(a) In-place directly on the concrete with portable eddy current instruments per schedule specified by the contract (see Table 1). The instrument shall be calibrated with thickness reference standards. Three reference standards should be prepared:

(i) The contract specified thickness.

(ii) The contract specified thickness minus 0.004 in. (100 m).

(iii) The contract specified thickness plus 0.004 in. (100 m).

(b) Duct tape or metal “companion coupons” attached to the concrete surface to be sprayed.

(i) For duct tape thickness measurements:

1. Remove the duct tape with the sprayed zinc thermal spray coating.

2. Remove the sprayed zinc thermal spray coating from the duct tape.

3. Measure the zinc thermal spray coating with a caliper or micrometer.

4. Assure that the duct tape does not leave residual contamination on the substrate from the heat of thermal spraying.

5. The non-coated area under the duct tape should receive a flash coat of zinc after removal of the duct tape to maintain the cosmetic appearance of the overall zinc coating.

(ii) For metal coupon thickness measurements:

1. Measure thickness with calipers or micrometers.

2. Magnetic thickness measurement instruments may be used for steel coupons. Routinely calibrate magnetic instruments with secondary thickness standards.

3. The non-coated area under the coupon should receive a flash coat of zinc after removal of the coupon to maintain the cosmetic appearance of the overall zinc coating.

(4) Zinc Thermal Spray Coating Thickness on Exposed Rebar (for sacrificial CP). Measure the zinc thermal spray coating thickness in accordance with SSPC-PA 2 using either a Type 1 magnetic pull-off gage or a Type 2 electronic fixed probe gage. Routinely calibrate instruments with thickness standards.

(5) In-Place Zinc Thermal Spray Coating Tensile Bond Strength on Concrete. Measure the in-place zinc thermal spray coating tensile bond strength on concrete in accordance with ASTM D 4541. The minimum tensile bond shall meet the requirements of the purchaser. The precision and bias of the portable adhesion tester, the test method, and the interpretation of results shall be as agreed by the purchaser and contractor.
8. Application-Process Method

The application-process method is shown in Figure 1. The in-process quality-control checkpoints are listed in Annex I.

8.1 Surface Preparation. Surface preparation of the concrete and the exposed rebar is necessary for application of the zinc thermal spray coating. Clean the surface of the concrete per ASTM D 4258 practice for removing grease, dirt, and loose material. Use the abrasive blast cleaning procedure of ASTM D 4259 practice for abrading concrete. The essential elements of ASTM D 4258 and D 4259, expanded for the preparation of reinforced concrete for zinc thermal spray coating, follow in 8.1.1.

### SAFETY PRECAUTION

The selection and use of abrasive blasting media must comply with appropriate government environment safety and pollution control requirements. Review and adhere to the local government compliance requirements for the use, control, and disposal of abrasive blasting media.

8.1.1 Concrete. Prepare the concrete surface by light abrasive blasting to remove all surface debris and contamination (oil, grease, dirt, and loose material), and other material that could degrade the bond of the zinc thermal spray coating to the prepared concrete. Note: Heavy oil or grease contamination may have to be removed by detergent cleaning, water rinsing and drying prior to abrasive blast cleaning.

1. Patched concrete areas shall have a cure period specified by the purchaser. Allow for a cure period prior to abrasive blasting for thermal spraying.
2. Use blasting media and blasting equipment capable of delivering clean dry air at pressures and flow rates necessary to meet the purchaser's surface preparation requirements and demonstrated in the pre-contract award validation (see 4.7). Note: Conventional pressure-pot air blast cleaning may use an airflow rate of 150 ft³/min (4.3 m³/min) at 80–100 lb/in.² (0.55–0.70 MPa) pressure at the nozzle with a standoff blasting nozzle of approximately 3–4 ft (1–1.2 m) from the surface.
3. Remove all dust and loosely adherent material from the blasted concrete surface by sweeping, air blowing, or vacuuming.

8.2.2 Thermal Spray Equipment Setup

1. Set up, adjust, and operate the thermal spray equipment per the manufacturer's instructions and technical manuals or the contractor's validated thermal spray parameters.
(2) Use the bend test to validate proper equipment setup and spraying parameters. Use the proper mandrel diameter for the purchaser’s specified zinc thermal spray coating thickness.

(3) Attach a copy of the spray parameters used to the Job Control Record.

### 8.2.3 Post-Blasting Substrate Condition and Thermal Spraying Period

#### 8.2.3.1 Concrete Surface Temperature and Cleanliness

(1) Concrete surface temperature shall be measured/confirmed with a contact pyrometer to be 5°F (3°C) above the dew point.

(2) Spraying shall not be conducted during periods of rain or high winds unless the operation is carried out in a protected area or inside an enclosure. Do not spray on concrete surfaces that are moist or wet.

(3) It may be necessary to dry the concrete surface by air blowdown or heating to achieve the bond strength requirements of the contract. The drying method should be validated with the Job Reference Standard per 4.2. **Caution should be exercised not to damage the concrete.**

(4) Maintain surface cleanliness: no oil, grease, dirt, moisture, or loose material on the concrete surface.

#### 8.2.3.2 Holding Period. Thermal spray coatings should be applied as soon as possible after surface preparation to minimize oxidation and contamination of the prepared surface. The permissible holding period between *start final blasting for surface preparation and completion of thermal spraying* shall be agreed to by the purchaser and contractor. The holding period depends on the moisture content of the concrete, and the temperature-humidity conditions that prevent moisture on the concrete surface and rusting of the rebar. The tensile bond will be reduced by surface moisture, high humidity, and long exposure time prior to coating. In low-humidity environments or in enclosed spaces using dehumidification equipment, it will be possible to prevent or to retard surface moisture and extend the holding period on the concrete and before flash rusting of the exposed rebar.

#### 8.2.3.3 Low Temperature Environments. Thermal spraying in low temperature environments (<40°F [4°C]) must be qualified with statistically valid in-place tensile bond strength tests. The average of the tests should be above the minimum acceptable tensile bond strength. The range of the test strength cannot exceed a 3 sigma variation from the mean (average).

### 8.2.4 Plan the Thermal Spraying Sequence

#### 8.2.4.1 Spraying Time Interval. Thermal spraying should start as soon as possible after the final blasting. Complete the thermal spraying on:

(1) Concrete without exposed rebar within 16 hours after start of final blasting for surface preparation subject to the holding period established in 8.2.3.2.

(2) On concrete with exposed rebar; within the holding period established in 8.2.3.2.

#### 8.2.4.2 Plan the Spraying. Inspect the surface geometry of the item or area to be sprayed. Plan the spraying pass or sequence to:

(1) Maintain the gun as close to perpendicular as possible and within ±45° of the perpendicular to the substrate.

(2) Use the manufacturer’s recommended standoff distance for the air cap installed or the contractor’s revisions thereto. See Table 4 for nominal standoff and spray-pass width values obtained from equipment manufacturers.

### 8.2.5 Execute Thermal Spraying Sequence

**PROCESS PRECAUTION**

The heat transferred to the concrete in spraying zinc, may vaporize residual moisture near the surface of the concrete. This vaporized moisture will blister or delaminate the zinc TSC from the concrete.

---

**Table 4**

<table>
<thead>
<tr>
<th>Flame- and Arc-Spray Standoff Distances and Spray-Pass Widths (Nominal)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perpendicular Standoff in. (mm)</strong></td>
</tr>
<tr>
<td>------------------------------------</td>
</tr>
<tr>
<td><strong>Air Cap</strong></td>
</tr>
<tr>
<td>Flame Wire</td>
</tr>
<tr>
<td>Arc Wire</td>
</tr>
</tbody>
</table>
SAFETY PRECAUTION

Remove or protect flammable material from the heat of the arc- or flame-spray gun in the work area. Keep adequate fire extinguishers available for use by the thermal spray operator and equipment tender during thermal spraying.

1. **Start-up and adjustment of the spray gun** should not be made on the work piece (or surface to be thermal sprayed). Do not allow any non-validated spray coating on the prepared surface to be thermal sprayed.

2. **Apply the specified coating thickness** in several perpendicular and overlapping passes.

   *Note 1.* For manual spraying, use crossing passes to minimize the occurrence of thin spots in the coating.

   *Note 2.* For mechanized spraying, programmed overlapping and crossing passes shall be used to eliminate the occurrence of thin spots and stay within the coating thickness specification.

   *Note 3.* For manual and mechanized spraying, validate the spraying procedure or the spraying program with thickness measurements, bend tests, or both.

3. Complete the spraying within the holding period of 8.2.3.2.

4. When spraying zinc for an impressed current CP system, continuously monitor for short circuits between the zinc thermal spray coating and the rebar. Shut down and eliminate the short circuit if a short circuit occurs.

### 8.2.6 Thickness and Tensile Bond Strength Measurements

#### 8.2.6.1 Thickness Measurement.
Measure the thermal spray coating thickness in locations and at a frequency specified by the purchaser. 7.2(3) details how thickness is measured.

#### 8.2.6.2 Tensile Bond Strength Measurement.
Measure the zinc thermal spray coating tensile bond strength to concrete in accordance with 7.2(5). Make tensile bond strength measurements in accordance with the purchaser’s criteria and sampling schedule per Table 1.

#### 8.2.7 Degraded Zinc Thermal Spray Coating.
If dust, dirt or debris accumulates on the concrete (for impressed current system), and rust appears on the exposed rebar (for sacrificial system), proceed as follows:

1. Stop spraying.
2. Mark off the acceptable sprayed area.
3. Call the thermal spray coating inspector to observe and evaluate the cause and magnitude of the error, notify the purchaser or his agent, and record the actions taken to resume the job in the Job Control Record.

### 9. Repair of Zinc Thermal Spray Coating on Reinforced Concrete

Figure 3 illustrates the process for repairing degraded zinc thermal spray coating. The repair of degraded zinc thermal spray coating on concrete and concrete with exposed rebar, e.g., excessive oxidation, delamination,
blistering, peeling, cuts through the coating, and loss of coating shall include the following:

1. Remove all degraded zinc thermal spray coating by scraping or strip blasting or both. Remove all degraded zinc thermal spray coating prior to the final surface preparation for thermal spraying per 8.1.

2. Prepare concrete and rebar for thermal spraying per 8.1.

3. Apply zinc thermal spray coating per 8.2.

4. Inspect zinc thermal spray coating thickness and bond of the repaired area for conformance to Table 1 or the purchaser's specifications.

10. Records

The contractor should use a Job Control Record to record the production and QC information required by the purchaser or the purchasing contract. Additionally, the contractor should have its own Quality Assurance Program and a Job Control Record to record all pertinent information. Use the Annex I Job Control Record to record the major planning, production, and QC items and actions.

The contractor shall keep records for a time period consistent with the contractor’s quality assurance and records program and as required for regulatory compliance and the purchasing contract.

11. Debris Containment and Control

The purchaser shall specify the requirements, responsibilities, and actions for the containment, collection, and removal of the debris produced by the contractor and its subcontractors.

12. Utility Services

List the utility services and the period of time they are required for use by the contractor. These may be provided by the purchaser.

13. Work Procedures and Safety

The purchaser shall provide standard operating and safety procedures, and regulatory compliance requirements to the contractor. The contractor should follow all appropriate procedures and meet all appropriate requirements.
Mandatory Annex

Annex I

Sample Job Control Record for Applying Zinc Thermal Spray Coating on Concrete

(This Annex is a part of AWS C2.20/C2.20M:2002, Specification for Thermal Spraying Zinc Anodes on Steel Reinforced Concrete, and includes mandatory requirements for use with this standard.)

Date ________________________________ JCR No. ________________________________

(1a) **Thermal Spray Contractor** Name ________________________________ Tel. __________________
    Address _______________________________________________________ Fax ____________________

(1b) Job Control or Identification No. ___________________________________

(1c) Point of Contact ________________________________________________

(2a) **Purchaser** Name _______________________________________________ Tel. __________________
    Address _______________________________________________________ Fax ____________________

(2b) Completion Date __________________________ (2c) Contact Person ____________________________

(2d) **Job Description** ________________________________________________

(3) **Zinc TSC Feedstock, Thickness, Tensile Bond Strength, and Measurement Requirements**

(3a) Feedstock Material Certification ______ Manufacturer ________ Heat/Control No. _______

<table>
<thead>
<tr>
<th>Wire Diameter</th>
<th>TSC Thickness/Pass</th>
<th>Total TSC Thickness</th>
<th>Tensile Bond Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Customary</td>
<td>in.</td>
<td>in.</td>
<td>in.</td>
</tr>
<tr>
<td>Metric</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
</tr>
</tbody>
</table>

(Attach Material Safety Data Sheet [MSDS] to the Job’s first Job Control Record)

(3b) Sampling Schedule ________________________________________________

(4) **Safety Precautions** ________________________________________________

__________________________________________________________________________
(5) **Surface Preparation Media and Parameters**

Mfg./Type/Model Pressure Pot Blasting Equipment

<table>
<thead>
<tr>
<th>Media</th>
<th>Size Range</th>
<th>Nozzle Diameter and Pressure</th>
<th>Air Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Customary</td>
<td>mesh in. lb/in.² ft³/min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metric</td>
<td>mesh mm kPa m³/min</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Attach media certification and MSDS to the Job’s first Job Control Record)

(6) **Flame-Spray Equipment and Parameters**

Mfg. ____________________________ Air Cap ____________________________

<table>
<thead>
<tr>
<th>Atomizing Air</th>
<th>Perpendicular Standoff*</th>
<th>Gun Travel Speed</th>
<th>Spray Pass Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Customary</td>
<td>lb/in.² in. in./sec in.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metric</td>
<td>MPa cm cm/sec cm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*To substrate.

(7) **Arc-Spray Equipment and Parameters**

Mfg. _____________ Rectifier Type______ Air Cap ____________ Current (A) _______ Voltage (V) _______

<table>
<thead>
<tr>
<th>Atomizing Air</th>
<th>Perpendicular Standoff*</th>
<th>Gun Travel Speed</th>
<th>Spray Pass Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Customary</td>
<td>lb/in.² in. in./sec in.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metric</td>
<td>MPa cm cm/sec cm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*To substrate.

(8) **Thermal Spray Operator**

Name___________________________________ Employee No. (ID) _______

Last Date Qualified to AWS C2.20/C2.20M:2002 ___________________________________________________

Qualification Test Tensile Bond Strengths (Five qualification samples)

<table>
<thead>
<tr>
<th>Average lb/in.² (MPa)</th>
<th>Maximum lb/in.² (MPa)</th>
<th>Minimum lb/in.² (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>______________________</td>
<td>______________________</td>
<td>______________________</td>
</tr>
</tbody>
</table>

(9) **Notes/Remarks**

Conversion factors for metric 1 lb/in.² = 0.69 kPa; 1 in. = 25.4 mm.
### Quality Control Check Points Made During Production per Section 7

<table>
<thead>
<tr>
<th>QC CP No.</th>
<th>Action</th>
<th>Value Req’d</th>
<th>Value Measured</th>
<th>Pass Fail</th>
<th>Date Time</th>
<th>Inspector Initials</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surface Preparation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td><strong>Clean Dry Air</strong> (per ASTM D 4285). Vent air into dry container for 1 min</td>
<td>None</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vent air through clean white cloth for 1 min. Any wetting or staining indicates contamination. Correct deficiency before going further.</td>
<td>None</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><strong>Clean Blasting Media</strong></td>
<td>None</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Visually inspect for absence of:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) Fines and contamination.</td>
<td>None</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2) Oil contamination per test with distilled water</td>
<td>None</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) Fill a small clean bottle (4–6 oz [120–180 ml]) half full of abrasive particles.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) Fill the remainder of the bottle with distilled water.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c) Cap and shake the bottle. Inspect water for oil sheen. If any oil sheen is observed, do not use the blasting media.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(3) If contaminated, clean the blasting equipment, especially the pot and hoses, then replace with blasting media and retest.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><strong>Clean Concrete</strong></td>
<td>None</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) Absence of dust, debris, oil, and grease.</td>
<td>None</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td><strong>Clean Concrete and Near-White Metal-Finish Rebar</strong></td>
<td>SSPC SP-10</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(1) Absence of rust, debris, and contamination.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(2) Pass the <strong>Pass/Fail Job Reference Standard of 7.1(2)(b)</strong>.</td>
<td>Pass</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td><strong>Thermal Spray Equipment Setup</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) Validate parameter settings and attach to Job Control Record.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(2) Observe successful surface preparation and <strong>bend test</strong> at each shift or crew change.</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>(3) Retain bend coupon with the Job Control Record file or as specified by the contract.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QC CP No.</td>
<td>Action</td>
<td>Value Req'd</td>
<td>Value Measured</td>
<td>Pass Fail</td>
<td>Date</td>
<td>Inspector Initials</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------------------------</td>
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</tr>
<tr>
<td>6</td>
<td>Zinc Thermal Spray Coating Application</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Observe the surface preparation, spraying set-up,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>concrete preheating, and thermal spraying process</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>for conformance to Section 8. Measure and record*:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Zinc TSC thickness/pass ________________________</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total thickness _____________________________</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Zinc TSC Thickness Measurement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) Per purchaser’s sampling schedule*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2) Check method used and value:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Eddy current instrument ________________________</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Companion duct tape ___________________________</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Companion steel coupon _________________________</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Tensile Bond Strength Measurement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) Tensile bond strength per purchaser’s</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>sampling schedule.*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2) Make tensile bond measurements per 7.2(5).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Enter values specified in the contract.

**Notes/Remarks**

TSC Inspector Name (Stamp or Print) ____________________________ Date __________

TSC Operator Name (Print) ____________________________ Date __________
Nonmandatory Annexes

Annex A

Safety Information for Thermal Spraying

(This Annex is not a part of AWS C2.20/C2.20M:2002, Specification for Thermal Spraying Zinc Anodes on Steel Reinforced Concrete, but is included for informational purposes only.)

A1. General

Thermal spraying can be hazardous to health. Potential thermal-spraying hazards include exposure to vapors, dust, fumes, gases, noise (from the spray gun) and arc ultraviolet (UV) radiation. Additionally, improperly used thermal-spray equipment can create potential fire and explosion hazards from the fuel and carrier gases and a potential electrical shock hazard from the electrical and electronic equipment and charged wire spools. Follow proper safety precautions to minimize hazards. Operators should comply with the procedures in the safety references and the manufacturer’s technical manuals and the Material Safety Data Sheets.

Thermal spraying can be a completely safe process when performed by an operator who follows the recommended precautionary measures, has a proper understanding of thermal-spraying practices and has knowledge and skill in using thermal-spray equipment.

A1.1 Graphic Symbol Definition. This Safety Annex uses graphic symbols to alert the user to the presence of important operating instructions, safety considerations, and special instructions. These symbols (along with their definitions) are shown in Table A1.

A2. Abrasive Blasting and Thermal Spraying: Common Elements

Both abrasive blasting and thermal-spraying operations generate dust and fumes that may pose a respiratory hazard. Treat airborne metal dusts, finely divided solids, or their accumulations, as explosives. Use adequate ventilation in the thermal-spray work area and collect the overspray to minimize the danger of dust explosions and fires. In shop environments, wet, bag, and filter-cartridge collectors may be used to collect the fine overspray particles thus minimizing the explosion and fire hazard and release of controlled and hazardous materials. Keep bag-and filter-cartridge-collector units at least 50 ft [15 m] away from the spraying area to preclude ignition from the flame or heat of thermal-spray guns.

Fieldwork may require partial or complete containment of the work site for surface preparation and thermal spraying and the collection and safe disposal of the used blasting media and thermal-spray overspray. Ensure compliance with the purchaser’s and government agency requirements for air-quality and hazardous-materials control.

Wear appropriate personal respiratory protection during abrasive blasting, thermal spraying, and paint sealing operations. If operator discomfort such as dizziness or nausea develops, stop the operation. Determine the cause of the discomfort and correct before resuming operations.

When abrasive blasting, use a NIOSH certified Type CE respirator and Type CE hood (air line supplied-air hood with faceplate and devices to protect the wearer’s eyes, face, chin, neck, shoulders, and upper body from rebounding abrasive blasting media). Respirators selected from those currently approved and certified by NIOSH/MSHA Section 134,2 should be used. Personnel in or near blasting operations

1. This information is a synthesis of safety information from AWS thermal-spray standards and from Sulzer Metco technical manuals.

2. Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.
should wear helmets, hand shields, face shields, or goggles conforming to ANSI Z87.1, *Occupational and Educational Eye Protection*; eye protection conforming to ANSI Z89.1, *Protective Headwear for Industrial Workers*.

Noise levels generated in blasting and thermal-spray operations can cause temporary or permanent hearing damage and fatigue. Wear earmuffs and properly fitted earplugs when thermal-spray operators and personnel are in the immediate vicinity of thermal-spray operations to reduce the high intensity noise levels to acceptable conditions.

### A3. Thermal Spraying

#### A3.1 Use of Equipment

Follow the safety measures outlined below:

- Read, understand, and follow the safety and operation instructions provided in the instruction manuals.
- Do not operate equipment above recommended pressures and flows.
- Thermal-spray equipment has been expressly designed for thermal spraying. Never use it for any other purpose (such as welding, soldering or brazing).
- Keep hands and other parts of the body away from hot surfaces and objects. Sprayed metal and surfaces are hot.
- Use only spare parts recommended by the equipment manufacturer to preclude safety hazards.

#### A3.1.1 Equipment Handling

Operate and maintain the thermal-spray equipment in accordance with the manufacturer’s instruction manual.

The extremely hot conditions of thermal-spray operations require additional precautions such as not pointing the thermal-spray gun at any person, or at any combustible and explosive material. Remove paper, wood, oily rags, cleaning solvents, sealers, and paints away from the thermal-spraying area.

Be especially careful not to spray on the hoses, when operating the gun. Hoses will burn. Keep them out of the way. All air lines, compressors, regulators, etc., should be inspected regularly for leaks and loose connections.

Do not light flame-wire and rod guns without wire or rod in the nozzle as flames may shoot back into the gun causing operator injury and equipment damage. Use a friction lighter to light the flame gun; never use matches.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
<th>Symbol</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>!</td>
<td>Special instructions, safety instructions, etc. are being presented.</td>
<td>!</td>
<td>Ear protection must be worn.</td>
</tr>
<tr>
<td>!</td>
<td>Explosive material is present.</td>
<td>!</td>
<td>Eye protection must be worn.</td>
</tr>
<tr>
<td>!</td>
<td>Inflammable material or high temperature is present.</td>
<td>!</td>
<td>Safety gloves must be worn.</td>
</tr>
<tr>
<td>!</td>
<td>Danger: risk of electrical shock.</td>
<td>!</td>
<td>Safety overalls must be worn.</td>
</tr>
<tr>
<td>![Respiratory Equipment]</td>
<td>Respiratory equipment must be worn.</td>
<td>![Magnetic fields]</td>
<td>Magnetic fields from high currents can affect pacemaker operation. Persons wearing electronic life support equipment (Pacemaker) should consult with their doctor before going near spray equipment.</td>
</tr>
</tbody>
</table>
A4. Fine Particulates (Metal Dust) from Thermal Spraying

All dust having considerable calorific value can be explosive. This dust includes: flour, starch, hard rubber dust, wood flour, aluminum dust, and dust of other metals.

The basic safety rules for thermal-spraying include:

(1) Facility and Equipment Design and Installation

(a) Use adequate ventilation in spray booths and other confined spaces to prevent the accumulation of fumes and metal dust.

(b) All closed collectors should be provided with blowout holes or relief panels. All fans, pipes, dust arrestors, and motor should be external to the duct system.

(c) Use explosion-proof electrical components in the metal-dust environment.

(d) Minimize and dissipate the generation of static electricity to avoid spark discharge by bonding and grounding equipment as necessary.

(2) Operations and Maintenance

(a) Read, understand, and follow the equipment manufacturer’s safety instructions for arc spraying aluminum and zinc.

(b) All precautions and instructions on the feedstock Materials Safety Data Sheet.

(c) Avoid any action that generate sparks or flames, or otherwise result in reaching the ignition energy or temperature. This includes NO SMOKING.

(d) Prior to cleaning the metal dust collection system, turn off the power and “red-tag” electrical boxes and cabinets.

(e) Non-sparking tools should be used in cleaning and repair operations.

(f) When making repairs on the ventilating or dust collecting equipment, no welding or cutting should be done before the equipment is washed down and all metal dust removed.

Good housekeeping in the shop and work areas should always be maintained to assure proper storage of hazardous materials and to avoid accumulation of combustible materials and metal dusts, with particular attention given to inspecting for dust on beams, rafters, booth tops, and in-floor cracks.

A4.1 Aluminum and Zinc Powder Feedstock. Uncontrolled aluminum and zinc powder is a combustion and explosion hazard (from suspended fine aluminum or zinc dust). Thermal-spray aluminum and zinc powders, nominally 0.0016–0.0044 in. [40–110 \(\mu\)m] diameter, are not a combustion or explosive hazard when handled and used in accordance with powder manufacturer’s instructions. Refer to the Aluminum Association’s recommendations for the storage and handling of aluminum powder.\(^3\)

SAFETY PRECAUTION: The fine aluminum and zinc particulates (metal dust) produced in thermal spraying may be an extreme explosion hazard. Special precaution should be taken when arc spraying due to the higher spray rates concomitant with higher amounts of metal dust produced, especially if multiple arc-spray units are being used in the same work area. Do not use water to extinguish aluminum or zinc fires. Use dry sand or a Class D extinguisher.

A5. Ventilation During Thermal Spraying

(Consult Section 11.8 [Ventilation], AWS Thermal Spraying: Practice, Theory, and Application.)

A number of factors determine the amount of contamination to which the workman is exposed when performing blast and thermal-spray operations. These include the following:

(1) Volume of space in which the thermal spraying operation is to be done.

(2) Number of spray and grit blast operators.

(3) The evolution of hazardous fumes, gases, or dusts according to the abrasive used or material being sprayed.

(4) Heat generated by the spraying process.

(5) Presence of volatile solvents.

(6) All of the preceding factors should be considered in order to better protect the operators and to supply adequate ventilation to the spray area.

Local extraction or general ventilation systems, or both, should be used to control and remove toxic fumes, gases, and particulates from the work area. Local extractor systems can remove gases and particulates at the source permitting concurrent work activities and reducing the performance requirements of the general ventilation system.

Where thermal-spray operations are incidental to general operations, it is good practice to apply local exhaust ventilation to the spray areas. This prevents contamination of the general work area.

\(^3\) Recommendations for Storage and Handling of Aluminum Powder and Paste, TR-2, SGE/5M/12-86-4A. Available from the Aluminum Association, Inc., 900 19th Street NW, Washington, DC 20006.
Individual respiratory protective devices should be well maintained. They should not be transferred from one employee to another without being cleaned and disinfected. Refer to ANSI/ASC Z88.2 for cleansing and disinfecting. Forced-air respiratory devices require Grade D or better air per Compressed Gas Association, Commodity Specification for Air (CGA No. G-7.1).4

Mechanical ventilation is required in spraying and blasting operations that are performed in any enclosed, or partially enclosed space. Dust generated may rapidly fill any large tank, building, or semi-enclosed space.

The ventilation equipment for most field thermal-spray and blast operations consists of engine or motor driven portable extractors with flexible piping or ducts. When removing dust with portable exhausters, it is necessary to attach a dust collector to trap the dust and prevent contamination of the surrounding areas.

In shop environments, use wet (water wash), bag, or filter type collectors for gathering spray dust. Dust collectors should be replaced and ventilation duct kept clean before entrapped dust builds up to create an explosion hazard or seriously reduces the efficiency of the system.

Spray cabinets used for spraying small and medium size parts should be equipped with extraction ventilation, with a minimum air velocity of 400 ft/min [2 m/s] entering the collector hood. The spray equipment should be operated within the face area of the hood and directed into it. The design of the cabinet should be such that turbulent eddy currents are eliminated. Industrial Ventilation, published by the American Conference of Governmental Industrial Hygienists, should be consulted.5

Blasting rooms should be designed to be well lighted and adequately ventilated. Ventilation should provide down draft and longitudinal airflow with a velocity of 80–100 ft/min [0.4–0.5 m/s]. The blasting room should be equipped with a dust collecting system. Conform to local, state, and federal regulations for blast cleaning operations. Blasting waste should not be exhausted directly into the atmosphere.

Use of the blasting room for spraying is not good practice and should be avoided whenever possible. Spray dust will quickly clog most cloth dust collectors used in the blasting rooms. Moreover, when spraying in a blasting room, the dust collector system will require more frequent maintenance to prevent fire or explosion due to accumulation of metallic dust.

When ventilating confined spaces, all air replacing that withdrawn should be clean and respirable. Fans should be sized to give at least 10 complete air changes per minute.

If portable gasoline or diesel-engine driven ventilators or compressors are used, they should be located so that engine exhaust gases cannot be drawn into the ventilating system. This precaution will also prevent exhaust gases from entering the intake of the compressor. This is particularly critical if the air is to be used for respirators.

If dust collectors are used, closed type collectors should be provided with blowout holes or relief panels. Blowout panels should also be provided in ventilation piping.

All fans, pipes, dust arrestors, and motors should be grounded. Ground to piping that carries fuel gas or oxygen should not be used. Ventilating fans should be kept running when cleaning out booths, pipes, etc. This prevents the accumulation of dust or fumes in the system. Aluminum and magnesium dusts present an explosive hazard, which requires special attention. Adequate wet collector systems should be used on either of these metals. Care should be exercised, since these metallic dusts may generate hydrogen gas in water. These systems should be designed to prevent hydrogen accumulation. Frequent cleanout operations should be performed to reduce residues.

When spraying on unusually large objects or in large confined spaces, such as encountered in boilers and tanks, it is imperative that fresh air helmets and protective clothing be worn.

No welding or cutting should be done in the repair of any ventilation or dust collecting equipment unless the equipment has been thoroughly cleaned and accordingly inspected.

If there is any question as to the effectiveness of the ventilation and exhaust system or as to the presence of airborne particles that the operator might inhale, consult a competent industrial hygienist.

### A6. Hazardous Materials

All thermal-spray feedstock materials are supplied with a Material Safety Data Sheet. Never spray a material without reading, understanding, and following the precautions contained in the Material Safety Data Sheet.

Some materials (beryllium, tellurium and their oxides, for example) are very dangerous to the respiratory system and should not be used at all, except under the supervision of a competent industrial safety engineer.

Blasting, spraying, and finishing all produce dust. Blasting, spraying, and finishing should be considered

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4. CGA documents can be obtained from the Compressed Gas Association, Inc., 4221 Walney Road, 5th Floor, Chantilly, VA 20151-2923.

5. AIGHI documents can be obtained from the American Conference of Government Hygienists, 1330 Kemper Meadow Drive, Suite 600, Cincinnati, OH 95240-1634.
as hazardous as spraying these hazardous feedstock material.

The following materials are specifically listed because they are commonly sprayed. There are many other hazardous materials that are not listed because they are not commonly sprayed. Because standards change and new information becomes available from time to time, it is important to use and follow up-to-date Material Safety Data Sheets.

Current regulatory information should be obtained from national and local agencies and followed.

**A6.1 Lead, Lead Alloys, Cadmium, and Chromium.** The fumes of lead, lead alloys (such as solder and lead base babbitts), cadmium alloys, and chromium alloys are extremely hazardous. Consult an industrial hygienist for the proper protection.

**A6.2 Zinc and Zinc Alloys (Zinc, Bronzes, and Brasses).** Fumes of these metals are toxic. Consult an industrial hygienist for the proper protection.

**A6.3 Nickel and Nickel Components.** Fumes of nickel components are potentially hazardous. Consult an industrial hygienist for the proper protection. One known highly toxic compound is nickel carbonyl. Under certain conditions, nickel carbonyl can be formed by the combination of nickel and carbon monoxide.

**A6.4 Solvents and Gases.** Solvents used for cleaning or to apply sealers or topcoats (e.g., acetone, xylene, or alcohol) have vapors that are harmful and can be fatal. Use only with adequate ventilation or proper respiratory protection and other protective clothing as needed. Avoid breathing solvent vapors and skin contact with solvents. Most solvents are also flammable liquids. All solvent tanks should have lids and be covered when not in use. Take proper safety precautions. Keep all solvents and flammable materials at least 50 ft away from welding, oxyfuel cutting and heating, and thermal-spray operations.

Before beginning work, and specifically before opening any gas valve, make sure that there is adequate ventilation in the work area. Adequate ventilation depends on the specific work activity but should be calculated and verified by a safety professional if there is any doubt.

1. Examine all gas equipment regularly for leaks and loose connections. Replace defective parts as necessary.
2. Always secure gas cylinders to keep them from falling.
3. Keep gas cylinders in use away from the thermal-spray operation so that molten spray or flame will not reach them. Alternatively, provide fire resistant shields.
4. When not in use, shut off the gas, remove the regulators, and place valve caps on the cylinders.

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**A7. Personal Protection**

**A7.1 Respiratory Protection.** Consult the Thermal-spray Equipment Instruction Manual, Material Safety Data Sheet, and applicable national and local jurisdiction safety and health regulations (or local standards), before using spray materials.

During the spray process, a respirator approved by applicable national and local regulations should be worn at all times, to protect the operator from exposure to dust and fumes. Respirators should also be worn when product handling generates dust. Consult an industrial hygienist for the proper protection.

Individual respiratory protective devices should be well maintained. They should not be transferred from one employee to another without being cleaned and disinfected. Refer to ANSI/ASC Z88.2 for cleansing and disinfecting.

Forced air respiratory devices require Grade D or better air per Compressed Gas Association, *Commodity Specification for Air* (CGA No. G-7.1).

Any finely divided material may damage the respiratory system in varying degrees. Whenever fume concentration is high enough to cause operator discomfort (dizziness, nausea, etc.), stop spraying. Check the ventilating and exhaust systems and related equipment. If this equipment is not adequate and not operating properly, respirator equipment must be provided. If operator discomfort continues, even with the added protection, stop spraying and recheck all equipment. Do not resume spraying until all possibilities of discomfort have been eliminated.

In areas distant from spraying, where no respiratory protection seems needed, periodic air sampling is recommended.

Air samples should also be taken in the spray area after spraying has been stopped. Respiratory protection is not required when spraying is stopped and area is known to be free of harmful dust and fumes.

**A7.2 Body Protection.** Possible allergic reactions to dust, fumes and the like or other unknown causes of health impairment due to contact with the body cannot usually be predicted. To avoid such reaction, never allow spray dust to enter eyes, mouth, cuts, scratches, or open wounds. After spraying, and especially before eating or handling food, wash hands thoroughly. Wear fireproof or flame-resistant protective clothing.

Wear flame-resistant clothing and leather or rubber gauntlets during thermal-spray operations to keep harmful flying particles and thermal-spray materials from skin contact. Aluminized clothing may be used with precau-
A7.3 Hearing Protection. The operator and other personnel close to the thermal-spray operation must be protected from excessive noise. If possible, the thermal-spray operation should be in an approved spray cabinet or room. Hearing protection (that meets local standards) should be used. Do not rely on wads of cotton for hearing protection. They are ineffective against high-intensity noise.

Noise levels at any location depend on such factors as equipment operating parameters; background noise; room size; and wall, floor, and ceiling materials. To determine the exact noise level, it is necessary to measure the sound level. The various spray guns can produce the noise levels as shown in Table A2.

A7.4 Eye Protection. Always wear proper eye protection when operating or watching the spray operation. Inspect the lens and cover plates frequently. Lenses and cover plates scratched, pitted, or damaged can impair vision and seriously reduce protection.

Infrared (IR), visible, and UV radiation from the various thermal-spray processes can cause eye and skin damage. When spraying, thermal-spray operators and personnel viewing the thermal-spray work should wear suitable eye protection: goggles, face shield, or goggles plus a face shield when it is required to lift the face shield during spraying. The recommended shade number for helmets and goggles are shown in Table A3.

Use opaque or arc-radiation protective screens suitable for attenuating the thermal spraying IR and UV radiation to protect personnel working outside the immediate thermal-spray work area and personnel passing nearby.

### Table A2
**Noise Levels Produced by Spray Guns**

<table>
<thead>
<tr>
<th>Thermal-Spray Process</th>
<th>Noise Level (dBA)</th>
<th>Minimum Recommended Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma</td>
<td>134</td>
<td>Earplugs and Earmuffs</td>
</tr>
<tr>
<td>High Velocity Oxygen Fuel (HVOF)</td>
<td>134</td>
<td>Earplugs and Earmuffs</td>
</tr>
<tr>
<td>Flame Powder</td>
<td>110</td>
<td>Earplugs</td>
</tr>
<tr>
<td>Flame Wire</td>
<td>125</td>
<td>Earplugs and Earmuffs</td>
</tr>
<tr>
<td>Arc Wire</td>
<td>116</td>
<td>Earplugs and Earmuffs</td>
</tr>
</tbody>
</table>

### Table A3
**Recommended Shade Numbers for Helmets and Goggles**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Shade Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire flame spraying</td>
<td>2–4</td>
</tr>
<tr>
<td>Powder flame spraying</td>
<td>3–6</td>
</tr>
<tr>
<td>Arc spraying with gun shield</td>
<td>3–6</td>
</tr>
<tr>
<td>Arc spraying without gun shield</td>
<td>9–12</td>
</tr>
<tr>
<td>Plasma spraying</td>
<td>9–12</td>
</tr>
</tbody>
</table>

A8. Electric Power Protection

Ensure that adequate power line capacity is provided to avoid electrical hazards.

If a line cord with a ground lead is provided with the equipment for connection to a switchbox, connect the ground lead to the grounded switchbox. If a cable plug is added for connection to a grounded mating receptacle, the ground lead must be connected to a safety ground. If the line cord comes with a three-pole plug, connect to a grounded mating receptacle. Never remove the ground from a plug or use a plug with a broken off ground prong.

The heat for spraying with an arc-spray gun is produced by an electric arc of extremely high intensity. This relatively large amount of electric power can be dangerous if handled carelessly.

The metallizing wires of the arc-spray gun are electrically energized when the gun is in operation. Anyone touching both energized wires at the same time could receive a harmful or fatal electric shock or burn. When the spray is shut off, electrical charge is removed from both metallizing wires.

A8.1 Cables. Frequently inspect cables for wear, cracks and damage. Immediately replace those with excessively worn or damaged insulation to avoid a possibly lethal shock from bare cable. Cables with damaged areas must be replaced.

Keep cables dry, free of oil and grease, and protected from hot metal and sparks. Do not walk on or drive vehicles over cables. Terminals, wire raceways, and other exposed parts of electrical units should have insulating covers secured before operation.

A8.2 Safety Devices. Safety devices such as interlocks and circuit breakers should not be disconnected or shunted out.
Before installation, inspection, or service of equipment, shut off all power and remove line fuse (or lock or red-tagged switches) to prevent accidental turning on of power.

Do not open power circuit or change polarity while spraying. If, in an emergency, it must be disconnected, guard against shock burns or flash switch arcing.

Before leaving equipment unattended, always shut off and disconnect all power from equipment.

A power disconnect switch must be available near the power source as required by code.

**A8.3 Protection For Wearers of Electronic Life Support Devices (Pacemakers).** Magnetic fields from high currents can affect Pacemaker operation. Persons wearing electronic life support equipment (Pacemaker) should consult with their doctor before going near thermal-spray equipment.

**A9. Fluorocarbon Material (O-Rings) Precautions**

Thermal-spray equipment manufacturers often specify the use of O-rings made of fluorocarbon synthetic rubber. This material provides a wide range of desirable properties, including high flame and heat resistance, resistance to compression-set, and broad chemical compatibility.

At elevated temperatures above 316°C (600°F), fluorocarbon material may degrade, emitting hydrogen fluoride fumes that, in the presence of water, may react to form highly corrosive hydrofluoric acid. This can cause severe burns on bare skin with delayed symptoms.

In normal operation of gas guns, gun O-ring temperatures are well below the 316°C (600°F) level at which fluorocarbon O-rings start to degrade. However, the excess heat that occurs in gas guns during prolonged backfire, and in plasma guns when nozzle burnout occurs may cause O-ring degradation.

**A9.1 Precautions.** A heat-degraded fluorocarbon O-ring will look charred or gummy and sticky. To avoid corrosive skin burns, observe the precautions given below:

1. Put on neoprene or PVC gloves before handling any part contaminated with heat-degraded fluorocarbon O-ring residue.
2. Wash the part thoroughly with soap and water. Fluorocarbon rubber manufacturers advise further neutralizing the part with limewater (calcium hydroxide solution).
3. Discard the gloves when finished.

**A9.2 First Aid.** If heat-degraded fluorocarbon rubber contacts bare skin, do the following immediately:

1. Wash skin thoroughly with soap and water.
2. Rub a 2.5% calcium gluconate gel into the skin until any existing irritation disappears. If irritation persists, consult a physician.

**A10. Disposal of Materials and Equipment**

Disposal of all equipment material and collected overspray shall be in accordance with local regulations. Some materials may be classified as hazardous. Follow local requirements and information on Material Safety Data Sheet.

Some guns may contain a small amount of oil. Drain oil and dispose of per local regulations.
Annex B

Guidelines for Preparation of Technical Inquiries for AWS Technical Committees

(This Annex is not a part of AWS C2.20/C2.20M:2002, Specification for Thermal Spraying Zinc Anodes on Steel Reinforced Concrete, but is included for informational purposes only.)

B1. Introduction

The AWS Board of Directors has adopted a policy whereby all official interpretations of AWS standards will be handled in a formal manner. Under that policy, all interpretations are made by the committee that is responsible for the standard. Official communication concerning an interpretation is through the AWS staff member who works with that committee. The policy requires that all requests for an interpretation be submitted in writing. Such requests will be handled as expeditiously as possible but due to the complexity of the work and the procedures that must be followed, some interpretations may require considerable time.

B2. Procedure

All inquiries must be directed to:

Managing Director, Technical Services
American Welding Society
550 N.W. LeJeune Road
Miami, FL 33126

All inquiries must contain the name, address, and affiliation of the inquirer, and they must provide enough information for the committee to fully understand the point of concern in the inquiry. Where that point is not clearly defined, the inquiry will be returned for clarification. For efficient handling, all inquiries should be type-written and should also be in the format used here.

B2.1 Scope. Each inquiry must address one single provision of the standard, unless the point of the inquiry involves two or more interrelated provisions. That provision must be identified in the scope of the inquiry, along with the edition of the standard that contains the provisions or that the Inquirer is addressing.

B2.2 Purpose of the Inquiry. The purpose of the inquiry must be stated in this portion of the inquiry. The purpose can be either to obtain an interpretation of a standard requirement, or to request the revision of a particular provision in the standard.

B2.3 Content of the Inquiry. The inquiry should be concise, yet complete, to enable the committee to quickly and fully understand the point of the inquiry. Sketches should be used when appropriate and all paragraphs, figures, and tables (or the Annex), which bear on the inquiry must be cited. If the point of the inquiry is to obtain a revision of the standard, the inquiry must provide technical justification for that revision.

B2.4 Proposed Reply. The inquirer should, as a proposed reply, state an interpretation of the provision that is the point of the inquiry, or the wording for a proposed revision, if that is what inquirer seeks.

B3. Interpretation of Provisions of the Standard

Interpretations of provisions of the standard are made by the relevant AWS Technical Committee. The secretary of the committee refers all inquiries to the chair of the particular subcommittee that has jurisdiction over the portion of the standard addressed by the inquiry. The subcommittee reviews the inquiry and the proposed reply to determine what the response to the inquiry should be. Following the subcommittee’s development of the response, the inquiry and the response are presented to the entire committee for review and approval.
by the committee, the interpretation will be an official interpretation of the Society, and the secretary will transmit the response to the inquirer and to the Welding Journal for publication.

B4. Publication of Interpretations

All official interpretations will appear in the Welding Journal.

B5. Telephone Inquiries

Telephone inquiries to AWS Headquarters concerning AWS standards should be limited to questions of a general nature or to matters directly related to the use of the standard. The Board of Directors’ policy requires that all AWS staff members respond to a telephone request for an official interpretation of any AWS standard with the information that such an interpretation can be obtained only through a written request. The Headquarters staff cannot provide consulting services. The staff can, however, refer a caller to any of those consultants whose names are on file at AWS Headquarters.

B6. The AWS Technical Committee

The activities of AWS Technical Committees in regard to interpretations are limited strictly to the Interpretation of provisions of standards prepared by the committee or to consideration of revisions to existing provisions on the basis of new data or technology. Neither the committee nor the staff is in a position to offer interpretive or consulting services on (1) specific engineering problems; or (2) requirements of standards applied to fabrication outside the scope of the document or points not specifically covered by the standard. In such cases, the inquirer should seek assistance from a competent engineer experienced in the particular field of interest.
## List of AWS Documents on Thermal Spraying

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<td>C2.15</td>
<td><em>Corrosion Tests of Flame Sprayed Coated Steel, 19-Year Report</em></td>
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For ordering information, contact Global Engineering Documents, an Information Services Handling (IHS) Group company, 15 Inverness Way East, Englewood, Colorado 80112-5776; telephones (800) 854-7179, (303) 397-7956; fax (303) 397-2740; Internet: www.global.ihs.com.