

METRIC

DOD-STD-2138(SH)
23 November 1981

MILITARY STANDARD

METAL SPRAYED COATING SYSTEMS FOR
CORROSION PROTECTION ABOARD NAVAL SHIPS

(METRIC)

NO DELIVERABLE DATA REQUIRED
BY THIS DOCUMENT

AREA MFFP

DOD-STD-2138(SH)

23 November 1981

DEPARTMENT OF DEFENSE

Washington, DC 20362

Metal Sprayed Coating Systems for
Corrosion Protection Aboard
Naval Ships

DOD-STD-2138(SH)

1. This Military Standard is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 3112, Department of the Navy, Washington, DC 20362 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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1. SCOPE

1.1 Scope. This standard covers the requirements for the use of metal sprayed coatings (aluminum and zinc) for corrosion-control applications aboard Naval surface ships. The requirements specified by this standard are applicable to wire-flame spraying of consumable coating material using oxygen-fuel gas, restricted use of electric arc spray, and powder metal spraying using oxygen-fuel gas for selected corrosion-control applications. This standard covers: certification of facilities, certification of operators, application procedures, metal-spray procedures, production quality assurance, test procedures, and records.

2. REFERENCED DOCUMENTS

2.1 Issues of documents. The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this standard to the extent specified herein.

SPECIFICATIONS

FEDERAL

- O-T-620 - 1,1,1-Trichloroethane, Technical Inhibited (Methyl Chloroform).
- BB-A-106 - Acetylene, Technical, Dissolved.
- BB-O-925 - Oxygen, Technical, Gas and Liquid.
- TT-T-548 - Toluene, Technical.

MILITARY

- MIL-M-3800 - Metallizing Outfits (Wire Gas), Guns and Accessories.
- MIL-W-6712 - Wire; Metallizing.
- MIL-P-23377 - Primer Coatings: Epoxy-Polyamide, Chemical and Solvent Resistant.
- MIL-P-24441 - Paint, Epoxy-Polyamide, General Specification for.
- MIL-P-24441/1 - Paint, Epoxy-Polyamide, Green Primer, Formula 150.
- MIL-P-24441/2 - Paint, Epoxy-Polyamide, Exterior Topcoat, Haze Gray, Formula 151.
- DOD-P-24555 - Paint, Aluminum, Heat-Resisting (650°C), Low-Emissivity (0.40 or Less) (Metric).
- MIL-M-80141 - Metallizing Outfits, Powder-Gas, Guns and Accessories.
- MIL-M-80226 - Metallizing System, Wire, Electric Arc, Guns and Accessories.
- MIL-P-83348 - Powder, Plasma Spray.

STANDARD

MILITARY

- MIL-STD-1687 - Metal Spray Processes for Naval Ship Machinery and Ordnance Applications.

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PUBLICATIONS

NAVAL SEA SYSTEMS COMMAND

NAVSEA S9086-VD-STM-000,
Chapter 631 - Preservation of Ships in Service (Surface
Preparation and Painting).

NAVSEA S9086-CH-STM-030,
Chapter 074, Volume 1 - Welding and Allied Processes.

NAVSEA S9086-CH-STM-030,
Chapter 074, Volume 3 - Gas Free Engineering.

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this standard to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

C 633 - Adhesion or Cohesive Strengths of Flame-Sprayed Coating,
Test Method for.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

AMERICAN WELDING SOCIETY (AWS)

A3.0 - Welding Terms and Definitions Including Terms for Brazing,
Soldering, Thermal Spraying, and Thermal Cutting.

C2.1 - Recommended Safe Practices for Thermal Spraying.

(Application for copies should be addressed to the American Welding Society, 2501 Northwest 7th Street, Miami, FL 33125.)

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC No. 5 - Volume 2, Section 2, White Metal Blast Cleaning.

(Application for copies should be addressed to the Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh, PA 15213.)

DEPARTMENT OF LABOR

Code of Federal Regulations, Title 29

Part 1910 - Occupational Safety and Health Standards.

(Application for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

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(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. DEFINITIONS

3.1 Thermal spraying terminology and definitions. Terminology and definitions used in the preparation of drawings, spraying procedures, specifications and correspondence related to thermal spraying shall conform to AWS A3.0.

3.2 Other definitions.

3.2.1 Acceptable. Complies with or conforms to the applicable standard or specification.

3.2.2 Approved (approval). The item under consideration has been sanctioned in writing by the Commander, Naval Sea Systems Command (NAVSEA) or his authorized agent.

3.2.3 Authorized agent. Any Government representative specifically authorized to approve equipment, materials, or procedures within the scope of this standard for NAVSEA. The authorized agent shall have appropriate training and experience to implement and evaluate inspection functions of this standard. They are as follows:

- (a) For Government shipyards: The delegated representative of the Shipyard Commander.
- (b) For commercial shipyards: The delegated representative of the Supervisor of Shipbuilding, Conversion and Repair.
- (c) NAVSSES: Naval Ship Systems Engineering Station Philadelphia is also authorized to provide field support for Naval activities.
- (d) For commercial activities other than shipyards: The delegated representative of the Defense Contract Administration Services Management Area (DCASMA).

3.2.4 Inspector. A contractor, Naval Shipyard, or Government agency employee designated to accept or reject materials or workmanship on the basis of the results of specified tests.

3.2.5 Certified. The item under consideration has been approved as required by this standard.

3.2.6 Procedure. A metal spray procedure is a written instruction which contains all the applicable essential elements listed in this document.

3.2.7 Application procedure. The method used to apply the metal sprayed coatings for corrosion control.

3.2.8 Blasting. A method of cleaning or surface roughening by a forcibly projected stream of sharp angular abrasive.

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3.2.9 Flame spraying. A metal spraying process wherein an oxygen-fuel gas flame is utilized as the source of heat for melting the coating material. Compressed air may or may not be used for atomizing and propelling the material to the work piece.

3.2.10 Electric arc spraying. A metal spraying process using an electric arc as a heat source between two consumable wires. Compressed air or inert gas is used to atomize and propel the molten material to the substrate.

3.2.11 Interface. The contact surface between the spray deposit and the substrate.

3.2.12 Masking. The method of protecting the areas adjacent to the areas to be thermal sprayed or blasted to prevent adherence of a coating or surface roughening.

3.2.13 Powder metal flame spraying. A method of metal spraying wherein the metal to be sprayed is in powder form.

3.2.14 Seal coat. Material applied to infiltrate the pores of a metal spray deposit.

3.2.15 Spalling. The flaking or separation of a sprayed coating.

3.2.16 Substrate. Any material upon which a coating of sprayed metal is deposited.

3.2.17 Metal spraying. A group of processes wherein finely divided metallic materials are deposited in a molten or semi-molten condition to form a coating. The coating material may be in the form of powder or wire.

3.2.18 Wire flame spraying. A method of metal spraying wherein the metallic material to be sprayed is originally in wire form.

4. GENERAL REQUIREMENTS

4.1 Safety precautions (personnel hazard). All personnel concerned with metal spraying shall become familiar with and follow the practices specified in AWS C2.1, NAVSEA S9086-CH-STM-030, Chapter 074, Volume 3, and NAVSEA S9086-VD-STM-000, Chapter 631. Safety and health requirements as specified in OSHA 29 CFR 1910 shall also be followed.

4.1.1 Cleaning solvents (toluene or trichloroethane). Shipping containers are marked to indicate dangerous or safety related items. These labels shall be read prior to using the solvent and the stated precautions followed in their use. The following safety precautions shall be followed when using toluene and trichloroethane:

- (a) Toluene vapor is flammable - keep away from heat, sparks, and open flame.

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- (b) Toluene and trichloroethane vapors are harmful and can be fatal --use only in adequate ventilation. Avoid prolonged breathing of vapor.
- (c) Avoid prolonged or repeated contact with skin.

4.1.2 Metal spray gases. NAVSEA S9086-CH-STM-030, Chapter 074, Volume 3 shall be used for guidance and the following safety precautions followed when using metal spray gases:

- (a) Inspect all gas equipment regularly for leaks and loose connections.
- (b) Charged gas cylinders are potentially dangerous. Keep cylinders away from heat. Always secure cylinders to keep them from toppling. Shut off gas and place valve caps on the cylinders when they are not in use.
- (c) Do not hang a metal spray gun on a regulator or cylinder valve. Provide for portable equipment storage or permanent work station.
- (d) Provide adequate ventilation of the work area before opening any of the gas valves. No container shall be presumed to be clean or safe until proven and certified safe by a Gas Free Engineer.
- (e) Never point a gas hose, air hose, or other pressurized item at any part of the human body, your own or others.

4.1.3 Blast cleaning. Safety precautions for abrasive blasting specified below and covered by NAVSEA S9086-VD-STM-000, Chapter 631 shall be followed.

- (a) If fire or explosion hazards are present, precautions shall be taken before any blast cleaning is initiated. If the structure previously contained flammable materials, it shall be purged of dangerous concentrations. Prior to commencing work, structure shall be certified safe by a Gas Free Engineer.
- (b) While blasting, face shields with dust hoods or helmets with forced fed purified air shall be used to protect the eyes, face, chin, and neck from airborne particles.
- (c) Safety glasses or goggles shall be worn by all persons near any blasting operation.
- (d) Blast hose shall be grounded to dissipate static charges.
- (e) Never point a blast nozzle at any part of the human body, your own or others.

4.1.4 Wire spray gun. Safety precautions for wire spray guns are as follows:

- (a) Wire spray guns shall be maintained in accordance with the manufacturer's recommendations.
- (b) Do not light the gun without having the wire in the nozzle. Without the wire in the gun, the flame can shoot back through the front wire guide, damaging the nozzle, guide, drive rolls, and causing injury to the operator.

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- (c) Do not use matches for lighting wire spray guns because hand burns may result. Use a friction lighter, a pilot light, or arc ignition.

4.1.5 Reduction of respiratory hazards. The following safety precautions shall be followed in order to reduce respiratory hazards:

- (a) Use of a wet spray booth with a positive exhaust system shall be used on board Navy ships and other closed areas to avoid the toxic or irritating effects of dust, fumes, and mists generated by metal spraying. Work stations shall have adequate air flow and safe breathing apparatus (see 5.2.1) in accordance with NAVSEA S9086-VD-STM-000, Chapter 631 and AWS C2.1.
- (b) Breathing zinc or aluminum dust may damage the respiratory system. If signs of operator discomfort develop (i.e., dizziness or nausea), stop spraying at once and determine if the ventilating and exhaust systems are working properly before resuming the spraying operation.

4.1.6 Personal protection. The following safety precautions shall be followed for personal protection:

- (a) Never permit spray dust to enter the eyes, mouth, cuts, scratches, or open wounds. After spraying, and especially before eating or handling food, wash hands thoroughly.
- (b) Finely divided metallic airborne particles can be hazardous from an explosive standpoint and partially wet metal dust creates a hazard of spontaneous combustion. For spraying in enclosed or internal spaces, see 4.4.5, category III.

4.1.7 Protective clothing. Flame-resistant clothing shall be used and leather or rubber gauntlets shall be worn. Clothing shall be strapped tightly around the wrists and ankles to keep dusts from harmful metal sprayed materials and abrasives away from the skin.

4.1.8 Reduction of noise hazard. Hearing protectors or properly fitted soft rubber ear plugs shall be used. Wads of cotton for hearing protection shall not be used since they do not protect against high intensity noise.

4.1.9 Eye and respiratory protection. Eye and respiratory protection shall be as follows:

- (a) Helmets, face shields, or goggles shall be used to protect the eyes during all metal spraying or blasting operations. It may be necessary for metal sprayers or blasters to use goggles at all times for protection against radiation or airborne particles from adjacent operations. Attendants or helpers shall be provided with proper eye protection.

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- (b) While metal spraying, the helmet, face shield, or goggles shall be equipped with a suitable filter plate as required by NAVSEA S9086-CH-STM-030, Chapter 074, Volume 1 to protect the eyes from excessive infrared (as well as intense visible light) radiation. The following is a guide for the selection of the proper shade number:
 - (1) Wire flame spraying - Shades 2-4
 - (2) Metal spraying of powder - Shades 3-6
- (c) When metal spraying in the open, or where ventilation is adequate to eliminate the need for additional respiratory protection, properly shaded goggles only shall be worn. These shall be of the eyecup type, fitted with lenses of about 50 millimeters (mm) in diameter, or the coverup type for those wearing corrective spectacles.
- (d) The goggles shall have indirect ventilating fins to eliminate the danger from airborne particles and to reduce fogging.
- (e) While blasting, face shields or abrasive blasting helmets equipped with dust hoods shall be used to protect the eyes, face, chin, and neck from airborne particles.

4.1.10 Compressed air. The following safety precautions shall be followed when using compressed air:

- (a) Compressed air shall not be used to clean clothing.
- (b) Compressed air for metal spraying or blasting operations shall be used at pressures recommended by the equipment manufacturers.
- (c) Compressed air shall be clean and free of oil, moisture, and other contamination for blasting and metal spraying.

4.2 Equipment.

4.2.1 Abrasive blasting system.

4.2.1.1 Blasting equipment. There are three types of blasting equipment that may be used depending on the application, and as specified (see 6.4):

- (a) Type I - Pressure blasting machines (blast generators).
- (b) Type II - Suction blast cabinets and portable units.
- (c) Type III - Centrifugal blast equipment.

4.2.1.1.1 Type I shall be used for large area work where the blasting is done by hand. Type I shall also be used for production jobs. The nozzles may be set in any desired position. Open blast and recirculating chamber equipment are examples of type I systems.

4.2.1.1.2 Type II is less efficient than type I but may be used for small odd lot and production work that can be handled in cabinets or portable units.

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4.2.1.1.3 Type III is highly efficient for blasting large volume production work. The grit is thrown out in a fan from a large rotating wheel. For this reason the work shall be brought in front of the wheel or wheels and rotated so as to blast all sides. Type III is only practical for a limited class of work. Additional information can be obtained from NAVSEA S9086-VD-STM-000, Chapter 631.

4.2.1.2 Air equipment. The air equipment used in the abrasive blasting process shall furnish air which is free of oil and moisture (less than 0.03 parts per million (p/m) oil). The air supply shall be adequate to maintain a minimum pressure of 520 kilopascals (kPa) (75 pounds per square inch (lb/in²)) at the blast generator for angular chilled iron grit and a minimum of 350 kPa (50 lb/in²) at the blast generator for aluminum oxide grit.

4.2.2 Spraying system (see 6.4).

4.2.2.1 Wire oxygen-fuel gas spray system. A wire-feed metal spray system shall consist of a source of compressed air, air drying unit, air receiver, gas control unit, oxygen, fuel gas, a reel to hold the feed wire, gages and valves to control air flow, gas mixture and flow, and the spray gun itself. A typical metal spray system is shown in figure 1. A typical metal spray gun is shown in figure 2. The metallizing outfits shall meet the requirements for either class 8 or 10 of MIL-M-3800, except class 10 shall be for use with 0.8 through 5.0 mm (0.032 through 3/16 inch) diameter wire having a melting point up to and including 2600°C (4700°F). The guns shall be equipped with an air turbine or an air motor wire drive mechanism and shall have a performance capability equal to or in excess of the spraying rate requirements specified in MIL-M-3800. The class 10 gun shall also conform to all other requirements applicable to the class 8 gun as specified herein.

4.2.2.2 Air equipment. The air equipment used in the metal spraying system shall furnish air which is free of oil and moisture (less than 0.03 p/m oil). For the metallizing operation, a pressure of at least 415 kPa (60 lb/in²) shall be available at the air control unit. There shall be not more than 11 meters (m) (35 feet) of 10 mm (3/8 inch) inside diameter (i.d.) hose between the air control unit and the wire spray gun. Each metal spray outfit shall consist of all components and accessories listed in table I.

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TABLE I. Equipment and quantity.

Equipment	Quantity	
	Class 8	Class 10
Metallizing gun, complete with lubricants, carry case, tool set, and manuals	1	1
Air caps	2	4
Wire nozzles	2	4
Hose set, complete	1	1
Regulator, oxygen	1	1
Regulator, fuel gas	1	1
Flowmeter, oxygen	1	1
Flowmeter, fuel gas	1	1
Flowmeter, air	1	1
Control unit	1	1
Wire reel and stand	1	1
Wire straightener	-	1
Gun mounting fixture	1	1

4.2.2.3 Air quality. In-line water and oil filters shall be located between the compressor and the metal spray equipment. These filters shall be periodically inspected and serviced to assure delivery of uncontaminated dry air. When greater control is required, automatic dew point measuring instruments with feedback to control the quality of air shall be installed. Optional equipment may be required as specified in the contract for special applications in accordance with MIL-M-3800.

4.2.2.4 Powder metal spray. The powder metal spray system shall consist of powder spray gun, hoses, flowmeters, fuel gas and oxygen regulators, and mechanical or aspirator feed for powder. Equipment shall meet the requirements of MIL-M-80141, type I, class 1.

4.2.2.5 Consumable electrode, electric arc spray. The electric arc system shall consist of an electric arc gun, flowmeter, compressed air, air cleaner, air dryer with ceramic cartridge for intermittent work (less than 4 hours per day), or refrigerated air dryer for production work direct current (d.c.) power supply unit, dual wire feeding mechanism, controls, and all necessary connecting cables and hoses. Equipment shall meet the requirements of MIL-M-80226.

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4.3 Materials.

4.3.1 Cleaning solvents. The following cleaning solvents may be used:

<u>Solvent</u>	<u>Specification</u>
Trichloroethane	O-T-620
Toluene	TT-T-548

WARNING: Toluene is flammable. Both toluene and trichloroethane are toxic. Use only in well ventilated spaces. Do not use near open flames, blasting, metal spraying work, or sources of sparks. Do not allow prolonged contact with bare skin. Read and follow precautions on container shipping labels before using contents.

4.3.2 Masking materials. Any masking material that provides adequate protection of the substrate without causing substrate corrosion or contamination may be used. Acceptable masking materials may be masking tape to protect exposed threads, gasket seats, and similar surfaces. Navy high pressure tape, NAVSEA-approved metallic tape (heat reflecting), or silicon rubber tape shall be used for delicate or critical surfaces. Plastic cap-plugs or rubber stoppers may be used for small holes or openings. Hose sections may be used to cover threaded studs, stems, and protrusions. For masking irregular shapes such as holes, slots, keyways, or other types of recesses and machined surfaces that cannot be protected with tapes or shields, inserts of wood, metal, or other form-fitting filler may be used.

4.3.3 Abrasive blasting particles. Abrasive blasting particles used to provide the anchor tooth of 50 to 75 micrometers (μm) (2 to 3 mils) during final surface preparation of the substrate shall be one of the following as specified (see 6.4):

<u>Type abrasive</u>	<u>Mesh size</u>	<u>Surface to be blasted</u>
Aluminum oxide grit	16-30	Steel or aluminum
Angular chilled iron grit	25-40	Steel

4.3.3.1 Requirements. Abrasive particles shall be clean, dry, sharp, and free of rust and excessive fines. Excessive fines are defined as greater than 25 percent fines.

4.3.3.2 Restrictions. Abrasive particles shall not contain any feldspar or other mineral constituents that tend to break down and remain on the surface. Abrasive particles that have been used for cleaning

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heavily contaminated surfaces shall not be used for final surface preparation, even though the abrasive has been rescreened. Iron grit shall not be reused for anchor tooth blasting. Angular chilled iron grit shall not be used for blasting of aluminum or other materials when contamination of the surface may result from the presence of iron residue. Use of iron grit on aluminum or other soft metals will result in iron bits becoming imbedded in the surface resulting in corrosion under the coating and early failure. Iron grit shall be clean and reasonably sharp. Grit that is rusty, noticeably worn, or dull when compared with new grit under a magnification of 10X shall not be used.

4.3.4 Metal spray coating (see 6.4).

4.3.4.1 Metal spray wire. Metal spray wire for use in corrosion-control applications shall conform to MIL-W-6712. Wire surfaces shall be clean and free from scale, corrosion products, oil, or other material which will adversely affect the application, density, or adhesion of the coating. The wire shall be of uniform composition and quality, and free of seams, cracks, nicks, or burrs. The wire shall uncoil readily and be free of bends, kinks, or slivers that would prevent its passage through the spray gun. The wire shall be stored and handled carefully to avoid bends or kinks that would prevent its passage through a spray gun.

4.3.4.2 Metal spray powder. Metal spray powder for use in corrosion-control applications shall conform to MIL-P-83348 or MIL-STD-1687. Metal spray powder shall be uniform in quality, condition, and color. It shall be dry, granular, free from dust and foreign material, thoroughly blended, nonagglomerated, and shall be capable of producing acceptable metal spray coatings.

4.3.5 Metal spray gases. The following gases shall be used in the metal spray process for corrosion-control applications:

<u>Gas</u>	<u>Specification</u>
Oxygen	BB-O-925
Acetylene	BB-A-106
Propane	-----
MAPP	-----

4.3.6 Seal coat systems.

4.3.6.1 For temperatures above 80°C (175°F). Seal coat system for components whose operating temperature is greater than 80°C (175°F) shall be heat resistant aluminum paint in accordance with DOD-P-24555 or equivalent seal coat approved by NAVSEA (see 4.4.4.3, type I coating system).

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4.3.6.2 For temperatures below 80°C (175°F). Seal coat system for

components whose operating temperature is less than 80°C (175°F) shall be strontium chromate in accordance with MIL-P-23377, formula 150 paint in accordance with MIL-P-24441 and MIL-P-24441/1, and formula 151 paint in accordance with MIL-P-24441 and MIL-P-24441/2 (see 4.4.4.3, type II coating system).

4.3.7 Top coats. Top coats for metal sprayed components, if required, shall be as specified in the applicable contract, work order, specification, ship requirement, or NAVSEA publication (see 6.4).

4.4 Metal spray process.

4.4.1 Surface cleaning. Areas to be metal sprayed, and those adjacent thereto, shall be free from grease, oil, paint, corrosion products, moisture or any other foreign material that may contaminate the coating. If contamination is excessive, a trisodium phosphate solution may be used to clean the surface prior to solvent cleaning.

4.4.1.1 Solvent cleaning. Prior to any masking, blasting, or spraying, surfaces that have come in contact with oil or grease shall be solvent cleaned. Solvents shall be in accordance with 4.3.1. Cleaning may be done by wiping, brushing, or spraying. Precautions shall be taken to protect any parts which may be attacked by the solvents.

4.4.1.2 Contaminated surfaces. Surfaces shall be cleaned with a trisodium phosphate solution, rinsed with clear, potable water, and dried after solvent cleaning.

4.4.1.3 Abrasive cleaning. Preliminary abrasive blast cleaning may be used to remove heavy or insoluble deposits. An inexpensive, disposable abrasive is recommended. Dust and debris shall be removed by dry compressed air "blow off" prior to anchor-tooth blasting.

4.4.1.4 Heat cleaning. Porous materials that have been contaminated with grease or oil shall be solvent cleaned (see 4.4.1.2). If required, parts shall be heated in vented electric ovens for at least 4 hours to remove grease or contamination remaining after degreasing cleaning process.

Steel alloys may be heated to 315°C (600°F) maximum. Aluminum alloys, except age-hardened alloys, may be heated to 150°C (300°F) maximum.

4.4.2 Masking. Masking shall be performed on all adjacent areas which may be affected by abrasive blasting or metal spraying. The mask (tape) shall be applied tightly enough to prevent grit from seeping under

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the mask. Two layers of tape shall be applied with the second layer at right angles to the first. Protective masking shall be inspected for damage between the abrasive and metal spray processes and replaced if damaged.

4.4.2.1 Special requirements. When a machinery component is not to be disassembled, working and threaded surfaces shall be masked. Unless otherwise noted on applicable drawings for specific surfaces, the following surfaces shall be properly masked or plugged to prevent their being damaged by abrasive blasting or sprayed metal coating:

- (a) Machined surfaces that are required to move with respect to each other, such as threads, bearing contacts, gear teeth, and slides.
- (b) Surfaces related to component alignment, proper seating, and mounting, such as flange faces, counterbores, and keyways.
- (c) Electrical assemblies, such as contacts, relays, and insulators.

4.4.3 Abrasive anchor-tooth blasting for surface preparation. Prior to metal spraying for corrosion control, the surfaces to be coated shall be prepared by abrasive blasting to provide an anchor tooth for the metal spray.

4.4.3.1 Aluminum oxide or angular chilled iron grit (see 4.3.3) shall be used for the final surface preparation of the substrate. Only aluminum oxide may be reused for anchor-tooth blasting. Prior to reuse, the aluminum oxide shall be screened using a 30-mesh screen, visually inspected for debris and oil contamination, and shall pass the following oil contamination test:

- (a) Fill a clean 150 milliliter (5-ounce) vial or bottle half full of screened abrasive particles.
- (b) Fill the remainder of the vial or bottle with clean water.
- (c) Cap and shake vial or bottle.
- (d) Inspect water for oil sheen.
- (e) If any oil is observed, the abrasive particles shall not be used in the final anchor-tooth blasting process.
- (f) Clean blasting equipment, replace blasting material, and retest.

4.4.3.2 The blasted surface shall have a white metal blast appearance with an anchor-tooth (not peened) surface profile of 50 to 75 μm (2 to 3 mils) (see figure 3) and validated (measured) with profile tape and a dial micrometer. Blasting shall be done in accordance with SSPC No. 5. A white metal blast cleaned surface finish is defined as a surface with a gray-white, uniform metallic color, slightly roughened to form a suitable anchor pattern for coatings. The surface, when viewed using a magnification of 10X, shall be free of oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint, or any other foreign matter. The color of the clean

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surface may be affected by the particular abrasive medium used. Photographic or other visual standards of surface preparation shall be used to further define the surface if specified in the contract. Abrasive blasted surfaces shall not be allowed to come in contact with contaminated surfaces prior to completion of metal spray and sealing processes. Prepared surfaces shall be handled only with clean gloves, rags, or slings. Contact with any oil or grease (such as touching with a bare hand) will result in failure of the coating. Blasting shall not be so severe as to distort the component being prepared for metal spray. The slightest presence of oil oxidation or other foreign material on the surface to be sprayed will result in separation of the metal spray coating.

4.4.4 Metal spraying.

4.4.4.1 Surface protection. The metal spray operation shall be started within 4 hours after anchor-tooth surface preparation for steel has been completed and shall be finished within 6 hours. The metal spray operation on aluminum shall be started within 2 hours after anchor-tooth surface preparation has been completed and shall be finished within 4 hours. If the steel or aluminum substrate temperature is not greater than 5°C (10°F) above the dew point, no metal spraying shall be conducted. If more than 15 minutes, but not over 4 hours is expected to elapse between the surface preparation and the start of the metal spray process, or if the part must be moved to another location, the prepared anchor-tooth surface shall be protected from moisture, contamination, and fingermarks. Wrapping with clean paper will normally provide adequate protection. When specified in the contract or other guidance documents, for periods longer than 4 hours, a flash coat of metal spray (at least 25 µm (1 mil)) shall be used to protect the surface until final metal spray can be applied. If the period exceeds 6 hours for steel or 4 hours for aluminum, or if other contamination or deterioration of the surface occurs, the surface shall be reblasted in accordance with 4.4.3.

4.4.4.2 Air quality. Any of the following procedures and equipment may be used to monitor water content of the compressed air:

- (a) Open a valve downstream of the filter/dryer components slightly, allowing air to vent with a slightly audible flow into an open dry container for 1 minute. Any wetting or staining will indicate moisture or contamination.
- (b) Repeat (a) above using a clean white cloth. Any wetting or staining will indicate moisture and contamination.
- (c) An electrolytic hygrometer having an indicator graduated in p/m on a range which is no greater than ten times the maximum specified moisture content.

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- (d) A frost point analyzer in which the temperature of the viewed surface is measured at the time frost first begins to form.
- (e) A piezoelectric adsorption hygrometer on a range which is no greater than ten times the specified maximum range.

Techniques (a) and (b) above are primarily for use in the field, and (c), (d), and (e) for shop monitoring instruments.

4.4.4.3 Seal coating system application. The metal coating shall be applied in multiple layers, and in no case shall less than two crossing passes, at right angles, be made over every part of the surface. The sprayed metal shall overlap on each pass of the gun to assure uniform coverage. A type I coating system application for high temperature components (see 4.4.5, category I) shall consist of 250 to 375 μm (10 to 15 mils) of metal sprayed aluminum plus the appropriate seal coat (see 4.3.6.1). A type II coating system application for topside equipment (see 4.4.5, category II) and interior wet spaces (see 4.4.5, category III) shall consist of 175 to 250 μm (7 to 10 mils) of metal sprayed aluminum or zinc plus the appropriate seal coat (see 4.3.6.2). The spray gun shall be held 125 to 200 mm (5 to 8 inches) from the surface being sprayed (see gun manufacturer's recommendations for optimum spray distance). The angle of spray stream to the surface being coated shall be as close to 90 degrees as possible, and never less than 45 degrees. When spraying complex geometric shapes, the operator shall plan for (by masking) and accomplish spraying to minimize overspray onto areas of the component where no coating is desired. During the metal spray operation, the temperature of the object being

sprayed shall not exceed 350^oF. Cooling during the coating operation may be accomplished by use of blast of clean dry air, carbon dioxide, or other suitable gas introduced near, but not directly on the area being sprayed. The metal spray operation shall be interrupted only to measure thickness or temperature, or to permit cooling to prevent overheating. See 4.1.6 for personal protection.

4.4.4.4 Cooling process. Under normal conditions, the sprayed object shall be allowed to cool to room temperature at a normal rate. If required, accelerated cooling may be accomplished with a blast of clean dry air, carbon dioxide, or other suitable gas. In any case, the air or gas shall be maneuvered to obtain a uniform cooling rate over the entire metal sprayed area. Under no circumstances shall the component be quenched with liquid to accelerate cooling.

4.4.4.5 Seal coat application. Seal coats used shall be dependent on the normal operating temperature of the component to be metal sprayed (see 4.3.6), and as specified (see 6.4). Two coats of 38 μm (1.5 mils) dry film thickness (dft) shall be applied as shown in figure 4 for type I system (see 4.3.6.1). The seal coat for type II system shall be a coat of strontium chromate 13 to 19 μm (0.50 to 0.75 mil) dft; a coat of formula 150 paint 50 to 75 μm (2 to 3 mils) dft; a coat of formula 151 paint 50 to 75 μm (2 to 3 mils) dft; and a color top coat as required for the area (see 4.3.6.2). Type II system application is shown in figure 5.

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4.4.5 Approved applications of metal spray coatings for corrosion control. The following is a list of approved applications of metal spray coatings for corrosion control on Navy surface ships:

Category I - machinery space components:

- (a) Aluminum coating 250 to 375 μm (10 to 15 mils) thick:
 - (1) Low pressure air piping.
 - (2) Steam valves, piping and traps (except steam turbine control valves).
 - (3) Auxiliary exhaust (such as stacks, mufflers, and manifold).
 - (4) Air ejection valves.
 - (5) Turnstile.

Category II - topside weather equipment:

- (a) Aluminum or zinc coating - 175 to 250 μm (7 to 10 mils) thick.
 - (1) Aircraft and cargo tie downs.
 - (2) Aluminum helo decks.
 - (3) Stanchions.
 - (4) Scupper brackets.
 - (5) Deck machinery coatings and foundations.
 - (6) Chocks, bitts, and cleats.
 - (7) Pipe hangers.
 - (8) Capstans/gypsy heads (except wear area).
 - (9) Rigging fittings (block and hooks).
 - (10) Fire station hardware.
 - (11) Lighting fixtures and brackets.

Category III - interior wet spaces:

- (a) Aluminum or zinc coating - 175 to 250 μm (7 to 10 mils) thick:
 - (1) Decks in wash rooms and water closets.
 - (2) Pump room deck and equipment support foundations.
 - (3) Fan room decks and equipment support foundations.
 - (4) Water heater room decks and equipment support foundations.
 - (5) Air conditioning room decks and equipment support foundations.
 - (6) Deck plate supports.
 - (7) Machinery foundations.
 - (8) Boiler air casings (skirts).

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4.4.6 Prohibited applications of metal spray coatings for corrosion control. Metal sprayed coatings for use in corrosion-control applications are intended for selected application to steel and aluminum surfaces. Metal spray coatings for corrosion-control applications shall not be used for the following:

- (a) Plastic, rubber, painted surfaces.
- (b) Internal surfaces of moving machinery (example: pump casings, valves, etc.).
- (c) Brass, bronze, copper-nickel, or monel surfaces.
- (d) Stainless steels, 17-4PH, 15-4PH.
- (e) Surfaces subject to strong acids or bases (example: aircraft catapult slides).
- (f) Threads of fasteners.
- (g) Valve stems.
- (h) Within 20 mm (3/4 inch) of surfaces to be welded.
- (i) Steel alloys with yield strength greater than 827.4 megapascals (MPa) (120,000 lb/in²).
- (j) Nonskid deck coatings (except as approved by NAVSEA for research and development evaluation).
- (k) Exterior underwater hull surfaces.
- (l) Sanitary tanks interior.

5. DETAILED REQUIREMENTS

5.1 Certification. Prior to the utilization of this spraying procedure, Naval facilities and contractors shall submit a request for certification and obtain approval of certification of facilities and spray operators from the NAVSEA authorized agent prior to award of contract. Data submitted shall not relieve the facility or contractor of responsibility for conformance with all requirements of this standard. Contractors shall be responsible for similar qualification of all subcontractors. Certification may be terminated in the event NAVSEA or the authorized agent has evidence that all the requirements (facility, operator, and product quality assurance) of this standard are not being met. The applicable work covered by this standard may be suspended upon written notification by the authorized agent, until it has been demonstrated that such deficiencies have been corrected.

5.2 Facilities. Each facility, whether Government or privately owned, shall provide written evidence of compliance to the requirements of this standard to the NAVSEA authorized agent prior to award of contract. The NAVSEA authorized agent shall inspect the facility to verify that all requirements are met. The requirements address working areas, abrasive blasting equipment, and metal spraying equipment. Facilities meeting the requirements of this standard shall be deemed certified (see 5.1) to carry out the contractual obligations for the contracted metal spray procedure. Recertification will not be required except as noted in 5.1.

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5.2.1 Working areas. The following minimum requirements shall be met for shore side facility working areas. Work carried out aboard ship shall be conducted in accordance with NAVSEA S9086-VD-STM-000, Chapter 631 and this standard where applicable.

- (a) Abrasive blasting areas: If abrasive blasting is carried out in an enclosed area other than a designated blasting booth, the air in the enclosed area shall change at least once per minute. Additional safe breathing apparatus (operator's hood) shall be used.
- (b) Metal spraying areas:
 - (1) Spray booths: The wet spray booth shall be constructed with surfaces angled to deflect the metal spray blast inward and not blow dust out of the booth. The booth shall be equipped with a wet collector and an exhauster that will maintain air flow of at least 61 cubic meters per minute per square meter (200 cubic feet per minute per square foot) of booth opening into the booth entrance.
 - (2) Enclosed areas: Enclosed areas shall be equipped with a water-wash dust collector with a capacity in cubic meters per minute at least three times the volume of the enclosed space. Air inlets to the areas shall be located near the ceiling on the side opposite the working area (bench). The air exhaust shall be located at or near the floor along the entire side of the room adjacent to the working area. The duct work shall be large enough to permit air velocities greater than 610 meters (2000 feet) per minute. An air respirator mask shall be provided for the operator, as well as eye and ear protection.
 - (3) Open areas: Metal spraying in open areas shall be carried out only when suitable eye and ear protection and an air respirator are being used.

5.2.2 Abrasive blasting equipment. The following list of equipment identifies the minimum required for performing abrasive blasting operations. All equipment shall be in satisfactory working order.

- (a) Blaster utilizing air free of oil and moisture (see 4.2.1.2).
- (b) Steel blasting table or cabinet.
- (c) Oil and moisture separator.
- (d) Air pressure regulators with pressure gages.
- (e) Air volume indicator.
- (f) Blast nozzle equipped with a dead-man valve.
- (g) Abrasive (see 4.3.3).
- (h) Sample metal coupons.
- (i) Press-O-Film (available from TESTX, Inc.), or equivalent.
- (j) Caliper or dial micrometer.

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5.2.2.1 Special clothing. The following clothing shall be worn when blasting operations are performed in an enclosed space:

- (a) Helmet with forced air supply.
- (b) Canvas jacket.
- (c) Canvas trousers.
- (d) Steel toed work shoes.
- (e) Rubber or leather gloves.

5.2.3 Metal spray equipment. The list of equipment for metal spray operations shall meet the requirements of 4.2.2 for the applicable spraying system. All equipment shall be in satisfactory working order.

5.2.3.1 Protective equipment. The following protective equipment shall be worn for metal spray operations:

- (a) Air respirator.
- (b) Noise protection (ear muffs or plugs).
- (c) Eye protection (see 4.1.9).

5.2.3.2 Additional equipment. The following equipment is not required for certification but may be necessary to complete the thermal spray process:

- (a) Masking materials.
- (b) Surface pyrometer.
- (c) Magnetic thickness gage.
- (d) Eddy current gage.
- (e) Crane or handling equipment.

5.3 Application procedure certification. Certification of the application procedure will be given those facilities demonstrating the ability to successfully carry out the proposed procedure. The requirements set forth herein shall be met prior to obtaining certification. Electric arc wire spray systems are acceptable only where it can be demonstrated that the requirements set forth in this standard can be certified. Certification is required for each new application procedure. Recertification will not be required except as noted in 5.1.

5.3.1 Application procedures. Contractors, prior to award of contract, and Naval activities shall prepare written application procedures, and perform tests, as required, to obtain certification of these procedures. The written procedures shall include a description of the proposed application procedure and a listing of the various processes (such as blasting, metal spraying, inspection, and sealing) performed. Record forms shall be provided as evidence of the performance of quality assurance examinations.

5.3.2 Application procedure approval. Prior to the utilization of a metal spraying procedure, the contractor shall demonstrate the procedure, with the supporting test qualification data, to the authorized agent for

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approval. Data submitted shall not relieve the contractor of responsibility for conformance with other requirements of this standard. Contractors shall be responsible for similar certification of all subcontractors.

5.3.3 Certification test requirements. Application procedure certification shall consist of a visual examination, bend test, bond test, and shape test of metal sprayed specimens prepared by an operator using the proposed procedure. Specimens for the testing shall be prepared in accordance with 5.6.1 and the written application procedures. For the visual examination and bend test, four specimens shall be tested in accordance with 5.6.2 and 5.6.3. Results of the test shall conform to the requirements of 5.3.3.1 and 5.3.3.2. For the bond test, five specimens shall be prepared and tested in accordance with ASTM C 633, and shall meet the requirements of 5.3.3.3.

5.3.3.1 Visual examination requirements. The metal sprayed coating prior to sealing shall have a uniform appearance. Surface defects of the metallized coating shall be limited to small nodules not to exceed 1.1 mm (0.045 inch) in diameter and shall not exceed 0.6 mm (0.025 inch) in height above the surrounding sprayed surfaces. The coating shall not contain any of the following:

- (a) Blisters.
- (b) Cracks.
- (c) Chips or loosely-adhering particles.
- (d) Oil or other internal contaminants.
- (e) Pits exposing the undercoat or substrate.

5.3.3.2 Bend test. No disbonding, delamination, or gross cracking of the coating shall occur due to bending. Small hairline cracks or alligating of the coating in the vicinity of the bend are permissible. Figure 6 illustrates acceptable and nonacceptable bend test results.

5.3.3.3 Bond test. The bond strength of the metallized coating on the individual test specimens shall be 10.3 MPa (1500 lb/in²) or greater. The average bond strength of five samples of the metallized coating on the tested specimens shall be 13.8 MPa (2000 lb/in²) or greater.

5.3.3.4 Shape test. The thickness of the metallized coating shall meet the requirement of this standard for the metal spray process and shall be 0.25 to 0.40 mm (0.010 to 0.015 inch).

5.4 Certification of metal spray operators. This section provides the requirements for certification of metal spray operators. Each operator shall be certified by demonstrating, as specified herein, the ability to apply the specified coating system, using the applicable spray process, and correct and safe usage of the equipment.

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5.4.1 Responsibility. Prior to invoking this standard, each activity, contractor, or subcontractor, shall establish that each metal spray operator to be employed in the use of metal spray for corrosion-control applications has been certified by demonstrating the ability to produce satisfactorily in accordance with 5.3.3.

5.4.2 Operator certification.

5.4.2.1 Certification tests. The operator shall prepare specimens in accordance with 5.6.1, which in turn, shall meet the test requirements set forth in 5.3.3.

5.4.2.2 Limits of certification. Operators meeting the requirements for the certification tests shall be deemed "certified operators" with the coating system and spray process used in the application procedure testing.

5.4.2.3 Retest of operators. An operator failing the initial certification tests may be permitted to perform one retest for each type of test failed. If the operator fails the retest, he shall not be certified until completion of training or retraining and subsequent complete certification retesting.

5.4.3 Maintenance of operator certification.

5.4.3.1 Term of certification. Operator certification shall be retained as long as a period of 6 months does not lapse between production use of the applicable metal spray process. Production use shall be defined as performing metal spraying operations at least 8 hours in a consecutive 30-day period.

5.4.3.2 Recertification. Operators whose certification has lapsed may be recertified by satisfactorily completing the certification tests.

5.4.3.3 Special. Recertification testing may also be required at any time an operator's performance is questionable as evidenced by production quality assurance.

5.5 Production quality assurance. Production quality shall be assured by certification and the maintenance of production records and an inspection system by the performing activity, contractor, or subcontractor. Production records and inspection requirements shall be subject to modification by the contracting agency as stated in the contract (see 6.4).

5.5.1 Production records. The performing activity, contractor, or subcontractor shall maintain production records for lot sizes specified by the contracting agency. A production record form shall be prepared prior to commencement of work by the performing activity, contractor, or subcontractor. The record shall assign responsibility and provide accountability for performing work and assuring quality control. These records shall be available for review and audit by the authorized agent. The sample record form shown in figure 7 may be used as a guide for preparing production records.

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5.5.2 Inspection system. Sampling and inspection of end items shall be as specified in the contract, and at a minimum, shall consist of a comparison coupon bend test, visual inspection, and thickness measurement as directed herein. In the event of failure by a sample item during any test, the item shall be recoated by repeating the entire application procedure. Each item of the lot from which the failed sample item was drawn shall be subjected to the inspection system requirements. In the event the authorized agency suspects failure of a coating job, the knife-peel test (see 5.5.2.3) or the adhesion test (see 5.5.2.4) can be used to determine if the coating will meet the requirements of this standard. The adhesion test is applicable only to category III items specified in 4.4.5.

5.5.2.1 Visual inspection. Each sample item shall be examined visually at a magnification of 10X. The coating shall have a smooth, uniform appearance. The coating system shall not contain any blisters or loosely adhering particles, nor shall it contain any cracks, pinholes, or chips which expose the metal substrate. Areas of apparent nonadherence (blistering, loose particles, cracks, or chips) shall be subjected to the knife-peel test (see 5.5.2.3). Coatings displaying any of the above discontinuities shall be removed to base metal and the coating system replaced.

5.5.2.2 Thickness measurement. Thickness measurements shall be performed on each sample item by means of a calibrated thickness gage, or by direct caliper measurement of the increased dimension. Required thickness of the coating system and tolerances shall be as specified in this standard.

5.5.2.3 Knife-peel test. The knife-peel test consists of a single knife cut 40 mm (1.5 inches) long through the metal spray coating to the substrate. If any part of the coating system along the cut can be separated from the base metal using the knife, the bond shall be deemed unsatisfactory.

5.5.2.4 Adhesion test. An aluminum or steel dolly (3.2 square centimeters (0.50 square inch) surface contact area) shall be cemented to the metal sprayed surface. After curing, the dolly shall be pulled off the surface with a calibrated adhesion tester. An adhesive failure less than 6.9 MPa (1000 lb/in²) indicates a poor metal coating, and therefore, shall not be passed. This test shall be used in a noncritical area of the job and can be recoated with the topcoat if no failure occurs.

5.5.3 Periodic inspection. Prior to commencement of each day's production run, a sample coupon shall be prepared in accordance with 5.6.1.1 and tested in accordance with 5.6.3. The specimen shall meet the requirements of 5.3.3.2. In the event of failure, the cause shall be identified, and the problem corrected. This inspection is included to identify problems which can lead to subsequent failure of a production run.

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5.6 Certification test procedures.

5.6.1 Preparation of the test specimens.

5.6.1.1 Specimens for visual and bend tests. Four panels approximately 75 by 50 by 1.25 mm (3 inches by 2 inches by 0.050 inch) (minimum) shall be sprayed on one of the large faces using the appropriate spraying procedure and metal substrate. The coating thickness shall be 175 to 250 μm (7 to 10 mils). The same panel may be used for visual and bend test.

5.6.1.2 Specimens for bond test. Five specimens for the bond test shall be machined and prepared according to the requirements of ASTM C 633 and this standard.

5.6.1.3 Specimens for shape test. One specimen shall be manufactured in the shape of a "T" 75 by 75 by 13 mm thick by 150 mm long (3 inches by 3 inches by 1/2 inch thick by 6 inches long). Another specimen shall be cut from a length of 50 mm iron pipe size (ips) pipe, 150 mm long (2 inch ips pipe, 6 inches long). The specimen material shall be the applicable substrate and shall be coated using the spraying procedure of 5.6.1.1.

5.6.2 Visual examination. Each of the prepared panels shall be examined under magnification of 10X. The surface appearance shall meet the requirements of 5.3.3.1.

5.6.3 Bend test. The sprayed panels shall be bent approximately 180 degrees on a 13-mm (1/2-inch) diameter rod. The coating shall be on the tensile side of the bend. The bend specimen shall be examined visually to insure compliance with 5.3.3.2.

5.6.4 Bond test. The bond test specimens (see 5.6.1.2) shall be tested in accordance with ASTM C 633 for bond strength and the average bond strength of the five specimens. The strength of the individual specimen bonds shall be 10.3 MPa (1500 lb/in²) or greater. The average bond strength shall be 13.8 MPa (2000 lb/in²) or greater. Examination of the test specimen shall be conducted after rupture to determine the cause of failure. A new specimen shall be substituted if examination concludes that the failure occurred at the adhesive-coating interface.

5.6.5 Shape test. The thickness of the sprayed metal coatings shall be measured in sufficient areas to determine that the coating thickness is within the required range (see 5.3.3.4) across the specimen surfaces.

5.6.6 Test results. The results of all tests and examinations shall be documented and included in the application procedure certification package.

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5.7 Records. Records of facility, application procedure, and operator certification, including certification test results and production records, shall be maintained by each performing activity, contractor, or subcontractor. These records shall be available to the contracting agency for review and audit. The performing activity, contractor, or subcontractor shall maintain these records for a period of 6 months after completion of the contract work. Copies of the records shall be made available to the contracting agency upon request. Disposition of the records shall be as agreed upon in the contract.

5.8 Noncompliance. In the event the contracting agency or his representative has evidence indicating that the requirements of this standard are not being met, the applicable work covered by this standard may be suspended at no cost penalty to the Government upon written notification until the contractor has demonstrated that such work deficiencies have been corrected.

6. NOTES

6.1 Applications.

6.1.1 Approved applications. The use of metal spray coatings for corrosion-control applications that have been approved by NAVSEA are listed in 4.4.5. Selection of one of the listed applications does not eliminate the need for the application certification tests required by this standard.

6.1.2 Unauthorized applications. The use of metal spray coatings for corrosion-control applications that are not authorized by NAVSEA are listed in 4.4.6. NAVSEA assistance shall be requested for controlling corrosion in these areas.

6.1.3 Proposed applications. The use of metal spray coatings for corrosion control in areas other than those listed in 4.4.5 require prior approval of NAVSEA.

6.2 Additional precautions. In addition to the safety precautions contained herein, accomplishing abrasive blasting, metal spraying, and sealing on board ship shall be performed in accordance with NAVSEA S9086-VD-STM-000, Chapter 631 and NAVSEA S9086-CH-STM-030, Chapter 074. The performing activity, contractor, and subcontractor shall be responsible for insuring that the proper precautions are being observed to preclude personnel injury or machinery damage (including surroundings) prior to accomplishing the required operations.

6.3 Packaging. The performing activity, contractor, or subcontractor shall be responsible for packaging the end item in a manner that will afford adequate protection against damage during direct shipment from the

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facility to the receiving activity. These packages shall conform to the applicable carrier rules and regulations, as required. Marking information shall be provided on the exterior of the package and shall include the contract or work order number, the nomenclature, facility name and destination. This data may be modified by the contracting agency.

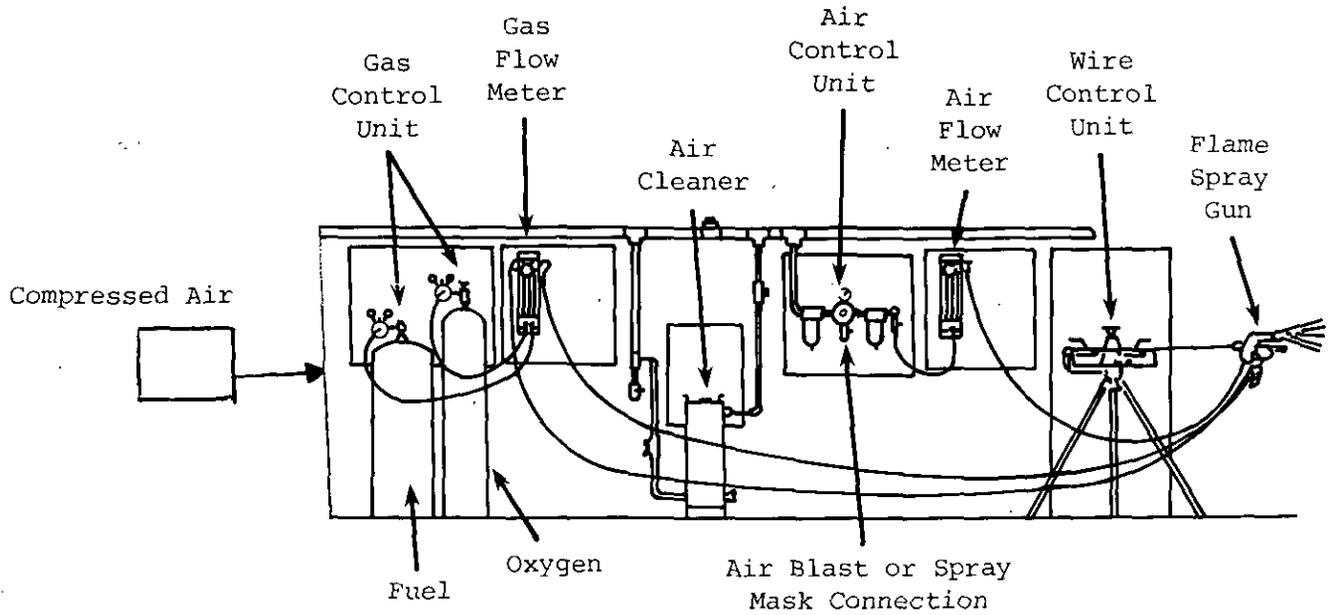
6.4 Ordering data. Acquisition documents should specify the following:

- (a) Work is to be performed in accordance with this document.
- (b) The use of NAVSEA S9086-VD-STM-000, Chapter 631 and NAVSEA S9086-CH-STM-030, Chapter 074 in the case of shipboard work.
- (c) Type I, II, or III abrasive blasting equipment (see 4.2.1.1).
- (d) Type of metal spraying system (see 4.2.2).
- (e) Type of abrasive blasting particles (see 4.3.3).
- (f) Type of metal spray coating (see 4.3.4).
- (g) Type of top coat (see 4.3.7).
- (h) Type of seal coat (see 4.4.4.5).
- (i) The requirement of certification as applicable (see section 5).
- (j) The sampling plan for production quality assurance (see 5.5).

Preparing activity:
Navy - SH
(Project MFFP-N236)

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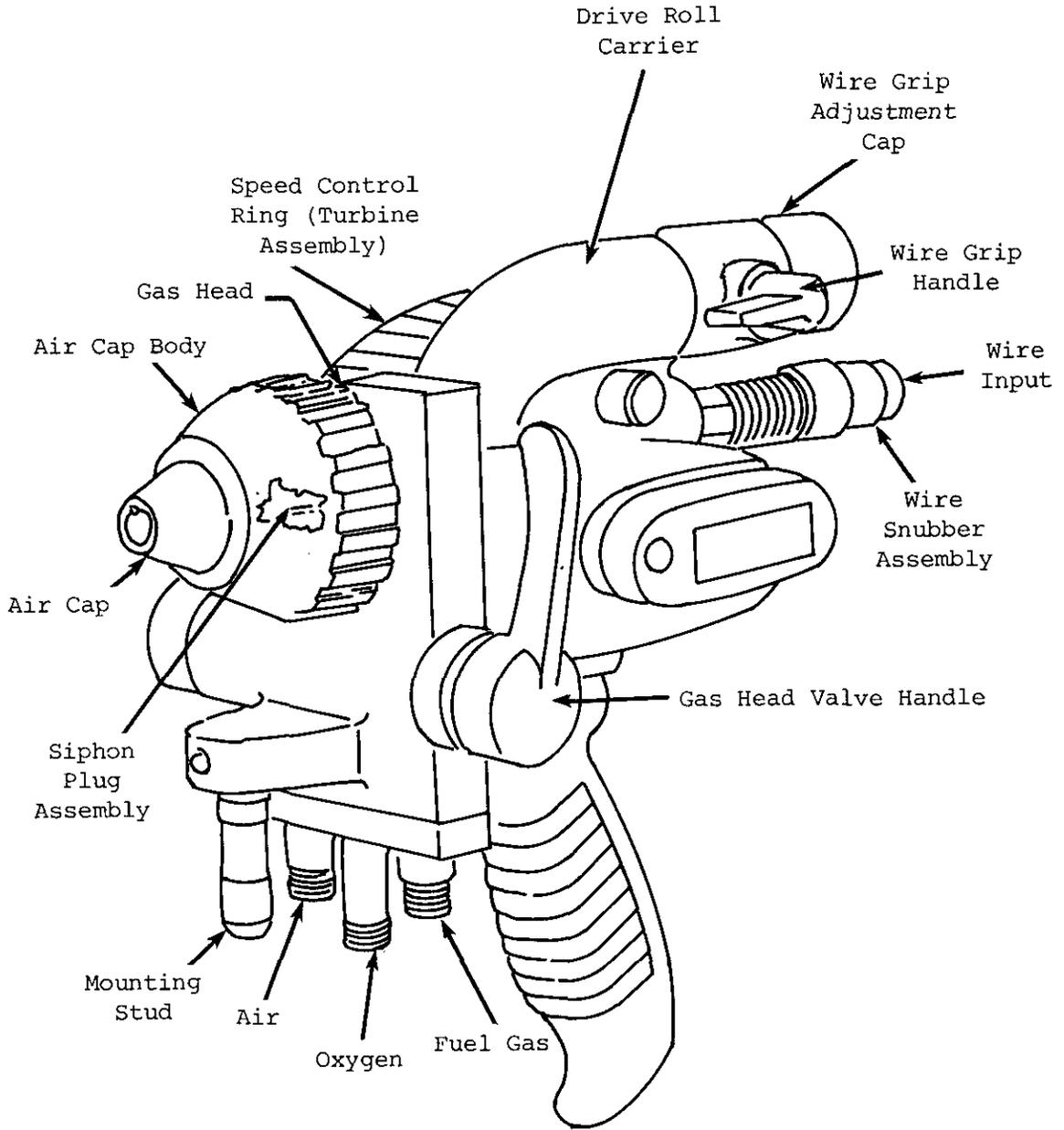
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FIGURE 1. Typical metal spray system.

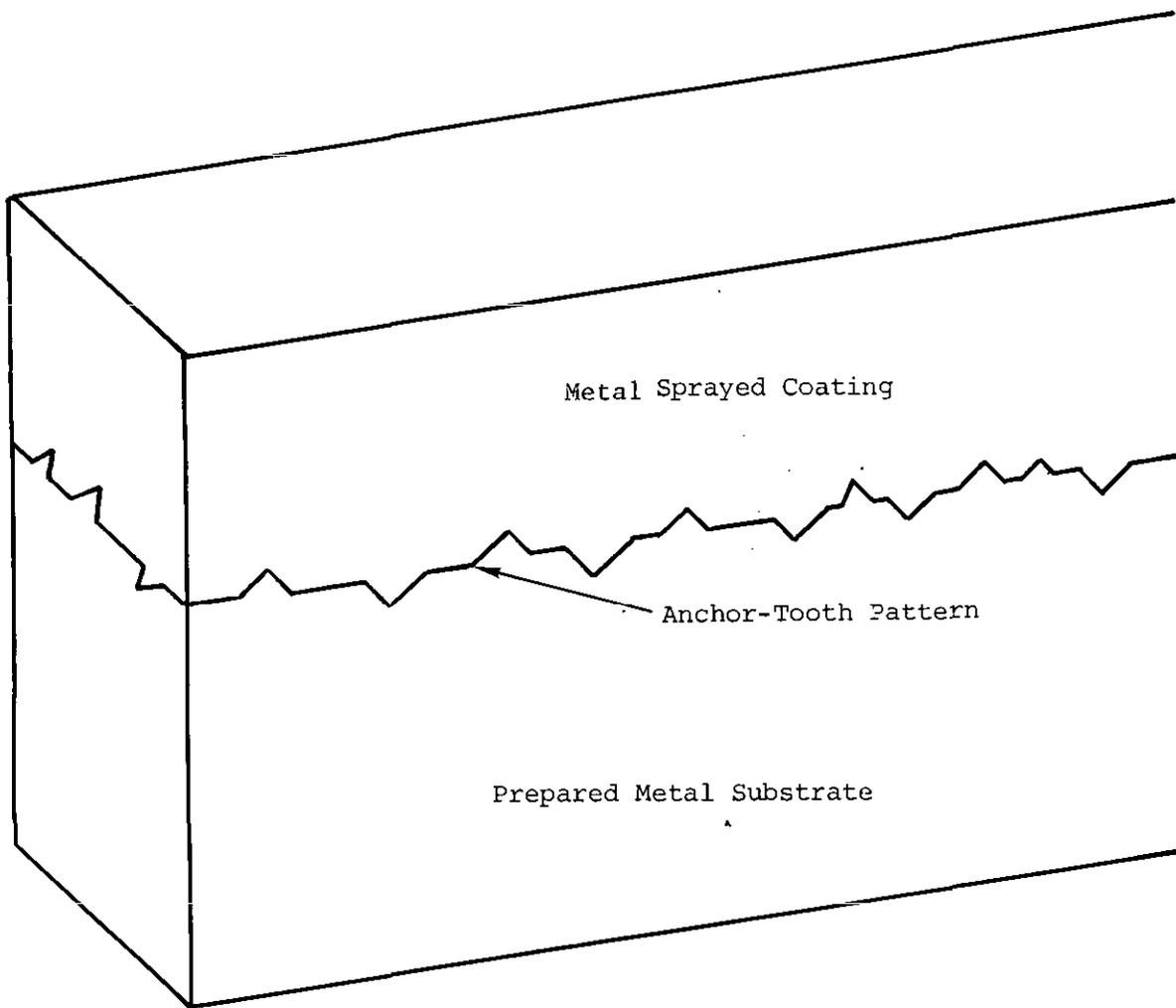
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FIGURE 2. Typical wire spray gun.

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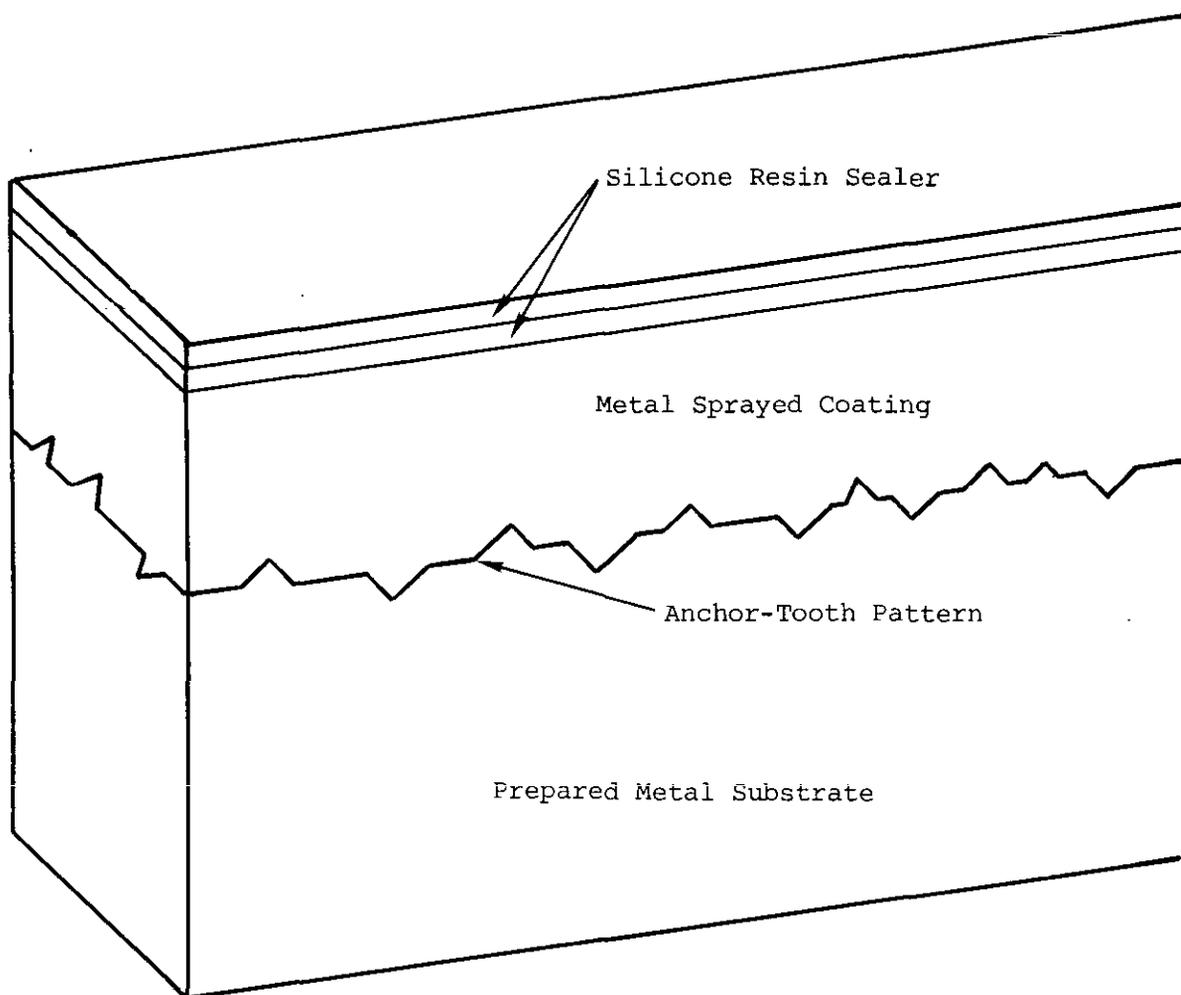


SH 12068

FIGURE 3. Profile of anchor-tooth pattern.

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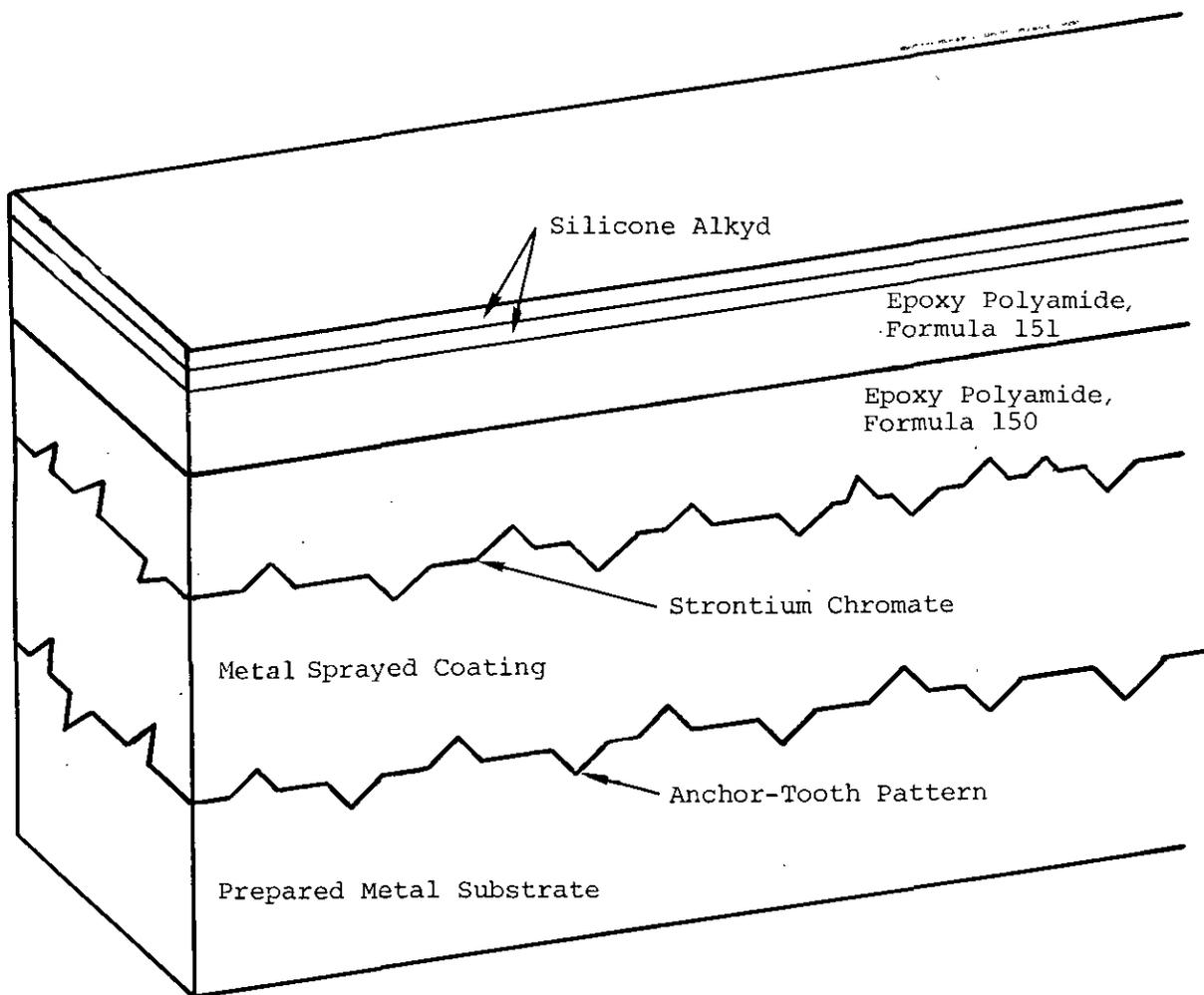
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SH 12069

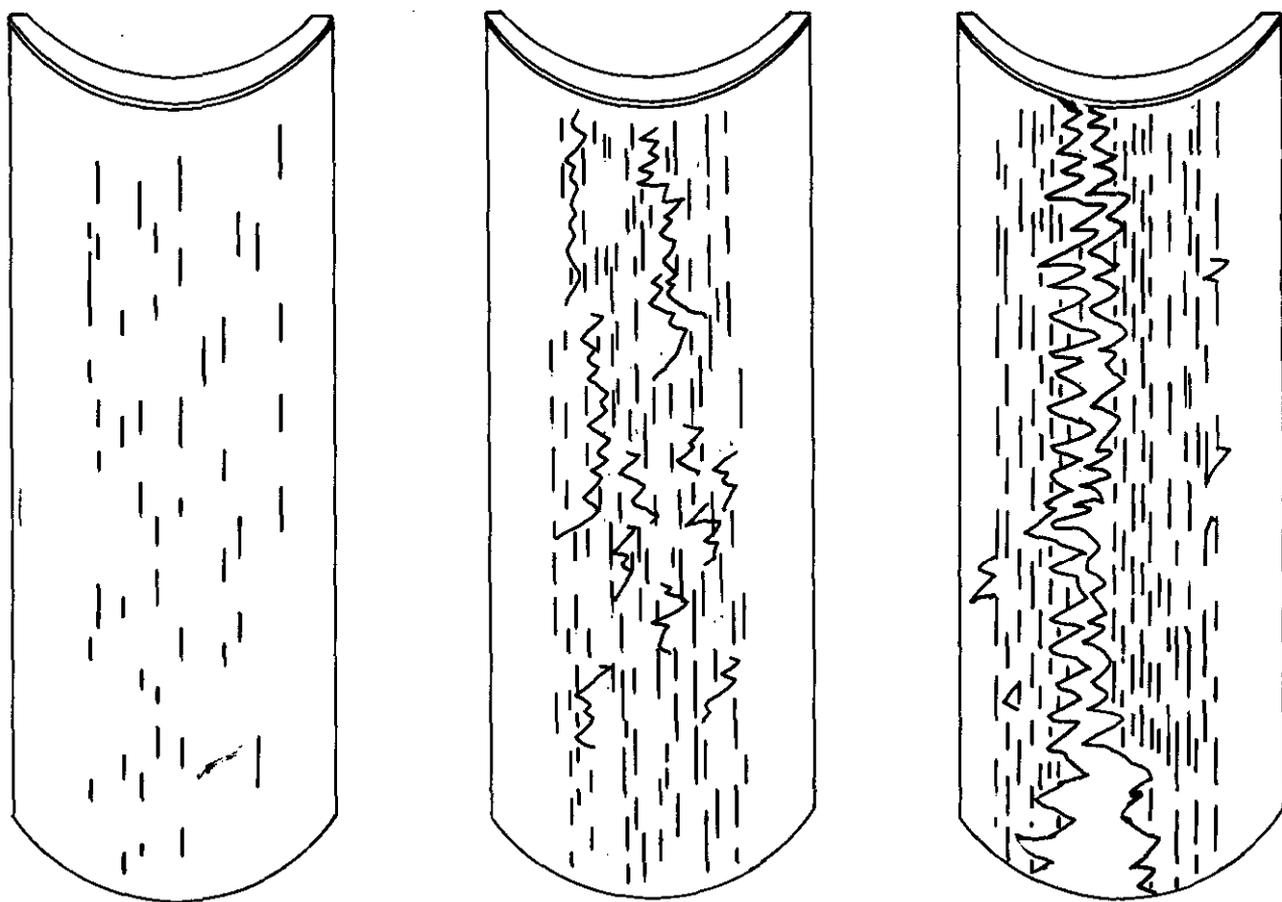
FIGURE 4. Type I system with heat-resisting, high-temperature sealer (silicone aluminum sealer).

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SH 12070

FIGURE 5. Type II system with low temperature sealer (epoxy polyamide and cosmetic topcoat).



SH 12071

IDEAL
Smooth Surface

MARGINAL
Cracks

REJECT
Disbonding
Delamination

FIGURE 6. Coupon bend test accept/reject examples.

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1. Job control number _____ 2. Date _____

3. Ship system _____ 4. System component _____

5. Area to be sprayed _____

6. Masking information (area not to be sprayed) _____

7. Base material (type) _____

8. Preparation methods:

Cleaning: Degrease solvent: _____
Oven bake: temp _____ ; time _____

Rough blasting: Grit type and size: _____

Anchor-tooth blasting: Grit type, size, and profile: _____

Masking information _____

9. Thermal sprayed coating (type and thickness) _____

10. Seal coat (types and thicknesses) _____

11. Top coat (type) _____

Inspection procedures and results

Visual examination (inspector initial) _____

Thickness measurement (inspector initial) _____

Knife peel test (inspector initial) _____

Item accepted? (Yes/No)

Sprayer's identification

Name/number _____

Inspector's identification

Name/number _____

FIGURE 7. Metal spray report format.

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APPENDIX
DATA REQUIREMENTS

10. DATA

10.1 Data requirements. When this standard is used in a contract which incorporates a DD Form 1423 and invokes the provisions of 7-104.9(n) of the Defense Acquisition Regulation (DAR), the data requirements identified below will be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (DD Form 1423) incorporated into the contract. When the provisions of DAR 7-104.9(n) are not invoked, the data specified below will be delivered by the contractor in accordance with the contract requirements. Deliverable data required by this standard is cited in the following paragraphs:

<u>Paragraph</u>	<u>Data requirement</u>	<u>Applicable DID</u>	<u>Option</u>
5.3.1, 5.5.1, 5.6.6, and figure 7	Documentation, management/ technical support	UDI-A-26199	-----

(Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

10.1.1 The data requirements of 10.1 and any task in the standard required to be performed to meet a data requirement may be waived by the contracting/acquisition activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item acquired to this standard. This does not apply to specific data which may be required for each contract, regardless of whether an identical item has been supplied previously (for example, test reports).

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL		OMB Approval No. 22-R255
<p>INSTRUCTIONS: The purpose of this form is to solicit beneficial comments which will help achieve procurement of suitable products at reasonable cost and minimum delay, or will otherwise enhance use of the document. DoD contractors, government activities, or manufacturers/vendors who are prospective suppliers of the product are invited to submit comments to the government. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements. Attach any pertinent data which may be of use in improving this document. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity.</p>		
DOCUMENT IDENTIFIER AND TITLE DOD-STD-2138(SH)		
NAME OF ORGANIZATION AND ADDRESS	CONTRACT NUMBER	
	MATERIAL PROCURED UNDER A <input type="checkbox"/> DIRECT GOVERNMENT CONTRACT <input type="checkbox"/> SUBCONTRACT	
<p>1. HAS ANY PART OF THE DOCUMENT CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?</p> <p>A. GIVE PARAGRAPH NUMBER AND WORDING.</p> <p>B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES</p>		
2. COMMENTS ON ANY DOCUMENT REQUIREMENT CONSIDERED TOO RIGID		
<p>3. IS THE DOCUMENT RESTRICTIVE?</p> <p><input type="checkbox"/> YES <input type="checkbox"/> NO (If "Yes", in what way?)</p>		
4. REMARKS		
SUBMITTED BY (Printed or typed name and address - Optional)		TELEPHONE NO.
		DATE

DD FORM 1426
1 JAN 72

REPLACES EDITION OF 1 JAN 66 WHICH MAY BE USED

S/N 0102-014-1802