INCREMENTAL CHANGE Release Notification Date: 01/12/2023

SPM 70-21-20 CLEANING METHOD NO. 20 - FOUR-STEP ALKALINE CLEANING AND ACIDIC DESCALING (WITH INHIBITED PHOSPHORIC ACID)

DISCLAIMER

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HIGHLIGHTS

HIGHLIGHT REFERENCE	DESCRIPTION OF CHANGE
tk70-21-20-110-038	Technical Change: Changed CAUTION and NOTE for this procedure.

TASK 70-21-20-110-038

1. General.

CAUTION: DO NOT APPLY THIS PROCESS ON ALUMINUM, TITANIUM, AND THEIR ALLOYS, ON CHROMIUM PLATED PARTS OR LOW ALLOY STEELS WITH LESS THAN 10 PERCENT CHROMIUM.

CAUTION: MASKING OF THERMAL SPRAY WEAR COATINGS INCLUDING T400, T800, TUNGSTEN CARBIDE/COBALT, CHROME CARBIDE/NICKEL CHROME, AND SEAL TEETH ALUMINUM OXIDE TOPCOAT ARE NECESSARY FOR THIS CLEANING PROCESS UNLESS OTHERWISE SPECIFIED IN THE APPLICABLE REPAIR DOCUMENT.

NOTE: If the thermal spray wear coat and seal teeth aluminum oxide topcoat will be stripped and replaced before the part is returned to service, then the masking is not necessary.

NOTE: Thermal spray coatings have a dull gray color while chrome plating has a shiny and lighter color. If FPI is used, a thermal spray coated bearing journal will have an even background glow, while a chrome plate will have the characteristic network cracking pattern.

NOTE: Ultrasonic agitation of the solution(s) can be used to increase the cleaning efficiency. Refer to Subtask 70-21-20-110-536 for process details.

A. This cleaning method is a multiple hot-tank process that is effective in removing heat scale and oxide formation from hot-section parts of the engine. This method is recommended for cleaning nickel-based alloys prior to fluorescent penetrant inspection.

2. Equipment.

Subtask 70-21-20-110-381

A. The following equipment is required for the application of this process:

(1) Safety equipment and devices which are standard equipment in surface treatment shops such as: eye bath, emergency showers, protective clothing against electroplating products and means for neutralizing acid or alkaline splashing.

(2) Processing plant for neutralizing waste and used solutions.

(3) Efficient ventilation system for extracting and neutralizing vapors.

(4) An alkaline degreasing tank made of stainless steel with a heating coil that is capable of heating the solution to 200°F (93°C).
(5) A water rinse tank made from stainless steel (or a carbon steel tank with a polypropylene liner) and a water spray gun, used after the degreasing bath.
(6) An acid stripping tank made of stainless steel with a heating coil that is capable of heating the solution to 185°F (85°C).
(7) A water rinse tank made from stainless steel (or a carbon steel tank with a polypropylene lining) and water spray gun, used after the acid stripping bath.
(8) A permanganate cleaning tank made of stainless steel with a heating coil capable of heating the solution to 180°F (82°C).
(9) A water rinse tank made from stainless steel (or a carbon steel tank with a polypropylene lining) and a water spray gun, used after the alkaline permanganate bath.
(10) A phosphoric acid cleaning tank made of stainless steel (or a carbon steel tank with a polypropylene lining).
(11) A water rinse tank made from stainless steel (or a carbon steel tank with a polypropylene lining) and water spray gun, used after the phosphoric acid bath.
(12) A hot water rinse tank made from stainless steel (or a carbon steel tank with polypropylene lining) that can increase the temperature of the solution to 200°F (93°C).

3. Materials.

Subtask 70-21-20-110-382

Alkaline Degreasing/Rust Removing Solution - Table 1

Solution	No.	Operating Temperature °F (°C)
Ardrox 185 or Ardrox 185L	S1024	180-200 (82-93)
Turco 4181, Turco 4181-L or Turco 4181-GL	S1006	180-200 (82-93)
MagChem HDP-2888	S1017	180-200 (82-93)
Cee-Bee J-84A or Cee-Bee J-84AL	S1026	180-200 (82-93)
MagChem HDL-202	S1150	180-200 (82-93)
Eldorado HTP-1150	S1161	180-200 (82-93)
Eldorado HTP-1150L	S1162	180-200 (82-93)
Applied 5-840	S1176	180-200 (82-93)

Acid Stripping Solution - Table 2

Solution	No.	Operating Temperature °F (°C)
Ardrox 1871	S1023*	180-190 (82-88)
Turco Scale Gon #5	S1159	175-195 (80-90)
Ardrox 1873	S1021	175-185 (80-85)
Cee-Bee J-19 or Cee-Bee J-19L	S1103	120-130 (49-54)
MagChem AP-988	S1152	175-185 (80-85)
Eldorado AC-111	S1165	170-180 (77-82)
Ardrox 1873A	S1184	175-185 (80-85)
Cee-Bee J-3	S1183	175-185 (80-85)
Applied 2-751	S1179	117-130 (47-54)

NOTE: * Do not use Ardrox 1871 to clean low alloy or high chrome steels. Ardrox 1873 or 1873A should be used for this purpose.

Alkaline Permanganate Solution - Table 3

Solution	No.	Operating Temperature °F (°C)
Turco 4338 or Turco 4338-L or Turco 4338-C	S1012	160-200 (71-93)
Ardrox 188 or Ardrox 188RFU	S1001	160-200 (71-93)
Ardrox 1435	S1205	160-200 (71-93)
Alkaline permanganate	S1004	160-200 (71-93)
MagChem HDP-2524	S1018	160-200 (71-93)
MagChem HDL-2524	S1203	160-200 (71-93)
Cee-Bee J-88 or Cee-Bee J-88L	S1014	160-200 (71-93)
Eldorado HTP 1190	S1163	160-200 (71-93)
Eldorado HTP 1190L	S1164	160-200 (71-93)
Applied 5-770	S1177	180-200 (82-93)

NOTE: Operating the alkaline permanganate solution in the low end of the temperature range will extend the bath life but may decrease effectiveness. Conversely, operating the batch at the high end of the temperature range will improve cleaning ability at the risk of decreasing bath life and increasing the frequency of de-sludging.

Phosphoric Acid Solution with Inhibitor - Table 4

Solution	No.	Operating Temperature °F (°C)

Phos-it	S1016	Ambient
Ardrox 1218	S1022	Ambient
Turco 4409	S1008	Ambient
* Turco 4409GL	S1008	Ambient to 150°F (65°C)*
MagChem AP-954	S1020	Ambient
Cee-Bee C-623	S1104	Ambient
Eldorado AC-183	S1166	Ambient
Applied 2-690	S1178	Ambient
Corrosol 853	S1185	Ambient

CAUTION: * TURCO 4409GL SHOULD NOT BE USED ABOVE AMBIENT TEMPERATURE GREATER THAN 90°F (32°C) ON STEELS DUE TO THE POSSIBILITY OF HYDROGEN EMBRITTLEMENT WHEN AN OUTGASSING HEAT TREATMENT IS NOT USED.

4. Procedure.

Subtask 70-21-20-110-383

NOTE: You can do Steps 4.F. and 4.G. (alkaline permanganate) before you do Steps 4.D. and 4.E. (acid stripping). Some supplier's chemicals are formulated to work better if you do Steps 4.F. and 4.G. before Steps 4.D. and 4.E.

A. In case of excessive dirt, pre-clean the part. Refer to TASK 70-21-01-110-001 (70-21-01, Cleaning Method No. 1 - Solvent Degreasing) or TASK 70-21-22-110-042 (70-21-22, Cleaning Method No. 22 Light Duty Aqueous Cleaning (method No. 1)).

B. Mask all areas that have thermal spray wear coatings including T400, T800, tungsten carbide/cobalt, and chrome carbide/nickel chrome. Refer to TASK 70-18-01-330-801, Masking Method No. 1 - Masking With Chemical Maskant, unless otherwise stated in the service document.

NOTE: Unless specified differently, TASK 70-21-04-120-E01 (70-21-04, Cleaning Method No. 4 - Dry Abrasive Blast Cleaning), can be used to increase the cleaning efficiency and remove contaminates before the chemical cleaning process.

WARNING: ALKALINE SOLUTIONS ARE VERY ACTIVE AND CAUSE SERIOUS BURNS. AVOID CONTACT WITH SKIN, EYES, AND CLOTHING. IF CONTACT OCCURS, WASH IMMEDIATELY WITH ABUNDANT QUANTITY OF WATER. AVOID BREATHING VAPORS.

WARNING: OPERATOR SHOULD WEAR FACE SHIELD, GLOVES, PROTECTIVE CLOTHING, AND PROTECTIVE SHOES.

C. Immerse the part in a tank containing one of the alkaline degreasing/rust removing solutions and maintain the solution at the specified temperature. The alkaline degreasing/rust removing solutions are listed in Table 1 in Subtask 70-21-20-110-382, Materials.

Duration: 15 to 60 minutes.

D. Rinse by spraying with a water jet and by immersion in water at room temperature.

WARNING: ACID SOLUTIONS ARE VERY ACTIVE AND CAUSE SERIOUS BURNS. AVOID CONTACT WITH SKIN, EYES, AND CLOTHING. AVOID BREATHING VAPORS. IF CONTACT OCCURS, WASH IMMEDIATELY WITH ABUNDANT QUANTITY OF WATER. AVOID BREATHING VAPORS.

WARNING: OPERATOR SHOULD WEAR FACE SHIELD, GLOVES, PROTECTIVE CLOTHING, AND PROTECTIVE SHOES.

E. Immerse the part in a tank containing one of the acid stripping solutions and maintain the solution at the specified temperature. The acid stripping solutions are listed in Table 2 in Subtask 70-21-20-110-382, Materials.

Duration: 15 to 30 minutes.

F. Rinse by spraying with a water jet and by immersion in water at room temperature.

WARNING: ALKALINE SOLUTIONS ARE VERY ACTIVE AND CAUSE SERIOUS BURNS. AVOID CONTACT WITH SKIN, EYES, AND CLOTHING. AVOID BREATHING VAPORS. IF CONTACT OCCURS, WASH IMMEDIATELY WITH ABUNDANT QUANTITY OF WATER.

WARNING: OPERATOR SHOULD WEAR FACE SHIELD, GLOVES, PROTECTIVE CLOTHING, AND PROTECTIVE SHOES.

G. Immerse the part in a tank containing one of the alkaline permanganate solutions and maintain the solution at the specified temperature. The alkaline permanganate solutions are listed in Table 3 in Subtask 70-21-20-110-382, Materials.

Duration: 15 to 30 minutes.

H. Rinse by spraying with a water jet and immersion in water at room temperature.

WARNING: ACID SOLUTIONS ARE VERY ACTIVE AND CAUSE SERIOUS BURNS. AVOID CONTACT WITH SKIN, EYES, AND CLOTHING. AVOID BREATHING VAPORS. IF CONTACT OCCURS, WASH IMMEDIATELY WITH ABUNDANT QUANTITY OF WATER.

WARNING: OPERATOR SHOULD WEAR FACE SHIELD, GLOVES, PROTECTIVE CLOTHING, AND PROTECTIVE SHOES.

I. Immerse the part in a tank containing one of the phosphoric acid solutions with inhibitor listed in Table 4 in Subtask 70-21-20-110-382, Materials.

Duration: 15 to 30 minutes.

J. Rinse by spraying with a water jet and by immersion in water at room temperature.

K. Rinse by immersion in hot water at minimum 150°F (66°C).

WARNING: WHEN USING COMPRESSED AIR FOR CLEANING, COOLING, OR DRYING, DO NOT EXCEED 30 PSIG (207 KPA). WEAR EYE PROTECTION AND DO NOT DIRECT COMPRESSED AIR AT SELF OR OTHERS.

CAUTION: PARTS MUST BE THOROUGHLY DRY PRIOR TO FPI INSPECTION. WATER ON THE PARTS MAY DEGRADE THE SENSITIVITY OF THE PROCESS, ESPECIALLY FOR THE WATER WASHABLE PENETRANT PROCESS.

L. Dry the part by one of the following two methods.

(1) Flash dry the part as follows:

(a) Keep the part submerged until the part reaches a temperature sufficient to provide for flash drying.

NOTE: The time required will vary with part size, water temperature and tank size. Proper

flash drying is indicated by seeing the water on the surface of a part start to "flash" or "whisk" off as the part is being removed from the hot water tank.

(b) Remove the part from the water. The part will flash dry as soon as it is removed from the water. Use repositioning, suction, blotting with a clean, absorbent material, or by blowing off with an oil and water filtered shop air gun to remove excess water.

(2) You can substitute drying the part in an air re-circulating oven for the dwell time in the hot water.

(a) Remove the part from the water. You can remove excess water by repositioning, suction, blotting with a clean absorbent material, or blowing the water off with an oil and water filtered shop air gun.

(b) Move the part to the oven and dry at 200°F ± 25°F (93°C ± 14°C) until the part reaches the oven temperature and all traces of surface water are removed.

5. Quality Assurance.

Subtask 70-21-20-110-384

A. Visually check the part and assure that all traces of oxide on the part have been removed.

B. If oxides are still present on the part after this cleaning, use TASK 70-21-04-120-E01, Dry Abrasive Blast Cleaning - Method No. 4E, to remove the contaminants.

6. Ultrasonic Agitation of the Solution(s).

Subtask 70-21-20-110-536

CAUTION: ULTRASONIC CLEANING AND RINSING MUST NOT BE APPLIED TO SOFT METALS SUCH AS ALUMINUM AND MAGNESIUM WITHOUT SPECIFIC APPROVAL IN THE PROCESS DOCUMENT. SPECIAL TESTING CAN BE NECESSARY FOR THESE MATERIALS.

CAUTION: OTHER AGITATION METHODS (LIKE AIR AGITATION, MAGNETIC AGITATION, ETC) MUST NOT BE USED DURING ULTRASONIC AGITATION PROCESS OR DAMAGE TO THE PART CAN OCCUR.

A. Ultrasonic agitation of the solution can be used to increase the efficiency of the cleaning process. This subtask gives process parameters for ultrasonic agitation. Refer also to Subtask 70-21-20-110-536 for safety precautions and general information.

NOTE: Usually, the lower the frequency is, the stronger the cavitation action and cleaning efficiency is.

NOTE: Ultrasonic agitation process can only be used for approved part(s). Approval for use of "ultrasonic agitation" shall be obtained from design/life cycle engineer of the part. Submit data in Subtask 70-21-20-110-536 and listed in Sheet 1 to GE AVIATION Customer Support Center.

B. Processing tank with temperature control.

(1) The ultrasonic tank should be made of stainless steel and be equipped with either a heat exchanger or heating coil capable of controlling the working solution at the minimum and the maximum operating temperature established.

NOTE: The ultrasonic energy will tend to increase the temperature of the working bath. It must be taken into consideration during monitoring the bath operating temperature ranges.

CAUTION: THE LIQUID IN THE ULTRASONIC UNIT MUST BE AT THE CORRECT WORKING DEPTH OR DAMAGE TO THE PARTS CAN OCCUR.

(2) The tank should be clearly labeled with the minimum operating level.

(3) The tank must be provided with an automatic timer interlock to shut off the ultrasonic equipment, a low solution level shut-off interlock, or with a minimum solution level marker. The tank should be identified and clearly labeled with the chemical contents, power density, frequency of the ultrasonic unit, and rated capacity in gallons (or liters).

C. Generator requirements.

CAUTION: THE PARTS MUST NOT TOUCH THE TRANSDUCERS OR DAMAGE TO THE PARTS CAN OCCUR.

(1) The generator must be a fixed power rating and not be adjustable by the operator.

(a) The ultrasonic tank must be operated at a frequency between 25 and 80 kHz and shall be maximum 80 watts/gallons (21.1 watts per liter) power density.

(b) Transducers should be equipped with High Sweep Modulation capability for optimum cleaning efficiency. The sweep range should be 0.5 to 4 kHz.

NOTE: Cavitation meters/probes can be used for determination of tank properties.

CAUTION: ULTRASONIC ENERGY WILL TEND TO INCREASE THE TEMPERATURE OF THE WORKING BATH, SO COOLING AS WELL AS HEATING CAPABILITY MAY BE NECESSARY. THE BATH OPERATING TEMPERATURE RANGES MUST BE CAREFULLY MONITORED.

CAUTION: IT IS CRITICAL THAT THERE BE NO DIRECT MECHANICAL CONTACT BETWEEN THE ENGINE COMPONENT AND THE ULTRASONIC TRANSDUCER OR THE TANK. IF CONTACT OCCURS, HOLD THE PARTS AND CONSULT YOUR GE AVIATION REPRESENTATIVE FOR DISPOSITION.

CAUTION: NEW AND COLD SOLUTIONS ARE TO BE DEGASSED PRIOR TO USE. THE TIME REQUIRED FOR DEGASSING SOLUTIONS WILL VARY DEPENDING ON THE TANK CAPACITY AND TEMPERATURE. THIRTY MINUTES IS USUALLY ADEQUATE TO DEGAS HEATED SOLUTIONS. IF THE SOLUTION HAS BEEN PREVIOUSLY DEGASSED BUT HAS BEEN ALLOWED TO COOL, 10 MINUTES IS USUALLY ADEQUATE TO DEGAS THE HEATED SOLUTION. EVIDENCE THAT A SOLUTION HAS BEEN ADEQUATELY DEGASSED IS WHEN AIR BUBBLES ARE NO LONGER BEING GENERATED BY THE LIQUID.

D. Ultrasonic cleaning units must be checked for operating efficiency periodically, at a frequency depending on the usage, with a suitable method.

(1) Alternative Method:

(a) Use Heavy Duty Reynolds Aluminum Foil, or similar aluminum foil, 0.009 inch (0.023 centimeter) in thickness.

(b) Fabricate a foil sheet such that when placed vertically in the tank, foil spans the entire depth and the longest width of tank dimensions.

1 Bend edges of foil for rigidity (to prevent foil from bending when placing in solution/tank).

2 If the span is too large for one sheet of foil, fabricate a stainless-steel light rod framework (such as welding rod) to attach the foil.

(c) Cleaning solution should be that as specified by the cleaning procedure. If the cleaning solution reacts with aluminum foil, water should be used.

NOTE: Initial temperature should be set to minimum to avoid any possible overheating of the solution caused by ultrasonic agitation.

WARNING: OPERATOR MUST WEAR FACE SHIELD, GLOVES, PROTECTIVE CLOTHING AND PROTECTIVE SHOES.

CAUTION: ALUMINUM FOIL MAY REACT WITH CLEANING SOLUTION. USE WATER FOR SUCH CASES.

CAUTION: ALUMINUM FOIL REACTS WITH ALKALINE SOLUTION.

(d) Degas cleaning solution in an ultrasonic tank for the required time (approximately 15 minutes) for maximum cavitation intensity.

(e) Immerse aluminum foil vertically into an ultrasonic tank slow and gently to minimize disturbing the sheet.

(f) Keep aluminum foil immersed in an active ultrasonic tank for one minute.

(g) Remove aluminum foil sheet vertically slow and gently to minimize disturbing the sheet.

NOTE: The ultrasonic generator must be OFF during immersion and removal of foil.

(2) Alternative Method:

(a) If contamination by aluminum foil debris is not desired, the foil must be immersed in a suitability sized glass beaker that contains water.

(b) Degas the water in the beaker for 10 minutes for maximum cavitation intensity.

(c) Put the beaker in the solution and minimize the attenuation of the ultrasonic vibrations.

(d) Keep the foil immersed in the water in the beaker for 90 seconds of operation.

NOTE: Repeat the test several times with new foil for each different positions in the working zone. The number of times will depend on the size of the tank.

(3) Acceptance Criteria. Foil must have a complete and even distribution pattern of pockmarks or indentations throughout entire sheet. Some tiny through holes may be created, and are acceptable if there is a relatively even distribution of these holes.

(4) Rejection. If foil patterns include lack of or light pockmark patters, inconsistent and uneven pockmark distribution, and large through hole(s) in localized areas, the bath cannot be used for the cleaning process.

(5) Foil test must be repeated after:

(a) The first installation, upgrades, or repair of ultrasonic equipment (comprised of transducers, controls, wiring, power unit).

(b) The first installation of the immersion tank.

(c) Repair on the wetted walls of the immersion tank.

E. Fixture requirements.

(1) The parts must be suspended in the tank completely independent of the tank sidewalls, tank bottom, or transducer surface.

(2) The fixtures can be hung from the lip of the tank if the points of contact are insulated or dampened from the ultrasonic transducer or the tank.

(3) Parts should be placed at least 2 inches (50.8 mm) from the ultrasonic transducers or the tank walls and bottom. Parts shall never be closer than 1 inch (25.4 mm) from the tank walls and bottom. They shall be submerged at least 1 inch (25.4 mm) below the top of the solution. If the parts have holes and/or cavities, the parts must be rotated to be sure that all holes and/or cavities are filled with cleaning solution and all the air is removed.

(4) Part-to-part or metal (rack)-to-part contact during ultrasonic cleaning is not permitted. If more than one part is cleaned at a time, it is recommended that you use fixtures to put the parts in position so that it is impossible for the parts to touch one another during the ultrasonic agitation.

(5) Fixtures should be designed to maximize mesh opening size.

(6) Fixtures should be fabricated from plastic or plastic-coated metal to minimize the risk of part damage at the point of contact with the fixture.

F. Deleted.

CAUTION: MAXIMUM IMMERSION TIME IS ESTABLISHED DURING QUALIFICATION. ENSURE MAXIMUM EXPOSURE TIME AS PER QUALIFICATION IS NOT EXCEEDED.

G. Process requirements.

(1) For every new part to be cleaned with the assistance of ultrasonic, the 1st article must be run 4X (4 times) the maximum time based on the historical time needed to clean the part using the standard cleaning process. This should include the time in each tank of the cleaning process that is to be equipped with ultrasonic capability. All standard non-destructive inspections required for the part should be completed before and shall be completed after the 4X cleaning test to assure no damage or cracks are caused by the cleaning process.

(2) A demonstration of the cleaning procedure is necessary on a stock loss coupon of the alloy in question. This demonstration must use 4X (4 times) the maximum time based on the historical time needed to clean the part using the standard cleaning process. This should include the time in each tank of the cleaning process that is to be equipped with ultrasonic capability, maximum temperature and concentration of solution developed for the application. Stock loss testing should be performed according to ARP1755.

(3) Filtration and cleanliness requirements should be established for the cleaning solutions.

*** * * FOR ALL**

EQUIPMENT	DESCRIPTION OF TANK DIMENSIONS	LENGTH, WIDTH, HEIGHT (cm/inch)	
		ACTUAL VOLUME OF SOLUTION (gallons/liters)	
	DESCRIPTION OF GENERATOR AND FREQUENCY USED	WATTS/GALLON (watts/liter)	
	DESCRIPTION OF HIGH-END MODULATION (SWEEP FREQUENCY) RANGE	kHz	
PROCESS	PROCESS	SPM ATA NUMBER OF THE PROCESS	
	SOLUTION CONCENTRATION	SOLUTION CODE	
	PROCESS TIME IN TANK	minutes	
	SOLUTION TEMPERATURE RANGE	°C/°F	
	FIXTURE IDENTIFICATION DESCRIPTION OF HOW SUPPORTED		
PART	P/N SUBJECTED TO THE ULTRASONIC CLEANING	MENTION THE PART FINISH OF THE PART (E.G. COATING)	
COMPATIBILITY	STOCK LOSS CALCULATED	ACCORDING TO ARP1755 TO SUBJECTED PART BASE MATERIALS (inch)	
	NDT RESULTS	VIBE ANALYSIS RESULTS (IF EXISTS) OR NDT RESULTS PART REQUIRED	

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Figure 1 Cleaning Process Control Sheet for Ultrasonic Agitation