MIL-D-26549A(USAF)
15 July 1970

SUPERSEDING
MIL-D-26549
30 January 1959

MILITARY SPECIFICATION
DESCALING COMPOUND, ALKALINE, HOT SECTION JET ENGINE PARTS

1. SCOPE

1.1 This specification covers the requirements for one grade of alkaline descaling compound suitable for removal of carbon deposits, complex metallic oxides, and heat scale from hot section jet engine parts.

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

Federal

O-T-634	Trichlorethylene, Technical
PPP-D-729	Drums: Metal, 55-Gallon (For Shipment of Noncorrosive Material)
PPP-P-704	Pail Shipping Steel (1 Through 12 gallon)

STANDARDS

Military

MIL-STD-129	Marking for Shipment and Storage

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

2.2 Other publications. The following documents form a part of this specification 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

D 97 - Pour Point

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

3. REQUIREMENTS

3.1 Qualification. The descaling compound furnished under this specification shall be products which are qualified for listing on the qualified products list at the time set for opening of bids (see 4.3 and 6.3).

3.2 Materials. The descaling compound shall be a homogeneous liquid, the composition of which shall be optional with the manufacturer, but shall be restricted by the requirements of this specification.

3.2.1 Toxic products and formulations. The material shall have no adverse effect on the health of personnel when used for its intended purpose. Questions pertinent to this effect shall be referred by the procuring activity to the appropriate department medical service who will act as an advisor to the procuring activity.

3.3 Toxicity and waste disposal characteristics. The compound shall contain no ingredients for which the degree of hazard has not been appraised nor any combination of ingredients which might be hazardous to health when used in accordance with the manufacturer's recommendations. The compound shall contain no cresols, phenols (or their salts), chlorides, fluorides, sulfides, or cyanides. There shall be no caustic soda in the compound nor strong oxidizing substances such as chlorates, perchlorates, chromates, peroxides, and nitrates. The odor shall not be nauseating upon limited exposure to the vapor. The compound shall not present serious waste disposal problems.

3.4 Appearance. The compound shall be a homogeneous liquid at 25°C (77°F). Inert sediment shall be not more than 1.0 milliliter (ml) when tested in accordance with 4.6.1.

3.5 Viscosity. The viscosity of a portion of the undiluted compound when tested as specified in 4.6.2 shall be not greater than 120 centipoises (cps) at 25°C (77°F).

3.6 Rinsability. The descaling compound shall be completely rinsable with a stream of hot tap water when tested in accordance with 4.6.3.

3.7 Nonflammability. The descaling compound shall be nonflammable when a flame is applied as specified in 4.6.4.

3.8 Specific gravity. The specific gravity of the compound shall be no less than 1.255 nor greater than 1.495 at 25°C (77°F) when determined in accordance with 4.6.5.

3.9 Volatile ingredients. Upon distillation of the 250 milliliter (ml) sample of descaling compound there shall be no distallate other than water entering the receiving vessel when the vapor temperature is 100°C (212°F) and the temperature of the material in the distilling flask is in the range from 115.6°C to 135°C (240°F to 275°F) when tested in accordance with 4.6.6.

3.10 Solubility in water. The compound shall be completely miscible with cold distilled water in all proportions when tested as specified in 4.6.7.

3.11 Boiling point. The compound shall have a boiling point in the temperature range of 115.6°C to 135°C (240°F to 275°F) when determined in accordance with 4.6.8.

3.12 Performance. The performance of the descaling compound shall be equal to or superior to that of the comparison process when tested in accordance with 4.6.9 and 4.6.10.

3.13 Operational stability. The descaling effectiveness of the stability-tested compound tested in accordance with 4.6.11 shall be within 5 percent of fresh compound.

3.14 Alkalinity. When titrated with 0.5N HCl, a specific concentration of the compound shall require no less than 15.0 milliliter (ml) and no more than 18.0 ml to obtain a hydrogen-ion concentration of 12.0 as indicated in 4.6.12.

3.15 Hydrogen-ion concentration (pH). The pH of a 0.5 percent solution of the compound shall be greater than 12.0 at 25°C (77°F) when determined in accordance with 4.6.13.

3.16 Cold stability. The compound shall return to its original condition after being exposed to a temperature of -26°C (-14.8°F) for a period of 1 hour in accordance with 4.6.14.

3.17 Pour point. The pour point shall not be above -1°C (30.2°F) when tested in accordance with 4.6.15.

3.18 Cation precipitation. When tested in accordance with 4.6.16 the compound shall have no evidence of permanent turbidity.

3.19 Corrosion dimensional changes. Any dimensional changes as determined in accordance with 4.6.17 in representative samples of the hot section alloys listed in table I shall be no greater than 0.05 mil when processed in accordance with 4.6.17.2.

Table I. List of representative hot section alloys

Alloy	Remarks
Type 321	Austenitic Cr, Ni, stainless steel alloy
Stellite 31 (X-40)	Cobalt base Cr, Ni, W, alloy
Inconel 718	Nickel base Cr, Mo, Fe, alloy
Udimet 700	Nickel base Cr, Mo, Co, alloy
Nimonic 80	Nickel base alloy
Hastelloy X	Nickel base Cr, Co, Mo, alloy
Waspaloy	Nickel base Cr, Co, Mo, alloy
Type 410	Cr, Fe, alloy

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

(a) Qualification inspection (see 4.3)
(b) Quality conformance inspection (see 4.4)

4.3 Qualification inspection. Qualified inspection shall consist of all examination and tests specified herein. Qualification tests are those tests accomplished on samples submitted for qualification as satisfactory products.

4.3.1 Qualification samples. The test samples shall consist of 5 gallons of the descaling compound and 1/2 pint or 1 pound of each ingredient. Upon the request of the qualifying activity, an additional 50-gallon sample of the descaling compound shall be supplied for the field service test specified in 4.6.10. Samples shall be identified with the manufacturer's production code number (not experimental number) and forwarded to the qualifying activity or as otherwise directed in the letter or authorization from the qualifying activity (see 6.3).

4.3.2 Test report. In addition to the qualification test samples, the manufacturer shall furnish a test report showing results of all tests required by this specification except the test for field performance.

4.4 Quality conformance inspection.

4.4.1 Acceptance test. Acceptance tests are those tests performed on samples selected from each batch that has been submitted for acceptance under contract.

4.4.2 Batch. A batch shall consist of all of the descaling compound produced at one operation under the same conditions, the weight or volume of which may vary depending on the manufacturer's facilities.

4.4.3 Sampling. A 2-gallon sample shall be taken from each batch and subjected to all tests described under 4.6 with the exception of the laboratory performance test (4.6.9), field service performance test (4.6.10), operational stability test (4.6.11), and corrosion dimensional change test (4.6.17). Samples shall be selected from the first batch for the first production order submitted for acceptance and shall be selected from each batch thereafter.

4.5 Toxicology data and formulation. The supplier shall furnish the toxicological data and formulations required to evaluate the safety of the material for its intended use.

4.6 Test methods

4.6.1 Appearance. The appearance shall be tested as follows: Thoroughly mix contents of an unopened container of descaling compound by shaking for at least a 3-minute period. Fill a 100-ml graduate to the 100 mark with this compound. Stopper the graduage and let stand undisturbed for 24 hours at a temperature of 25°C (77°F). At the end of this period, examine the compound for sediment and undissolved matter. Inert sediment shall be not more than 1.0 ml. A 50 ml centrifuge tube can be used in place of the graduate cylinder. The inert sediment, however, shall be not more than 0.5 ml.

4.6.2 Viscosity. The viscosity shall be measured with the compound at 25°C (77°F) by means of a Brookfield Model LVF viscosimeter as follows: Fill a 600 ml beaker about two-thirds full with well-shaken descaling compound. Center a No. 1 or other suitable spindle in the beaker and immerse it in the compound up to the groove on its shaft. Operate the instrument at 60 revolutions per minute (rpm) (or other suitable speed) for 30 ±1 minutes. Take a minimum of three readings from the rpm 100 scale. Multiply the average of the readings by 1 (or other suitable factor) to obtain the viscosity in centipoises. (Corrections, if necessary, should be made to the final reading in accordance with the instrument manufacturer's instructions.) Viscosity of the compound shall be not more than 120 centipoises.

4.6.3 Rinsability. A 3 by 4 inch clean panel made of type 316, 321, 347, or similar stainless steel, having a hole drilled in one end, shall be immersed in the descaling compound for 2 or 3 seconds. The panel shall then be removed and suspended vertically in air for 5 minutes. A stream of hot tap water shall then be directed over the entire surface of the panel for at lease 2 minutes. The panel shall be exposed to air for at least 1 hour. The panel shall then be immersed in an 800 ml beaker filled with boiled distilled water to which has been added and thoroughly stirred 2 or 3 drops of 1-percent alcohlic phenolphthalein indicator solution. The water in the beaker shall remain colorless.

4.6.4 Nonflammability. The test panel that was used in the rinsability test (4.6.3) may be used to test nonflammability. The clean, dry panel shall be dipped in a beaker of the descaling compound and immediately upon removal suspended on a ring stand. A small flame from a microburner shall be passed back and forth along the lower edge of the panel. The flame shall be removed and the panel carefully observed. There shall be no evidence of flammable compound.

4.6.5 Specific gravity. The specific gravity of the compound shall be determined by means of a Westphal or equal specific gravity balance and shall be reported at 25/25°C (77/77°F). The specific gravity shall be no less than 1.255 nor greater than 1.495.

4.6.6 Volatile ingredients. Distillation apparatus shall be assembled using a 500 ml, round-bottomed flask with a thermometer well, Liebig condenser, distilling tube, and thermometers. Boiling chips shall be placed in the flask and 250 ml of the well-shaken descaling compound shall then be added. The flask shall be carefully and uniformly heated by any convenient method. As the contents of the flask are heated from 25°C (77°F) to 135°C (275°F) the receiver shall be watched to determine if any liquid is distilled over at the temperature specified. There shall be no distillate other than water in

the receiving vessel when the temperature of the vapors in the distilled tube portion of the apparatus reaches 100°C (212°F). About 15 ml of the distillate shall be collected and about 5 ml poured on a large watch glass. In a hood an open flame shall be passed over the watch glass. There shall be no evidence of burning or flashing. By means of an Abbe-3L Refractometer, B&L, or similar device, the refractive index ($N = {}^{20}_{D}$) of a fresh portion of the distillate shall be determined. The refractive index shall be 1.3330 ± 0.0005.

4.6.7 Solubility in water. The descaling compound shall be tested for solubility as follows: Pour 10 ml of the compound into a 100 ml graduated cylinder. Add 10 ml of cold distilled water. Stopper the cylinder and thoroughly agitate contents by shaking for 30 seconds. Examine contents for immiscibility. Add additional 80 ml of cold distilled water to the solution in increments of 10 ml and each time agitate and examine as above. Let solution stand for at least 16 hours. There shall be no visible separation of components at the end of this period.

4.6.8 Boiling point. The boiling point of the descaling compound shall be determined as follows: Clamp a Pyrex glass test tube, approximately 1.5 inches in diameter and 8 inches in length, to the steel rod of a rectangular base support. The bottom of the tube shall be 12 inches above the pedestal. Attach a mercury thermometer (range 0°F to 302°F, with a 3-inch immersion marking on the stem) to the rod above the open test tube by means of a thermometer clamp. Fill the tube to the 3-3/4 inch level with the compound. Add two small boiling chips. Lower the thermometer into the compound so that the tip is 2.5 inches from the bottom of the test tube. Leave top of test tube open. If a layer of bubbles are observed at the air-liquid interface they may be removed by adding a very small droplet of antifoam agent or by waiting for them to clear. Slowly apply uniform heat to bottom of the test tube by passing back and forth a 1 inch high blue flame of a Bunsen burner. At no time shall the flame remain stationary. The temperature at which continuous ebullition (state of boiling, bubbling) occurs at the surface of the liquid in the tube shall be the boiling point. Disregard small bubble formation initially observed at the bottom of the tube. The boiling point shall be in the range of 115.6°C to 135°C (240°F to 275°F).

4.6.9 Performance (laboratory)

4.6.9.1 Preparation of test specimens. A heavily scaled combustion chamber inner liner assembly, a transition liner assembly, 6 turbine buckets, and 6 turbine nozzle vanes shall be obtained from a jet engine having a minimum operational time since last overhaul (if possible) of 500 hours. (Agency supplying the parts will furnish the operational time data.)

4.6.9.1.1 Combustion chamber inner liner. This assembly during operation is subjected to considerable variations in temperature, flame impingement patterns, et cetera; consequently, the nature of the scale formation varies in the various areas of the liner. Proper evaluation of the descaling action of a compound on the inner liner is particularly difficult and important. Random selection of the inner liner sections for evaluation is unreliable. The following technique, proven to be most satisfactory by numerous experiments conducted shall be used to evaluate the effectiveness of the descaling compound on the inner liner:

(a) Cut off the dome section of the liner.
(An acetylene torch shall not be used for cutting liners.)

(b) Make a straight cut the entire length of the cylindrical portion of the component.

(c) By means of yellow marking pencil or a crayon, mark the entire surface area of the inner liner into 64 equal squares approximately 3 by 3 inches. (This is based on a J57 liner.)

(d) By means of a metal stamping or scribing device legibly and permanently number the squares as shown on figure 1.

(e) After marking, cut the inner liner along the guide lines drawn. (Do not cut up the liner until all squares are permanently identified.) An acetylene torch shall not be used for cutting liners.

(f) Divide the 64 specimens into 4 groups as specified in table II.

4.6.9.1.2 Transition liner assembly. Prepare the transition liner into 64 equal specimens in the same manner as specified in paragraph 4.6.9.1.1, except that the shape will necessarily vary.

4.6.9.1.3 Turbine buckets and nozzle vanes shall be from the same engine. If the engine has multiple turbine stages, the buckets and vanes shall be from the same wheels. The turbine buckets and nozzle vanes need not be cut.

4.6.9.2 Quantitative measurement of percent descaling. (The test method described here is considered more accurate than subjective methods that depend upon direct ocular measurements of processed specimens.)

Clean all test specimens free of loose carbon, grease, and oil by scrubbing in trichoroethylene, conforming to O-T-634, and air dry.

1T	2T	3T	4T	5T	6T	7T	8T
1B	2B	3B	4B	5B	6B	7B	8B
9T	10T	11T	12T	13T	14T	15T	16T
9B	10B	11B	12B	13B	14B	15B	16B
17T	18T	19T	20T	21T	22T	23T	24T
17B	18B	19B	20B	21B	22B	23B	24B
25T	26T	27T	28T	29T	30T	31T	32T
25B	26B	27B	28B	29B	30B	31B	32B

Figure 1. Marking of liner test specimens.

Table II. Test specimen groups for liners.

1/ Group I	2/ Group II	3/ Group III	4/ Group IV
1T	2T	5T	6T
3T	4T	7T	8T
2B	1B	6B	5B
4B	3B	8B	7B
9T	10T	13T	14T
11T	12T	15T	16T
10B	9B	14B	13B
12B	11B	16B	15B
17T	18T	21T	22T
19T	20T	23T	24T
18B	17B	22B	21B
20B	19B	24B	23B
25T	26T	29T	30T
27T	28T	31T	32T
26B	25B	30B	29B
28B	27B	32B	31B

1/ Specimens for comparison descaling process (see 4.6.9.3).
2/ Specimens for practical laboratory descaling test (see 4.6.9.4).
3/ Specimens for stability test (see 4.6.11).
4/ Specimens for repeat test, if necessary.

Sixteen specimens prepared in accordance with 4.6.9.1 shall be used to quantitatively measure the descaling effectiveness of the compound. The following method shall be used for all tests:

(a) Take the average value of the 16 specimens as a criterion. Dry each individual specimen after being processed. Superimpose a piece of tracing paper over one side of the specimen and then another piece of tracing paper over the opposite side. Trace an accurate outline of the inside face of the specimen and all islands or areas of residual dark (black or brown) scale. Ignore surface staining or discoloration due to metallic surface conditions in the drawing of the residual scale area. reproduce all smaller descaled areas which appear as openings in the residual scale and which are surrounded by undescaled areas. Repeat entire procedure on the outside face of the specimen. Place the two tracings over carbon

paper. Insert underneath the carbon a sheet of Dietzen No. 340R-10, or equal, graph paper containing 10 by 10 squares to the inch. Retrace all boundaries on the tracing paper to reproduce the area of the test specimen and the scaled areas on the graph paper. Determine by careful counting the total area of each face and the area of residual scale on each face in terms of the number of squares.

(b) Determine the percent of the test specimen descaled by the following formula:

$$\text{Percent Descaling} = \frac{\text{Number of squares representing descaled area (two sides)}}{\text{Number of squares representing surface area of specimens (two sides)}} \times 100$$

4.6.9.2.1 When visual inspection indicates extreme contrast in descaling efficacy, the method specified in 4.6.9.2 need not be performed.

4.6.9.3 Comparison descaling process (fused salt). The process for comparison shall be as follows: Place approximately 750 grams of caustic potash (chloride free) into the iron pot of a Hoskins 110-volt electric furnace, or similar device. Insert a thermocouple into the caustic flakes so that its tip is almost to the bottom of the iron pot. Adjust temperature device to read 398.8°C (750°F). Turn on current and watch caustic flakes until fused. Add more caustic flakes as necessary to raise molten bath level in pot to half way mark. (CAUTION: Wear goggles, faceshield, and gloves while working with fused salt bath. Perform under a well-ventilated hood. Type 316 stainless steel tank and ordinary hot plates may be used in place of Hoskins furnace. The tank should be stress relieved. Do not permit any water to contact the fused salt bath.) Preheat group I specimens (prepared in accordance with 4.6.9.1 and specified in table II) on a hot plate to 398.8°C (750°F) for 15 minutes. Temperature shall be checked with a pyrometer. Carefully immerse heated group I specimens into the fused salt bath for 30 minutes. Remove specimens and drain until free of most of the molten caustic. Drainage time shall not exceed 15 seconds. Then immerse specimens in 25°C (77°F) distilled water for 3 minutes. Remove and wash with cold, flowing tap water to rinse completely the alkali from the specimens. Freshly prepare an alkaline permanganate bath as specified in 4.6.9.4.2. Immerse specimens for 1 hour while maintaining bath at 88°C (190°F). Remove specimens and thoroughly pressure rinse with cold water, or scrub with a soft bristle, wooden handled brush if suitable facilities for pressure rinsing are not available. Prepare a nitric acid bath as specified in 4.6.9.4.2. Immerse specimens for 30 minutes while maintaining bath at 25°C (77°F). Remove specimens and rinse as indicated above for alkaline permanganate. This comparison descaling process should result in 80 to 95 percent scale removal when computed in accordance with 4.6.9.2. These specimens shall be used as comparisons for the laboratory practical descaling test (manufacturer's product) described in 4.6.9.4.3.

4.6.9.3.1 Two turbine buckets, two nozzle vanes, and sections of transition liners shall be subjected to the process described in 4.6.9.3.

4.6.9.4 Practical laboratory descaling test

4.6.9.4.1 Preparation of processing line. Three 6 by 6 by 6 inch, or larger, immersion tank baths fabricated from approximately 0.060 inch gauge, type 302, 304, 316, or 321 stainless steel shall be used as a processing line. Tanks shall be arranged under a hood. Each tank shall be placed on an adjustable, thermostatically controlled, electric hot plate. A variable speed, electric stirring device shall be mounted over each immersion bath. The unit shall be set to operate at moderate speed. Dial reading, stainless steel (18-8) thermometers, 10°C to 204.4°C (50°F to 400°F) range, shall be used to indicate bath temperatures. Shielded thermocouples will also be satisfactory provided shields are impervious to attack by hot caustic or room temperature nitric acid solution. Interval timers shall be used to control immersion intervals.

4.6.9.4.2 Preparation of solutions. Auxiliary solutions are required to properly evaluate descaling compounds submitted under this specification.

(a) Descaling compound bath: The first tank (described in 4.6.9.4.1) shall be filled about two-thirds full with descaling compound to be tested. The descaling compound bath shall be maintained at 5 degrees below its boiling temperature.

(b) Alkaline permanganate bath: The second tank shall be filled two-thirds full with a solution containing 20 ounces of sodium hydroxide, 20 ounces of sodium carbonate, and 10 ounces of potassium permanganate dissolved in sufficient water to make one gallon of solution. The alkaline permanganate solution at 88°C (190°F).

(c) Nitric acid bath: The third tank shall be filled two-thirds full with a 25 percent of volume (70 percent) nitric acid solution. The solution shall be maintained at 25°C (77°F).

4.6.9.4.3 Descaling test procedure (manufacturer's compound). Group II specimens prepared in accordance with 4.6.9.1 and as specified in table II, and specimens similarly prepared from the transition liner, 2 turbine buckets, and 2 turbine nozzle vanes shall be used in testing the descaling compound. After preparation of testing apparatus and solutions in accordance with 4.6.9.4.1 and 4.6.9.4.2, specimens shall be processed as follows: Immerse specimens in first tank for 1 hour. Remove and pressure rinse with

a steam pr air-water gun. If pressure rinse facilities are not available, scrub specimens with a soft bristle, wooden handled brush for at least 3 minutes under a stream of hot tap water. Immerse specimens in second tank for 1 hour. Remove and rinse as indicated above after removal from first tank. Immerse specimens in third tank for 30 minutes. Remove and rinse as stated above. Calculate descaling percentage in accordance with 4.6.9.2. Compare specimens with specimens processed through molten salt bath (see 4.6.9.3). The descaling percentage shall be equal to or greater than that obtained by the comparison test (80 to 95 percent).

4.6.10 Performance (field service). At the option of the qualifying activity, field service tests will be conducted as specified herein, provided the descaling compound has satisfactorily passed all laboratory tests conducted by the qualifying activity. A field evaluation of the descaling properties of each compound shall be made by Air Force pilot line test facilities prior to qualification. For the field service tests hot section parts from aircraft jet engines currently in use and having a minimum operational time of 300 hours shall be processed. The descaling procedure (see 4.6.9.4.3) shall be followed at the service test facility except that steam and air-water gun rinsing shall be used. The molten salt bath comparison will not be required. Parts shall be descaled sufficiently to enable complete inspection and permit repair. No more than 5-percent residual scale shall remain on the parts.

4.6.11 Operational stability. A stainless steel tank similar to the tanks described in 4.6.9.4.1 shall be filled about two-thirds full with the descaling compound for testing as follows: Carefully lower the tank into a larger stainless steel tank containing a 50 percent by weight aqueous solution of potassium hydroxide, and a 1-1/2 inch thick piece of stainless steel placed flat on the bottom thereof. Bath level in the larger tank shall be no greater than two-thirds full after immersion of descaling tank. Mark levels of both baths by any suitable method. Insert a dial reading, stainless steel (18-8) thermometer, 10°C to 204.4°C (50°F to 400°F) range, in the descaling compound. Place the entire system on an adjustable, thermostatically controlled, electric hot plate. Heat the bath so that temperature of descaling compound is within 5 degrees of its boiling temperature. Maintain this temperature for 7 consecutive days (168 hours). To minimize water evaporation place a large glass lid over the system. Replace water losses in both tanks when necessary, using the previously marked levels as guides. After completion of the stability test, cool the descaling compound, remove it from the potassium hydroxide heating bath and subject it to the laboratory performance test described under 4.6.9.4.3. Group III specimens prepared in accordance with 4.6.9.1 and specified in table II shall be used for performing this test. Material shall be considered unstable if the descaling effectiveness of the stability tested material is not within 5 percent of that obtained with fresh material.

4.6.12 Alkalinity. The compound shall be tested for alkalinity as follows: Weigh accurately a sample containing 48.7 grams of the descaling compound. Dilute sample to 1 liter with cold, boiled distilled water. Be sure complete transfer of material is made. Shake flask thoroughly. Pipette 50 ml of the diluted material into a 250-ml, low-form beaker. Standardize (according to the manufacturer's directions) a Beckman pH meter, Model H2, or equal, that has an entire pH range glass electrode. Immerse electrodes in the solution, and with constant stirring by means of a magnetic stirring device slowly titrate with 0.5 N HCl to a pH of 12.0. The quantity of acid used to obtain this pH shall be no less than 15 ml and no more than 18 ml.

4.6.13 Hydrogen-ion concentration (pH). The pH of the descaling compound shall be determined as follows: Standardize (according to the manufacturer's directions) a Beckman pH meter, Model H-2, or equal, that has an entire pH range glass electrode. Fill a 250-ml beaker half full of a 0.5 percent solution of the compound. Immerse electrodes in solution, allow sufficient time for electrodes to reach temperature equilibrium with solution, switch to 6-14 range, and read pH. Record the temperature of solution. The pH shall be greater than 12.0 at 25°C (77°F).

4.6.14 Cold stability. The test of cold stability of the descaling compound shall be as follows: Pour approximately 50 ml of the compound into a suitably sized test tube. By any suitable means lower the temperature of the compound to -26°C ±1°C (-15°F ±2°F). Maintain temperature for 1 hour. Remove compound from cooling bath and allow to return to room temperature 25°C (77°F). Invert test tube 5 times and examine contents. Any evidence of either precipitation or layering shall be cause for rejection.

4.6.15 Pour point. Pour point shall be determined in accordance with ASTM D97-66. The pour point shall not be above -1°C (30.2°F).

4.6.16 Cation precipitation

4.6.16.1 Preparation of solutions. Metal ion solutions (concentration 1 ml = 10 milligram (mgs) of cation) shall be prepared as follows: Weigh separately 40.3720 grams of $CoCl_2.6H_2O$ and 40.5010 grams of $NiCl_2.6H_2O$. Transfer each weighed salt to a 1-liter volumetric flask and add sufficient cold distilled water to dissolve all crystals. Stopper and shake flasks thoroughly. Add additional water to the 1-liter marks and shake flasks again to assure complete solution.

4.6.16.2 Titration. The descaling compound shall be titrated as follows: Fill a 50-ml burette with the cobaltous solution prepared in accordance with 4.6.16.1. To a 50-ml, graduate cylinder with a ground glass stopper, or a suitable test tube, add 2 ml of descaling compound by means of a volumetric

pipette. Titrate 10 ml of the cobaltous ion solution into the graduate, stopper, and shake thoroughly for approximately 15 seconds. Let stand for 1 minute and examine. Any evidence of distinct, permanent turbidity at 25°C (77°F) shall be cause for rejection. Repeat the test using a fresh 2 ml of descaling compound, except that 12 ml of nickelous solution shall be used in place of the cobaltous solution.

4.6.17 Corrosion dimensional changes

4.6.17.1 Preparation of alloy specimens. One specimen, approximately 0.2 centimeters thick by 8.0 centimeters square, shall be obtained from each alloy specified in table I. If any of the specified alloys cannot be obtained in sheet form, bar stock sections approximately 1.5 centimeters thick and 4.0 centimeters long may be used for the corrosion tests. Specimens shall be prepared as follows: Cut to dimensions specified above and grind cut edges parallel to 0.001 inch. Polish first with Grit No. 180 aluminum oxide cloth and follow by finer polishing with Grit No. 240 until the surfaces are free of any dark oxide films. Calculate the total surface area of each specimen to the nearest 0.1 square centimeter. Thoroughly clean specimens in hot trichloroethylene conforming to O-T-634 flush with water to remove any loose metal particles or aluminum oxide powder, rinse in methyl alcohol, and air dry. Weigh on an analytical balance to the nearest 0.1 of a milligram.

4.6.17.2 Corrosion test procedure. Each set of alloy specimens shall be weighed as specified in 4.6.17.3 and processed only through the manufacturer's descaling compound as follows: Set a 2,000-ml Pyrex beaker or an adjustable type, thermostatically controlled, electric hot plate. Insert an insulating glass or porcelain plate on the inside, bottom surface of the beaker. Place into the large beaker either a 600-ml Pyrex beaker (if sheet stock corrosion specimens described in 4.6.17.1 are used), or a 400-ml tall-form Pyrex beaker (if bar stock specimens of equivalent surface area are available.) Pour enough descaling compound into the smaller beaker so that when the alloy specimens are submerged therein the compound level shall be 2 inches above the specimens. By means of a funnel or graduate, pour a 50-percent potassium hydroxide solution into the larger beaker up to the same level as that of the descaling compound in the smaller beaker. Insert ASTM thermometers (0° to 302°F) into the descaling compound and the heating bath to record temperatures. Place watch glass over smaller beaker. Apply heat and adjust hot plate regulator until thermal equilibrium is obtained. When the test temperature (5 degrees below the boiling point of the descaling compound) is reached, immerse the corrosion test specimens in the descaling compound for 1 hour. Remove specimens. Rinse under a stream of warm water for 1 minute. Brush with a soft, wooden handled brush, and flush in distilled water. Rinse with methyl alcohol, air dry for at least 15 minutes, and weigh each specimen to the nearest 0.1 milligram.

4.6.17.3 Calculation of weight losses. During processing in accordance with 4.6.17.2 each specimen shall be weighed before immersion in the descaling compound and after removal from the descaling compound. Weight differences shall be calculated in grams and converted to milligrams by multiplying by 1,000. Weight changes shall thus be expressed in milligrams per the entire surface area of the specimen.

4.6.17.4 Calculation of dimensional changes. Dimensional changes (penetration due to corrosion) for the specimens shall be no more than 0.05 mils and shall be calculated from the weight loss data as follows:

$$\text{Penetration in Mils} = \frac{\text{Miligrams loss}}{\text{total specimen area in square centimeters}} \times \frac{1}{8.5} \times \frac{1}{2.54} \text{ or}$$

$$= \frac{\text{mgs}}{\text{cm}^2} \times 0.05$$

4.7 Rejection and retest. Rejected descaling compound shall not be resubmitted for inspection without furnishing full particulars concerning previous rejection and measures taken to correct defects.

5. PREPARATION FOR DELIVERY

5.1 Preservation and packaging. Preservation and packaging shall be level A or C, as specified (see 6.2).

5.1.1 Level A. Unless otherwise specified, the descaling compound shall be furnished in 5-gallon drums conforming to ICC-5B, Type I of PPP-P-704b or in 55-gallon drums conforming to type I of PPP-D-729b(ICC-5b). The size of the container shall be specified by the procuring activity.

5.1.2 Level C. Unless otherwise specified, packaging shall be in accordance with the manufacturer's commercial practice.

5.2 Packing. Packing shall be level A or C, as specified (see 6.2).

5.2.1 Levels A and B. Compound packaged in accordance with 5.1.1 shall require no overpacking.

5.2.2 Level C. Compound packaged in accordance with 5.1.2 shall be packed to afford protection against damage during direct shipment from the supply source to the first receiving activity for immediate use. Containers shall comply with Consolidated Freight Classification Rules or other common carrier regulations applicable to the mode of transportation.

5.3 Marking. In addition to any special marking required by the contract or order, individual containers shall be marked in accordance with the requirements of MIL-STD-129. The shipment marking nomenclature shall be as follows: Descaling Compound, Alkaline, Hot Section Jet Engine Parts.

5.3.1 Additional marking. Each container shall also be durably and legibly marked with the following information so that the markings will not become damaged when the container is opened:

Specification No.
Mfr's Code No. _____
Date of Manufacture

CAUTION: The ingredients used in the manufacture of this compound are toxic and caustic, and proper precautions should be taken to prevent contact with skin and clothing and to avoid inhalation of the vapors. If skin contact should occur, remove clothing and wash with copious amounts of water. If eye contact should occur wash well with water, then with a saturated boric acid solution. See a physician as soon as possible in any case.

6. NOTES

6.1 Intended use. The compound covered by this specification, together with auxiliary solutions described under 4.6.9.4.2, is intended to be used for descaling hot section jet engine parts.

6.1.1 Precaution. The descaling compound should not be used on aluminum alloys. In addition, it should not be used on any other alloy whose dimensional losses will be greater than 0.05 mils, or on any alloy where dimensional losses in auxiliary baths, such as alkaline permanganate and nitric acid, exceed 0.05 mils. Check Technical Order 2J-1-13 before using material.

6.2 Ordering data. Procurement documents should specify the following:

a. Title, number and date of this specification.
b. Quantity of descaling compound desired.
c. Sampling plan, if other than specified (see 4.4.1).
d. Size of container required (see 5.1.1).
e. Applicable levels of preservation and packaging, and packing (see section 5).

6.2.1 Unit of purchase. The unit of purchase is the U. S. gallon of 231 cubic inches at 25°C (77°F).

6.3 Qualification. With respect to products requireing qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Air Force Materials Laboratory, Attn: MAAA, Wright-Patterson Air Force Base, Ohio 45433, and information pertaining to qualification of products may be obtained from this activity.

Custodians:
Air Force - 11

Reviewers:
Air Force - 68

Preparing Activity:
Air Force - 11

Project No.6850-F425

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 22-R255

INSTRUCTIONS: This sheet is to be filled out by personnel, either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.

SPECIFICATION

ORGANIZATION

CITY AND STATE

CONTRACT NUMBER

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO *(If "yes", in what way?)*

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

SUBMITTED BY *(Printed or typed name and activity - Optional)*

DATE

DD, FORM 1 JAN 66 1426

REPLACES EDITION OF 1 OCT 64 WHICH MAY BE USED.

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