INCREMENTAL CHANGE Release Notification Date: 06/30/2022

SPM 70-49-43 HIGH DENSITY HVOF T-800 (TRIBALOY) COATING

DISCLAIMER

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HIGHLIGHTS

HIGHLIGHT REFERENCE	DESCRIPTION OF CHANGE
sk70-49-43-340-424	Technical Change: Changed Quality Assurance procedure of the Macrohardness. Also, changed figure references.

TASK 70-49-43-340-042

1. General.
   A. Tribaloy T-800 material is usually applied by air plasma spray (APS) per TASK 70-49-30-340-031, Thermal Spraying Cobalt-Molybdenum-Chromium-Silicon Alloy (Powder) - Tribaloy 800, on surfaces in the HPT and LPT sections of the engine that are prone to fretting wear. The coating is normally used for operating temperatures greater than 1000°F (538°C). This procedure describes the application of pre-alloyed Tribaloy T-800 powder by the high velocity oxy fuel (HVOF) process.
   B. HVOF spraying is a combustion process using a suitable fuel gas such as oxygen/hydrogen, oxygen/propylene or kerosene which is ignited under a pressure of 35-125 psi (242-863 kPa). Powder is introduced axially or radially into the flame, melted, and accelerated onto the substrate at a velocity of 2000-5000 ft/sec (60690-152400 cps). The deposits that are produced have a bond strength greater than 9,000 psi (62100 kPa), a density of almost 100 percent, and can be deposited much thicker than conventional combustion or plasma processes. The material is self-bonding and is deposited at a rate of 4 to 8 lbs/hr (1.8 and 3.6 kg/hr). A higher rate of deposit is possible.
2. Equipment.

Subtask 70-49-43-340-421

   A. The equipment to do high density HVOF spraying consists of the following:
      (1) An HVOF gun system with a suitable controller.
      (2) A gas controller that can deliver up to 1000 SCFH oxygen, 1600 SCFH hydrogen, 300 SCFH propylene, and if required, 800 SCFH air. If liquid fuel is used, an appropriate controller is required. The unit shall provide gun power control and air delivery rate.
      (3) A pressurized powder feeder that can deliver powder between 4-15 lbs/hr (2-7 kg/hr).
      (4) A clean filtered air supply that can deliver up to 800 SCFH.
   B. Commercially available equipment consists of the following:

Model	Address
Jet Kote 2000	Stellite Coatings Deloro Stellite, Inc. Refer to the List of Suppliers in Step 4 of 70-80-00.
Diamond Jet 2600 Hybrid	Sulzer Metco, Inc. Refer to the List of Suppliers in Step 4 of 70-80-00.
JP-5000	Praxair/TAFA Concord. Refer to the List of Suppliers in Step 4 of 70-80-00.

3. Material.

Subtask 70-49-43-340-422

NOTE: Powders may be sieved to meet spray requirements for the equipment used.

A. Co-Mo-Cr-Si Powder, HVOF Application C07-047 .

4. Spraying Parameters.

Subtask 70-49-43-340-423

A. Starting parameter sets will be listed in the spray equipment manuals or are readily available from the spray equipment manufacturers or powder suppliers. Modifications may be necessary for your location and product application. See sprayability testing per TASK 70-49-00-340-001, Thermal Spraying, and TASK 70-70-00-700-001, Testing and Quality Analysis. When the final spray parameter settings are developed, all values should be recorded to ensure consistent achievement of high quality coatings. For initial recommendations, see Table 1.

Oxide Ratings - Table 1

Gases	Manifold Pressure	Flow Rate (SCFH)
Primary: Oxygen	120±5 psi (828±34 kPa)	550±100
Fuel: Hydrogen	120±5 psi (828±34 kPa)	1230±100
Carrier: Argon	100±5 psi (690±34 kPa)	25-35
Powder Rate:	22±4 grams/min	
Standoff Distance:	6.0±1.0 in. (152±25 mm)	
Traverse Rate:	3.0 - 4.0 in./sec (76 - 102 mm/sec)	
Part Rotation:	200 - 400 fpm (6 - 12 mps)	
Thickness per Pass:	0.0002 - 0.0010 in. (0.005 - 0.025 mm)	
Part Temperature:	150 - 300°F (66 - 148°C)	
Water Cooling:		
Water Inlet:	95 - 105°F (35 - 41°C)	
Water Outlet:	125 - 135°F (52 - 57°C)	
Line Pressure:	180±10 psi (124269 kPa)	
Maximum Substrate Temperature:		
Steel:	400°F (204°C)	
Titanium:	300°F (148°C)	
Aluminum:	300°F (148°C)	
Recommended Thickness: 0.0030-0.0300 in. (0.076-0.762 mm).		

5. Quality Assurance.

Subtask 70-49-43-340-424

A. Thickness.

Measure the coating thickness using a standard flat-anvil-and-spindle micrometer. The measurement may be made on either a coated production part or on a flat test specimen having a thickness of at least 0.060 inch (1.52 mm). Determine coating thickness to the nearest 0.001 inch (0.03 mm) at three different locations.

B. Appearance.

Visual examination of the coating shall be in accordance with the following:

(1) Adhesion.

The coating shall exhibit no spalling or lifting.

(2) Coverage.

The coating shall exhibit complete, uniform coverage in those areas specified for coating in the Engine/Shop Manual. Coating is not permissible in areas other than those specified.

(3) Surface condition.

The coating shall be uniform and free from cracks, blisters, spatter, chipping, and flaking.

C. Coating Microstructure.

Test specimens shall be prepared for microscopic examination, and evaluated in accordance with TASK 70-71-04-700-005, Metallographic Evaluation of Thermal Spray Coatings. Metallographic examination of the prepared specimen shall be made for uniformity of coating, as well as for the following other conditions:

(1) Delaminations.

The coating shall be free of delaminations as defined for metallic coatings in TASK 70-71-04-700-005, Metallographic Evaluation of Thermal Spray Coatings.

(2) Integrity.
The coating shall show acceptable integrity as defined in TASK 70-71-04-700-005, Metallographic Evaluation of Thermal Spray Coatings.

(3) Interface Separation.
The coating shall be free of interface separations as defined in TASK 70-71-04-700-005, Metallographic Evaluation of Thermal Spray Coatings.

(4) Transverse Cracks.
The coating shall be free of transverse cracks as defined for metallic coatings in TASK 70-71-04-700-005, Metallographic Evaluation of Thermal Spray Coatings.

(5) Interface Contamination.
Interface contamination in the coating shall be identified as defined in TASK 70-71-04-700-005, Metallographic Evaluation of Thermal Spray Coatings, and then rated per the guidelines of Table 2.

(6) Oxides and Oxide Clusters.
Oxides in the coating shall be identified as defined in TASK 70-71-04-700-005, Metallographic Evaluation of Thermal Spray Coatings, and then rated as described in the guidelines of Table 2. The coating shall be free of oxide clusters as defined in TASK 70-71-04-700-005, Metallographic Evaluation of Thermal Spray Coatings. Oxides shall be uniformly distributed.

(7) Porosity.
Porosity in the coating shall be classified for size as defined in TASK 70-71-04-700-005, Metallographic Evaluation of Thermal Spray Coatings, and then rated per the guidelines of Table 2. Porosity shall be uniformly distributed.

(8) Unmelts.
Unmelts in the coating shall be classified for size, shape, and bonding as defined in TASK 70-71-04-700-005, Metallographic Evaluation of Thermal Spray Coatings, and then rated per the guidelines of Table 2.

D. Tensile.
Tensile specimens shall be prepared for tensile bond testing and evaluated in accordance with TASK 70-71-01-700-002, Bond Strength Tensile Testing of Thermal Spray Coatings. Tensile bond strength for this coating at room temperature shall be 8,500 psi (58.6 MPa) minimum.

E. Macrohardness
Test specimens will be prepared for Rockwell hardness testing. The specimen material may be of a convenient size or shape but it should be at least 0.060 inch (1.52 mm) thick and of the same material as the coated part. The specimen must be coated with sufficient material to meet the thickness values of the part, the thickness values that are specified in TASK 70-49-00-340-001, Thermal Spraying, or the thickness requirements in TASK 70-34-03-220-009, Rockwell Hardness Testing and ASTM E-18 (whichever results in the maximum thickness). The Rockwell hardness for this coating shall be 87 minimum, based on an average of at least five readings on a Rockwell R15N scale. No individual specimen shall have a reading of less than 85.

F. Microhardness.
Test specimens will be prepared for microhardness testing. Test specimens shall meet a minimum average hardness DPH (Vickers) 675 using a 300 gram load. The specimen shall be prepared and tested in accordance with TASK 70-34-02-220-008, Vickers Hardness Testing, or ASTM specification E384. No individual specimen shall have a reading of less than 575.

G. Bend Test.
The technical requirement for this test has been deleted and no longer needs to be performed when specified in the Engine/Shop Manual.

Acceptance Limits for Thermal Spray - Table 2

Feature	Acceptance Criteria	Rating Photograph	Task	Comments
Porosity	Shall not exceed Figure 51	Figure 51	TASK 70-71-04-700-005	None
Oxides	Shall not exceed Figure 52	Figure 52	TASK 70-71-04-700-005	None
Oxide Clusters	None allowed	No figure for rating	TASK 70-71-04-700-005	See definition for ratable size
Interface Contamina-tion	Less than or equal to I-2	Figure 7	TASK 70-71-04-700-005	None
Interface Separations	None allowed	No figure for rating	TASK 70-71-04-700-005	See definition for ratable size
Unmelts	Less than or equal to P-1	Figure 8	TASK 70-71-04-700-005	None
Transverse Cracks	None allowed	No figure for rating	TASK 70-71-04-700-005	None
Delamina-tions	None allowed	No figure for rating	TASK 70-71-04-700-005	See definition for ratable size