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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ATTACHMENT 23

DELTA AIR LINES PROCESS STANDARD
FPI 900-6-3 NO. 2
DATED JUNE 15, 1996

(27 PAGES)

Pratt & Whitney
OVERHAUL STANDARD PRACTICES MANUAL

FLUORESCENT PENETRANT INSPECTION

1. Use Fluorescent Penetrants specified in P.S. 900-6-3 No. 02 for the SPOP applications as follows:

   (NOTE: Do not use water wash methods on rotating parts.)

NOTE: Where no specific crack limits exist in overhaul repair manual , refer to section "G", on pages 2A and 2B for "General Limits For All Hardware".

P&W MANUAL SPECIFICATION	DAL EQUIVALENT
SPOP 62 Method A (Water Wash - Normal Sensitivity)	P.S. 900-6-3 No. 02 (Class 4) (Water Wash - High Sensitivity)
SPOP 70 (Water Wash - Normal Sensitivity)	P.S. 900-6-3 No. 02 (Class 4) (Water Wash - High Sensitivity)
SPOP 63 (Obsolete) (Water Wash Normal Sensitivity) (Electrostatic Spray Application)	P.S. 900-6-3 No. 02 (Class 4) (Water Wash - High Sensitivity)
SPOP 82 Method A (Water Wash - High Sensitivity)	P.S. 900-6-3 No. 02 (Class 4) (Water Wash - High Sensitivity)
SPOP 70 (Water Wash - High Sensitivity)	P.S. 900-6-3 No. 02 (Class 4) (Water Wash - High Sensitivity)
SPOP 62 Method B (Post-Emulsifiable - Normal Sensitivity)	P.S. 900-6-3 No. 02 (Class 1) (Post-Emulsifiable High Sensitivity)
SPOP 82 Method B (Post-Emulsifiable - High Sensitivity)	P.S. 900-6-3 No. 02 (Class 1) (Post-Emulsifiable High Sensitivity)
SPOP 70 (Post-Emulsifiable, Normal and High Sensitivity)	P.S. 900-6-3 No. 02 (Class 1) (Post-Emulsifiable High Sensitivity)
SPOP 84 (Post Emulsifiable - Ultra-High Sensitivity.)	P.S. 900-6-3 No. 02 (Class 2) (Post-Emulsifiable Ultra High Sensitivity)
SPOP 70 (Post-Emulsifiable - Ultra-High Sensitivity.)	P.S. 900-6-3 No. 02 (Class 2) (Post-Emulsifiable Ultra High Sensitivity)

NOTE: Page 2 DELETED.

PROCESS STANDARD

INSPECTION - FLUORESCENT PENETRANT

1. SCOPE AND USE:

This Process Standard specifies the materials and procedures for Delta approved normal, high and ultra high sensitivity fluorescent penetrant inspection. The instructions provided are for general use and in such applications shall be used in lieu of other like procedures.

Specialized procedures and/or materials are occasionally required by specific vendor repair instructions and take precedence over this Process Standard. If doubt exists regarding applicable procedure, contact the Materials and Process Group of Engineering.

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2. APPLICABLE PROCESS STANDARDS:

NUMBER	TITLE
900-1 No. 02	Steam Cleaning
900-1-1 No. 09	Vapor Degreasing
900-1-1 No. 11	Mineral Spirits - Cleaning
900-1-1 No. 18	Paint Stripper - Carbon Remover (Turco 5948R Only)
900-1-1-1 No. 05	Cleaning - Jet Landing Gear
900-1-4 No. 01	Removal - Paint
900-1-4 No. 03	Landing Gear - Paint Removal
900-1-4 No. 04	Epoxy Paint Removal & Other Difficult-to-Remove Paints
900-1-1 No. 17	Cleaning - Ultrasonic

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PROCESS STANDARD

3. MATERIAL AND SPECIAL EQUIPMENT:

STOCK NUMBER	DESCRIPTION	MANUFACTURER
Non Stock	Test Panel - TAM 146040	Magnaflux
	Penetrant - Post Emulsifiable	
Non Stock	Ultra [Zyglo ZL30A	Magnaflux
Non Stock	High [Flouro-Check P60H2 Class 2	Turco
NonStock	High - Flouro-Check P41H1 Class 1	Turco
	Developer - Dry	
Non Stock	Zyglo ZP4A	Magnaflux
0322 01109	Flouro-Check DD2	Turco
	Developer - Non-Aqueous Wet (NAWD)	
0322 01108	Flouro-Check NAWD	Turco
	Emulsifier - Post Emulsifiable	
Non Stock	Zyglo ZR10A	Magnaflux
0322 01432	Flouro-Check E41	Turco
	Penetrant - Water Wash	
NonStock	Low Sensitivity, WP1BM Class 3	Turco
Non Stock	High Sensitivity, WP170LS Class 4	Turco
	Solvent - Halogenated	
0322 01428	1,1,1 Trichloroethane, EMC 13	Selig Chem.
	Solvent - Halogenated	
Non Stock	Chlorothene VG	Dow Chem.
0322 01105	Dy-Check Remover #3	Turco
0312 01660	Methyl Ethyl Ketone (MEK)	Commercial
Non Stock	Ultraviolet Light, Portable	Commercial
0422 01701	Pen, Black, No. 3201 TEC, "Sharpie"	Sanford
Non Stock	Pencil, White, No. 734	Berol Corp.
0562 01333	Towel, Kimwipe Lint-free Absorbent Paper	
0322 01104	Acid, Chromic	Commercial
0322 01344	Acid, Nitric, 42 Baume'	Commercial
Non Stock	Acid, Hydroflouric, 70% Concentrate	Commercial
0322 01115	Soda, Caustic (Sodium Hydroxide) P-S-631	Commercial
0322 01096	Acid, Sulfuric	
0322 01094	Acid, Hydrochloric, 20 Baume'	
Non Stock	Acid, Acetic, 99.7%	
Non Stock	Ferric Chloride ($FeCl_3 \cdot 6H_2O$)	

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4. INSTRUCTIONS:

A. General

(1) This Process Standard covers three basic methods of fluorescent penetrant inspection as follows:

(a) Normal (Class 3) and High (Class 4) Sensitivity Water Washable Method for production work on parts as specified in the manufacturers' manuals and Delta Process Standard equivalence charts.

(b) High (Class 1) and Ultra High (Class 2) Sensitivity Post Emulsifiable Method for production work on parts as specified in the manufacturers' manuals and Delta Process Standard equivalence charts.

(c) Water washable or Post-Emulsifiable Portable Spot-Check Method for inspections at remote locations. It is a localized process, limited to small specific areas for inspection. It is not intended for normal inspection. It is convenient to use for inspection of welded or other localized repair areas.

(2) Fluorescent Penetrant Inspection (FPI) Equivalence Charts are contained in this Process Standard. FPI Equivalence Chart I is used for engine and APU parts. FPI Equivalence Chart II is used on nonengine parts. These charts cross-reference between the manufacturer's FPI callouts and Delta's Process Standard for FPI. When the manufacturer's callouts are not listed on Chart II or the method and sensitivity levels are not specified for non-engine parts, use the following guidelines.

NOTE: The use of one higher sensitivity level within the same classification than what is specified for a part is permissable provided there is not excessive background fluorescence.

(a) Use P.S. 900-6-3 No. 02, Class 3 for parts that are cast or forged which are made of aluminum, magnesium, and titanium castings.

(b) Use P.S. 900-6-3 No. 02, Class 4 for parts with smooth surfaces such as wrought parts and parts that have machine finishes that are made of the following alloys: corrosion and heat resistant steel, stainless steels, alloy steels, titanium, and nickel alloys. (NOTE: P.S. 900-6-3 No. 02, Class 1 is an alternate inspection method.)

(c) Use P.S. 900-6-3 No. 02, Class 2 when a more detailed inspection is needed. (NOTE: Class 2 is limited in application to parts with smooth finishes. Too rough a surface finish will create excessive background fluorescences.

(3) Large surface defects, and open defects in thin material, visible to the naked eye, will usually not retain penetrants and consequently will not reveal indications under black light inspection.

4. A. (4) The bulk tank fluorescent penetrant materials specified herein have flash points in excess of 200°F (closed cup). Therefore, open dip tanks containing these materials are exempt from the special handling requirements of OSHA 1910.107 and 1910.108.

B. Handling Precautions

(1) Health

(a) Penetrant Handling

The entire penetrant process and inspection is to be accomplished in areas with adequate exhaust provisions to prevent breathing of vapors by operators and accumulation of flammable vapors.

Penetrants can cause skin irritation if the individual's skin is continually exposed to the penetrant. This is due to the oil or solvent base of the penetrant, not because of irritating or dangerous material in the solution. The following suggestions will greatly reduce irritation by the penetrant:

1) Avoid contact of penetrant and skin by handling parts in baskets or by wearing rubber gloves.

2) Keep interior of gloves clean.

3) Keep penetrant off clothing.

4) Wash any penetrant from skin with soap and water as soon as possible.

5) Check periodically for traces of fluorescent penetrant on skin, clothes, and inside of gloves by examining under ultraviolet light.

(b) Developer Handling

Dry developer powders are non-toxic, but excessive amounts should not be inhaled. Since the powder floats rather freely in the air, care should be taken in applying dry developer to prevent the annoyance of having airborne powder.

(c) Ultraviolet Light

Do not look directly at unfiltered ultraviolet light. UV absorbant goggles or prescription glasses may be worn to ease eye strain.

Do not wear light sensitive lenses or tinted lenses while inspecting with ultraviolet light.

4. B. (2) Product Protection

(a) Both the penetrant and the dry developer should be kept as free from moisture and contaminating liquids as possible.

(b) Never mix two different kinds of penetrants, emulsifiers or developers.

(c) If more than one manufacturer's fluorescent penetrant inspection materials are approved, the process must be set up using penetrant, remover and dry developer from the same manufacturer. Approval is based on a manufacturer's "system".

C. Surface Preparation

It is absolutely necessary that parts to be inspected are free from all surface contamination. Surface soil can cover or bridge a flaw inhibiting entrance of penetrant; or surface soil can absorb the penetrant and render a false indication. Soils which must be removed include oil, rust, paint, carbon, grease, oxide deposits and any other foreign material.

NOTE: Metal surfacing operations such as sanding, power grinding, grit blasting, tumble deburring or any method of metal surface finishing can bridge any existing flaws. Any magnesium or aluminum part that has been subjected to metal surfacing operations must be etched. (Refer to Para. 4.J.(1) for dip operation and Para. 4.L. for swab operation) prior to fluorescent penetrant inspection. Refer to Para. 4.L. for swab etching of other alloy parts.

(1) Strip paint and clean parts as specified in applicable overhaul manual. Contact Liaison Engineering for stripping and cleaning instructions on items not specifically covered in the overhaul manual.

(2) (a) Degrease all parts immediately prior to fluorescent penetrant inspection by one of the following methods (in order of preference):

Vapor Degreasing	P.S. 900-1-1 #09
Mineral Spirits - Cleaning	P.S. 900-1-1 #11
Steam Cleaning (Turco 5948R only)	P.S. 900-1 #02
Soap and Water Clean with Turco 5948R only	P.S. 900-1-1 #18
Ultrasonic Cleaning with Turco 5948R only	P.S. 900-1-1 No. 17

Mineral Spirits cleaning must be followed by one of the other methods. Clean titanium parts with solvent containing no halogen.

4. C. (2) (b) For local applications, the area to be inspected may be cleaned with an approved solvent and a clean cloth.

(c) CAUTION: **Use of visible dye penetrant inspection processes prior to fluorescent -penetrant inspection is prohibited. Absorption of visible dye penetrant will cause masking of indications and decrease fluorescent-penetrant inspection sensitivity.**

D. **High and Ultra High Sensitivity Post-Emulsifiable Methods**

NOTE: "Class 1" is designated as the high sensitivity post-emulsifiable method. Use the following material: Penetrant - P41H1, Remover - E41, Developer - DD2 or Flouro-Check NAWD.
"Class 2" is designated as the ultra-high sensitivity post-emulsifiable method. Use the following material: Penetrant - P60H2, Remover - E41, Developer - DD2 or Flouro-Check NAWD.

(1) Apply penetrant by immersion, spraying, brushing, or flowing. Immersion is preferred except when parts have areas where penetrant may be entrapped or for local applications.

(2) Allow a minimum of 30 minutes for penetration before removing excess penetrant.

NOTE: If processing is not continued within one hour, the part should be rewetted with penetrant before proceeding with penetrant removal. A maximum of 8 hours may elapse before water washing. If processing is interrupted for more than 8 hours, the part must be cleaned and reprocessed.

(3) Pre-rinse the part using coarse water spray at appx. 30 PSI. Hold the nozzle appx. 12" from and at an angle to the surface being rinsed to remove loosely held excess penetrant. Spray rinse until part is relatively free of visual penetrant, flushing entrapment areas such as undercuts, blind holes and oilways. One minute max. for Class 1 and Class 2. Water temperature should not exceed 100°F.

(4) Reposition or tilt part as required to aid draining excess water. Remove any large pockets of water by siphoning.

(5) Apply emulsifier by spraying or immersion. If immersion is used, immerse the part in mildly agitated emulsifier . If spraying is used, wet continuously. Use contact time of 0.5 min. to 1.5 min. to remove background fluorescence without removing defect indications.

NOTE: If necessary, 2 cycles of application of emulsifier and water rinse, instead of one cycle, may be used to reduce background fluorescence. Total contact time of emulsifier must not exceed 1.5 min.

4.D.(6) Rinse part with water to stop the emulsification process by immersion or spray. If spray is method used, water wash parts using coarse water spray at approximately 30 psi. Hold th nozzle approximately 12" from and at an angle to the surface being rinse, to remove exces background penetrant and emulsifier, flushing entrapment areas such as undercuts, blind holes and oilways. Maximum rinse time is 2.5 minutes for Class 1 and 2.0 minutes for Class 2. Water temperature should not exceed 100°F.

(7) Check part under ultraviolet light to make sure background fluorescence, which would interfere with inspection, is not present. If excessive background fluorescence is present, and caused by emulsifier, repeat water wash of the area. If excessive background fluorescence is caused by penetrant, clean the part completely and reprocess it.

(8) Position parts to allow excess water to drain and if necessary, rotate or shake the part. Remove entrapped water by siphoning, by blowing with shop air at less than 170 kpa (25 psi), or by blotting with clean, lint free towels.

(9) Dry the parts by placing them in a circulating hot air dryer. Do not allow parts to remain in dryer any longer than necessary to remove moisture. A temperature range of 140°-160°F is recommended; oven temperature not to exceed 160°F .

(10) Developing - Dry - Apply Turco DD2 assuring complete coverage of area to be inspected with a light dusting of powder.

Non-aqueous Wet Developer -Apply Turco Fluoro-check NAWD under white light. Hold aerosol spray nozzle about 8-10 inches from the surface spraying so as to note a slight moistening of the surface and flashing to a fine thin white coating. Normally 2 passes over same area are required. Coverage should be uniform and light enough so a metallic surface background is visible through developer coating.

CAUTION: HOLDING THE SPRAY APPLICATOR TOO FAR AWAY OR SPRAYING TOO LIGHTLY WILL RESULT IN UNDERDEVELOPMENT, MAKING SOME INDICATIONS NOT VISIBLE.

HOLDING THE SPRAY APPLICATOR TOO CLOSE OR SPRAYING TOO HEAVILY WILL RESULT IN OVERDEVELOPMENT, THEREBY COVERING UP INDICATIONS.

(11) Allow a minimum of 10 minutes for developer to absorb penetrant before inspecting parts.

✳ NOTE: Parts must be inspected within 2 hours of developing. If part is not inspected withir 2 hours, clean it completely and reprocess it. Consider indications found after one (1) hour to be questionable.

(12) Inspectors must accustom their eyes to darkness of the inspection booth for a period of 1 to 3 minutes if entering from a surrounding shop area. Eye adaptation may require 5 minutes or longer if entering from outside in bright sun.

4. D. (13) Direct ultraviolet light on part while in inspection booth or darkroom.

(14) Inspect to limits specified for the part.

(15) Inspect questionable indications as follows:

(a) Wipe area once with solvent using a cotton swab or fine-hair art brush. Do not use solvent containing halogen on titanium parts.

(b) Apply dry developer by dusting or by spray from bulb-type applicator to suspected area after solvent has dried. For extra-sensitive development, use NAWD per Para. 4.D.10.

(c) Inspect under ultraviolet light. Indications that reappear within 5 minutes shall be considered as valid indications.

(d) If indications do not reappear, inspect part under white light using a 10-power magnifying lens.

(16) Indications (cracks that extend through a part may be detected by applying penetrant to one surface and applying developer to other surface).

(17) Identify locations of defects on the part per Para. 4.H.

E. Normal and High Sensitivity Water Wash Method

NOTE: "Class 3" is designated as the normal sensitivity water wash method. Use the following material: Penetrant - WP1BM, Developer - DD2.
"Class 4" is designated as the high sensitivity water wash method. Use the following material: Penetrant - WP170LS, Developer - DD2.

(1) Apply penetrant to part to be inspected by spraying, brushing, or dipping. Allow penetrant to dwell on part from 5 to 10 minutes prior to rinsing.

NOTE: When fine tight-lipped defects are suspected the dwell time may be extended to 30 minutes.

(2) Allow excess penetrant to drain from component.

NOTE: The draining period should be considered as part of the total penetrant contact time which should not be less than 10 minutes. If, for any reason, the penetrant is allowed to dry or a draining time of one hour is exceeded, re-apply penetrant and allow to drain.

4. E. (3) Water wash parts using coarse water spray at appx. 30 psi. Hold the nozzle appx. 12" f and at an angle to the surface to remove excess background penetrant, flushing entrapr areas such as undercuts, blind holes and oilways. Maximum rinse time is 45 seconds. Water temperature should not exceed 100°F .

(4) Observe parts during rinsing with a 100 watt ultraviolet light to determine that excess penetrant has been removed. Rinsing is considered complete when ultraviolet light doe not indicate the presence of fluorescence on the part.

(5) Position parts to allow excess water to drain and if necessary, rotate or shake the part. Remove entrapped water by siphoning, by blowing with shop air at less than 170 kpa (2: psi) or by blotting with a clean, lint free towel.

(6) Dry the parts by placing them in a circulating hot air dryer. Do not allow parts to remain dryer any longer than necessary to remove moisture. A temperature range of 140°-160° is recommended; oven temperature not to exceed 160°F.

NOTHING ABOUT DRYING AFTER WASHING

(7) Immediately after drying, dust area to be inspected with powder developer (DD2) assuri complete coverage of area to be inspected with a light dusting of powder.

(8) After dusting allow part to stand for not less than 15 minutes to allow sufficient development.

(9) Parts must be inspected within 2 hrs. of development. If part is not inspected within 2 hr clean it completely and reprocess. Consider indications found after one hour to be questionable.

(10) Examine area to be inspected under ultraviolet light within one hour after applying developer.

NOTE: Inspectors must accustom their eyes to darkness of the inspection booth for a period of 1 3 minutes if entering from a surrounding shop area. Eye adaptation may require 5 minut or longer if entering from outside in bright sun. The use of visual aids (mirrors, boroscop or other suitable equipment) is required to examine areas not readily visible due to geometric configuration. Interpret penetrant indications per Section 4.G.

4. E. (10) Inspect questionable indications as follows:

(a) Wipe area once with solvent using a cotton swab or fine-hair art brush. Do not use solvent containing halogen on titanium parts.

(b) Apply dry developer by dusting or by spray from bulb-type applicator to suspected area after solvent has dried. For extrasensitive development, use NAWD per Para. 4.D.10.

(c) Inspect under ultraviolet light. Indications that reappear within 5 minutes shall be considered as valid indications.

(d) If indications do not reappear, inspect part under white light using a 10-power magnifying lens.

(11) Mark defective areas sufficiently to provide indications for necessary rework as specified in Section 4.H.

F. Fluorescent Penetrant Portable Spot Inspection

(1) This procedure can be used wherever the manufacturer's manuals call out specific classes using either water-washable or post-emulsified penetrant system.

(2) Parts must be cleaned of all traces of oil, grease, carbon, rust scale prior to penetrant application. Localized spot cleaning can be accomplished using 1,1,1 trichloroethane EMC13 (MEK or acetone on titanium) and wipe dry with lint-free absorbent paper wipe.

(3) Apply penetrant with soft-bristle brush, cotton swab or spray application. Allow a minimum of 20 minutes for penetration time.

(4) Remove excess penetrant by wiping with lint-free absorbent paper wipe.

(5) Remove background fluorescence by wiping with lint-free absorbent paper wipe dampened with Dy-Check Removers #3. (MEK or acetone on titanium) Observe part under ultraviolet light to make sure excess background has been removed. Use a minimum amount of cleaner application to remove excess background.

(6) Apply either dry powder or NAWD. Allow a minimum of 10 minutes for developer to absorb penetrant before inspecting part.

(7) Inspect area with ultraviolet light in a darkroom or under a hood to minimize white light.

(8) Evaluate questionable indications to the inspection standards.

4. G. Interpretation of Indications

(1) False Indications

Identify and ignore false indications, they are sometimes caused by rough areas on parts or by faulty rinsing. False indications can be wiped off without reappearing and generally do not show the brilliance of true defects. Resolve suspected defects by processing as follows:

(a) Remove questionable indications by touching with a camel hair brush dampened in solvent and allow to air dry. Do not use solvent containing halogen on titanium parts.

(b) Dust questionable indication area with developer powder. For extra-sensitive development use NAWD.

(c) Allow ten minutes minimum for development then re-examine under ultraviolet light.

(d) If questionable indications do not reappear, parts must be completely reprocessed through steps outlined in Para. 4.D.,4.E., or 4.F. as applicable.

(e) Indications which do reappear should be appropriately marked for rework as specified in Para. 4.H.

(2) True Indications - Defects

Determine probable type and extent of defect by noting shape and area of indication. Cracks, seams, laps, and cold shuts show up as lines. Porosity is revealed by round glowing spots. Glowing spots are indicative of sub-surface gas pockets. Since the larger the defect the greater the volume of the penetrant that seeps out during development, the extent of the defect can be estimated from the area of fluorescence at the defect. For establishing the extent of the defect, it is also helpful to examine under white light, the penetrant on the surface appears as a brown stain.

H. Marking of Valid Indications

Mark all indications clearly on the part using either a No. 3201 TEC black pen or a No. 734 white pencil. Select the color of the marker which will contrast most vividly with the color of the part.

NOTE: Where no crack limits exist in overhaul manual for Pratt & Whitney parts refer to Pratt & Whitney Standard Practice 70-33-00, Section G, General Crack Limits For All Hardware.

I. Post Inspection Cleaning

(1) Components shall be cleaned after inspection to remove developers and other inspection material residues if they are detrimental to subsequent operations or the components intended function.

(2) When cleaning parts made of titanium or titanium alloys with solvent, use only solvent which contains no halogens. If water is used for cleaning such parts, using tap water is permissible.

(3) Remove developer by water spray washing or scrubbing the part with brush and water.

(4) Remove penetrant residue by vapor degreasing, by soaking in solvent, or by soaking in remover followed by water spray washing.

(5) Make sure that all internal passages and recesses are completely flushed. Remove large pockets of water by rotating or shaking the part. Blow out passages and cavities with dry air.

(6) Re-check part under ultraviolet light to assure that all penetrant material has been removed. Re-clean if necessary.

J. Restrictions and Sequence of Reinspection (Aluminum and Magnesium Parts)

(1) When Fluorscent Penetrant Inspection is required by overhaul or repair manual aluminum or magnesium parts should be chemicalley etched if they have been subjected to any of the following operations:(1) shot peening, (2) machine honing, (3) tumble or vibrator deburring, (4) electropolishing, (5) liquid or dry abrasive blasting, (6) anodizing, (7) magnesium surface treatment (example: Dow 18), (8) buffing or grinding. This procedure is used to remove any smeared metal when required.

NOTE: Dissimilar metals can adversely react with both aluminum and magnesium etching fluids. In order to separate the dissimilar metal components complete disassembly of parts prior to etching is required.

PRECAUTIONS: THE CHEMICALS MAKING UP THE ALUMINUM AND MAGNESIUM ETCH SOLUTIONS ARE TOXIC AND WILL CAUSE SEVERE BODY BURNS. AVOID CONTACT WITH SKIN, EYES, AND CLOTHING. USE ONLY IN ADEQUATE VENTILATION. WEAR PROTECTIVE GOGGLES AND CHEMICAL RESISTANT GLOVES AND CLOTHING DURING PARTS ETCHING AND TANK MAINTENANCE.

4. J. (1) (a) Aluminum Parts Etching

1) Degrease to remove surface contaminants of oil and grease.

2) Immerse parts in the aluminum etching solution (Solution 1 of Table 2) for 10 ± 1 minutes.

CAUTION: FOR CLOSE TOLERANCE PARTS IT SHOULD BE NOTED THAT THE ETCHING SOLUTION WILL REMOVE APPROXIMATELY 0.0003 INCH PER SURFACE IN 10 MINUTES. ALCLAD ALUMINUM LESS THAN 0.062 INCHES THICK SHALL NOT BE ETCHED FOR MORE THAN 5 MINUTES.

3) Rinse thoroughly in clean water.

4) Penetrant inspect per applicable method.

(b) Magnesium Parts Etching

1) Degrease to remove surface contaminants of oil and grease.

2) Immerse parts in the magnesium etch solution (solution 2 of Table 2) for 5 to 6 minutes.

CAUTION: FOR CLOSE TOLERANCE PARTS IT SHOULD BE NOTED THAT THE ETCHING SOLUTION CAN REMOVE AS MUCH AS 0.001 INCH PER SURFACE IN 10 MINUTES.

3) Rinse thoroughly in clean water.

4) Penetrant inspect per applicable method.

K. Process Control

Keep a record of periodic checks on a form similar to Figure 1.

(1) When initially "charging" the inspection line with approved material, retain a sample of each product in a sealed container.

(2) On a weekly basis, perform the following process control checks:

(a) Penetrant test

Place one drop of retain sample on a filter paper or paper towel. Place one drop of working batch sample along side of master sample. Inspect samples under ultraviolet light. Both samples should have same fluorescence brilliance and color. If they do not, further investigation is required. Contact Materials & Process Engineering.

On a quarterly basis, perform the following control checks:

Brightness tests of in use penetrants shall be conducted in accordance with MIL-I-25135 with a sample of the unused penetrant serving as the reference. Brightness values less than 90% of the unused penetrant brightness are unsatisfactory.

NOTE: This test is provided as a service by the penetrant vendor Turco Products.

4. K. (2) (b) Dry developer test

Obtain a sufficient amount of powder from the working batch to form a thin layer about 4 inches in diameter on a filter paper. Examine the powder under ultraviolet light. If it fouoresces to the extent that it could interfere with valid indications, discard the working batch.

Visually examine the working batch of developer for moisture. If it is not fluffy and finely divided, or if it tends to cake, discard the developer.

(c) Emulsifier test

Apply fresh master sample penetrant to each test panel brushing or dipping. Suspend parts vertically for 10 minutes to drain.

Immerse one part in working bath of emulsifier under test and the other part in emulsifier from master sample. Contact time for each shall be 60 seconds.

Rinse both panels with water immediately, making sure that each part is identically rinsed.

Dry both panels with clean dry air.

Inspect the panels side-by-side, under ultraviolet light. If there is no significant difference in background fluorescence between panels, the emulsifier working bath is acceptable. If a significant difference in background fluorescence is noted, the working bath may be contaminated by penetrant.

When a significant difference exists, thoroughly clean the test panels and repeat the test, reversing the inspection materials on the test panels.

NOTE: When testing hydrophilic emulsifier, the contaminating penetrant may be skimmed off the top of the working tank and the emulsifier retested as above.

If both tests indicate the working bath has significantly more background fluorescence than the master sample, the working bath is contaminated.

Clean panels thoroughly after use by degreasing, soaking in solvent, and scrubbing with brush and water. Store parts in a closed container of clean solvent.

DELTA AIR LINES

PROCESS STANDARD

FPI PROCESS CONTROL RECORDS Beg. Date _____

	EACH SHIFT		WEEKLY				
DATE/ SHIFT	PANEL S/N CLASS ___	PANEL S/N CLASS ___	PEN'T COMP.	EMUL. COMP.	EMUL. CON.*	DEV. COMP.	U.V. & WHITE LIGHT

900-6-3 NO.02
PAGE 14A

* NOTE: 20% EMULSIFIER CONCENTRATION FOR DIP
5% FOR SPRAY .

FIGURE 1

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K. (3) Emulsifier working bath concentration test

On a weekly basis test the emulsifier working bath to ensure the concentration is 20% for immersion baths and 5% for spray baths using a refractrometer or test by cleaning and plating lab technicians.

(4) Re-charge the inspection line with approved material at any time performance is questionable or has obviously deteriorated.

(5) Test Panels - TAM 146040

(a) A test panel shall be processed along with the first set of parts to be inspected per FPI line p shift.

(b) After processing, the test panel should be cleaned to remove all inspection material and sto in alcohol.

(c) Panel Interpretation:

FPI Process	Panel Indications
Normal Sensitivity -	3 Star - Cracks
High Sensitivity -	4 Star - Cracks
Ultra High Sensitivity -	5 Star - Cracks

Panels processed in a normal or high sensitivity level system shall exhibit no evidence of background fluorescence on 75% or more of the grit blasted area.

(d) Test panels to be calibrated in checking shop (D.542B) once a year.

(e) Calibration procedure on file in Dept. 542B.

(6) Ultraviolet Light

(a) Test the ultraviolet light on a WEEKLY basis.

(b) Clean lens before testing and insure that there is no leakage of visible white light due to damaged or defective masking.

(c) Turn lamp on and allow 15 minute warm-up period.

(d) Use suitable ultraviolet & white light meter(s).

(e) In a darkened area where ambient light does not exceed 2 foot candles, measure the ultraviolet light output intensity at a distance of 15 inches. The intensity should not be less than 1000 uw/cm^2. NOTE: For black light borescopes, minimum intensity shall be 1600 uw/cm^2 at 1.5 inches.

(f) Insure that the bulb and filter combination used provide an even light dispersal with no dark spots in the projected beam which would drop below 1000 uw/cm^2 at 15 inches.

NOTE: Constant line voltage is essential for consistent light performance. Where line voltatge fluctuations exist, a constant voltage transformer should be used.

(7) Water Content Check for Water Washable Penetrants

(a) At least monthly the water content of water washable penetrants shall be measured in accordance with ASTM D 95. Water content in excess of 5 percent by volume is unsatisfactory

SOLUTION IDENTIFICATION	OPERATION TEMPERATURE	MAKEUP (PER 100 GALS. OF SOLUTION)	SOLUTION CONTROL	TANK MATERIAL (SUGGESTED)
1. Acid Etch (Aluminum parts only)	Ambient	10 gals. Nitric Acid 40 lbs. Chromic Acid 1 gal. Hydrofluoric Acid Remainder water	Maintain concentration of nitric acid between 9.3 & 10.3 gallons per 100 gallons. Maintain chromic acid as hexavalent chromium between 38 and 42 lbs. chromic acid per 100 gals. Control HF additions to maintain at least 50% of initial etch rate. Discard when ineffective.	Polyvinyl Chloride or Equivalent
2. Acid Etch (Magnesium parts only)	Ambient	23 gals. 70% Hydrofluoric Acid (1) Remainder water	24-29 oz/gal. as Hydrofluoric acid	Polyethylene Lined Container

(1) This solution must be made up of water, clear hydrofluoric acid from a polyethylene lined container. The solution shall be agitated thoroughly until a constant concentration is reached throughout the tank and then allowed to settle until it is water-clear before parts are processed.

TABLE 2

SOLUTION PREPARATION AND MAINTENANCE

4. L. Swab Etching Procedure for G.E. and CFM Engines Only

(1) General

Chemical etching can be used as a preliminary step before fluorescent penetrant inspection when cracks and flaws may have been masked by repair procedures. Such repairs include welding, grinding, etc. The etchants are used to remove any extraneous material and open the flaws for detection. This process should only be used when required by the various shop manuals or other Engineering documents.

(2) Precautions

a) Acid-resistant quality polyethylene or polypropylene containers should be used for storing solutions containing hydrofluoric acid. Glass containers may be used to store the other solutions.

b) The etchant solution container should be clearly labeled with the type etchant and the shelf-life expiration date. (See the Swab Etching Chart.)

c) The super alloy etchant has a very short shelf life and may become hazardous to personnel if stored longer. After one hour, the etch solution may become unstable and give off nitrous oxide. If capped, the container may burst. The solution may also become very hot. This solution should be mixed and used from open container only.

d) The chemicals used in making up the etch solutions are toxic and can cause severe body burns. Wear the proper protective equipment. Use only in adequate ventilation.

(3) Procedure

a) Degrease to remove surface contaminants of oil and grease.

b) Select the proper etch solution from the Swab Etching Chart.

c) Pour some of the etch solution into a separate clean plastic container. Use this as the working solution and do not return any left over solution back to the original container. Dispose of the left over working solution properly.

d) Mask any areas that are required to contain the etch solution to the area being etched.

CAUTION: 1) IMMEDIATELY AND COMPLETELY REMOVE ANY ETCHANT WHICH ESCAPES THE ETCH AREA.
2) ETCHANT MUST BE KEPT AWAY FROM ALL AREAS WHERE IT MAY BE ABSORBED OR ENTRAPPED.

4. L. (3) e) Using a cotton swab, saturate the area to be etched with the solution for 60-90 seconds except for the alternate solution for Inconel 718. The etch time for this solution is 3-4 minutes.

NOTE: During the etching period, maintain a fresh solution on the surface by dipping the swab in the solution periodically.

f) After etching period has expired, dilute the remaining etch solution on the surface with water and wipe with a paper towel or cloth.

g) Carefully wipe the etched area at least three times with clean water and cloth or paper towel.

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PROCESS STANDARD

SWAB ETCHING CHART

MATERIAL	ETCH SOLUTION	SHELF LIFE
Magnesium Alloys	67 ml - Distilled Water 23 ml - 70% Hydrofluoric Acid	6 months
Titanium Alloys	62 ml - Distilled Water 35 ml - 70% Nitric Acid 3 ml - 70% Hydrofluoric Acid	1 month
STAINLESS STEELS: 300-400 Series S.S., Precipitation Hardening Steels, A-286, Maraging Steels, Rene 77,80,95, 100,125, Udlment 500, SEL 15, TD-Ni-Cr, Waspalloy, 17-4 PH, Hastelloy B,C,W.	75 ml - Distilled Water 15 ml - 97% Sulfuric Acid 180 ml - 38% Hydrochloric Acid 50 ml - 70% Nitric Acid 75 ml - 99.7% Acetic Acid 45 g - Ferric Chloride	6 months
SUPER ALLOYS: Rene 41, Astroloy, Hastelloy X, H5188, Inconel 718, All Other Inconel Metals	10 ml - Stainless Steel Etch Solution 10 ml - 38% Hydrochloric Acid	30 minutes
CARBON STEELS	95 ml - Distilled Water 5 ml - 70% Nitric Acid	6 months
ALUMINUM ALLOYS	60 ml - Distilled Water 20 g - Sodium Hydroxide Addition of Water to Make 100 ml	1 year
INCONEL 718 (ALTERNATE)	38 g - Ferric Chloride 23 ml - Tap Water 28 ml - 38% Hydrochloric Acid Addition of Water to Make 76 ml	1 year

(ENGINE PARTS)

DAL EQUIVALENT	G.E. SPEC.	CFM SPEC.	PWA & HAM. STD.	R/R	ALLIED SIGNAL (Garrett)	COMMENTS
P.S. 900-6-3 No. 02 Water Wash High Sensitivity (Class 4)	Water Wash 70-32-02 70-32-03 Class A,B	Water Wash 70-32-11 70-32-21 (High Sens.)	°SPOP 70 (WW-Norm. Sens) °SPOP 62 Method A °SPOP 63 (Static Parts)	O.P. 213 Standard Sensitivity Type A	MIL-I-6866 Type I Method A Level 2 (Static Parts)	P.S. 900-6-3 No. 02 Class 1 Method also approved except on certain R/R parts. GAR/HAM parts - Request only.
P.S. 900-6-3 No. 02 Water Wash High Sensitivity (Class 4)	Water Wash 70-32-02 70-32-03 Class C	Water Wash 70-32-11 70-32-21 (High Sens.)	° SPOP 82 Method A °SPOP 70 (WW-High Sens.) (Static Parts)	O.P. 213 Med. & High Sensitivity Type B	MIL-I-6866 Type I Method A Level 3 (Static Parts)	P.S. 900-6-3 No. 02 Class 1 Method also approved except on certain R/R parts
P.S. 900-6-3 No. 02 *Post-Emulsifiable High Sensitivity (Class 1)	P.E. 70-32-02 70-32-03 Class A,B,C	P.E. 70-32-12 70-32-22	° SPOP 62 Method B °SPOP 70 (P.E.-Norm Sens) (Rotating Parts)	----	MIL-I-6866 Type I Method B Level 2 (Rotating Parts)	"Wet Developer should be included on JPC's when required.
P.S. 900-6-3 No. 02 Post-Emulsifiable High Sensitivity (Class 1)	P.E. 70-32-02 70-32-03 Class D	P.E. 70-32-13 70-32-23	° SPOP 82 Method B °SPOP 70 (P.E. High Sens) (Rotating Parts)	O.P. 210 P.E. (High Sensitivity)	MIL-I-6866 Type I Method B Level 3 (Rotating Parts)	"Wet" Developer should be included on JPC's when required.
P.S. 900-6-3 No. 02 Post Emulsifiable Ultra-High Sens. (Class 2)	P.E. 70-32-02 70-32-03 Class G	P.E. 70-32-14 70-32-15 70-32-24	SPOP 84 SPOP 70 (P.E.-Ultra High)	O.P. 210 P.E. (Ultra-High Sensitivity)	MIL-I-6866 Type I Method B Level 4 (Rotating Parts)	GAR Parts - Request Basis Only * "Wet" Developer should be included on JPC's when required.
*P.S. 900-6-3 No. 02 Post-Emulsifiable Ultra-High Sens. (Class 2)	P.E. 70-32-04 (High Resolution)	----	----	----	----	
P.S. 900-6-3 No. 02 Post-Emulsifiable Local (Spe[illegible] Applicati[illegible]gh Sensitivity	P.E. 70-32-03 Class D	P.E. 70-32-23	SPOP 70 (P.E.-High Sens)	----	----	Portable Process using aerosol cans (presentl not used)

* Substituted Process - No DAL Equivalent.

FPI EQUIVALENCE CHART II
(NON-ENGINE PARTS)

DAL EQUIVALENT	BOEING SPEC.	LOCKHEED SPEC.	DOUGLAS SPEC.	COMMENTS
P.S. 900-6-3 No. 02 Water Wash High Sensitivity (Class 4)	20-20-02 IA (b/c/d/e) 1 IA (b/c/d/e) 2	LCP 72-1068 Type I Method A Level 2	DPS 4.707 Code A,B, or C	P.S. 900-6-3 No. 02, Class I Method Also Approved.
P.S. 900-6-3 No. 02 Water Wash High Sensitivity (Class 4)	20-20-02 IA (b/c/d/e) 3 IA (b/c/d/e) 4	LCP 72-1068 Type I Method A Level 3	DPS 4.707 Code D	P.S. 900-6-3 No. 02, Class I Method Also Approved.
P.S. 900-6-3 No. 02 Post-Emulsifiable High Sensitivity (Class 1)	20-20-02 IB (b/c/d/e) 2 IB (b/c/d/e) 3 IB (b/c/d/e) 4	LCP 72-1068 Type I Method B Level 2 or 3	DPS 4.707 Code E or F	"Wet" Developer should be included on JPC's when required.
P.S. 900-6-3 No. 02 Post-Emulsifiable Ultra-High Sensitivity (Class 2)	20-20-02 IB (b/c/d/e) 4	LCP 72-1068 Type I Method B Level 4		Boeing - Request Basis Only. "Wet" Developer should be included on JPC's when required.

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6. Operator Qualification

Refer to Quality Control Procedure NDT-1, "Qualification and Certification of NDT Personnel."

FRONT COMPRESSOR FRONT HUB (STAGE ONE) - INSPECTION-01

1. Task 72-33-31-22-000: Visual/Dimensional Inspection

A. Prerequisites:

(1) Fluorescent penetrant inspect per Task 72-33-00-23-000, (Section 72-33-00, Inspection-01).

R NOTE: Remove the No. 1 bearing air seal and 1st stage
R compressor duct before fluorescent penetrant
R inspection of the hub. See Task 72-33-31-30-
R 005 and 72-33-31-30-008, (Repair-05 and
R Repair-08).

B. Equipment And Materials - None

C. Procedure

See Figures 801 and 802.

(1) Critical inspection areas. See Figure 801.

(a) Pay particular attention to the following areas during inspection.

1 Bore
2 All holes
3 Fillet radii
4 Pin slot bottom
5 Upper lug surface
6 Pressure face (inspect for fretting)

(2) Inspect general physical condition of hub.

(a) For failed disk, (hub), see instructions in Section 72-00-00, Inspection-01.

CAUTION: REGARDLESS OF CONTRARY INSTRUCTIONS, THE ONLY CHEMICAL CLEANING METHOD ALLOWED FOR ROUTINE OVERHAUL CLEANING OF TITANIUM AND TITANIUM ALLOY PARTS IS SPOP 18. ALSO, THIS CLEANING METHOD SHOULD ONLY BE APPLIED WHEN SPECIFICALLY CALLED FOR.

TITANIUM WELDMENTS AND ASSEMBLIES SHOULD NOT BE PROCESSED THROUGH TRICHLORETHYLENE DEGREASERS OR ANY CLEANER CONTAINING CHLORIDES, IN ORDER TO AVOID POSSIBILITY OF STRESS CORROSION ASSOCIATED WITH ENTRAPMENT OF CHLORINE CONTAINING MATERIALS IN TIGHT FITTING AREAS. THIS RESTRICTION ALSO APPLIES TO PARTS SUCH AS TITANIUM DISKS OR HUBS CONTAINING PLUGS, SLEEVES, OR PINS. TITANIUM DISKS MUST BE DEBLADED PRIOR TO CLEANING AND FLUORESCENT PENETRANT INSPECTION.

LIKE CRACKS?

DO NOT WIRE BRUSH TITANIUM DISKS AND HUBS FOR ANY REASON. SUSPECTED DEPOSITS OF CADMIUM